PSYCHOLOGY

VCE UNITS 3 AND 4

EIGHTH EDITION

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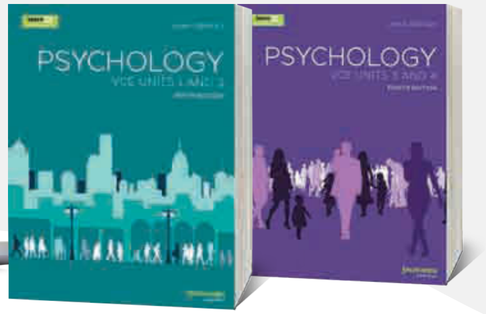

PSYCHOLOGY

VCE UNITS 3 AND 4 | EIGHTH EDITION

Developed by expert Victorian teachers for VCE students

Tried, tested and trusted. The NEW Jacaranda VCE Psychology series continues to deliver curriculum-aligned material that caters to students of all abilities.

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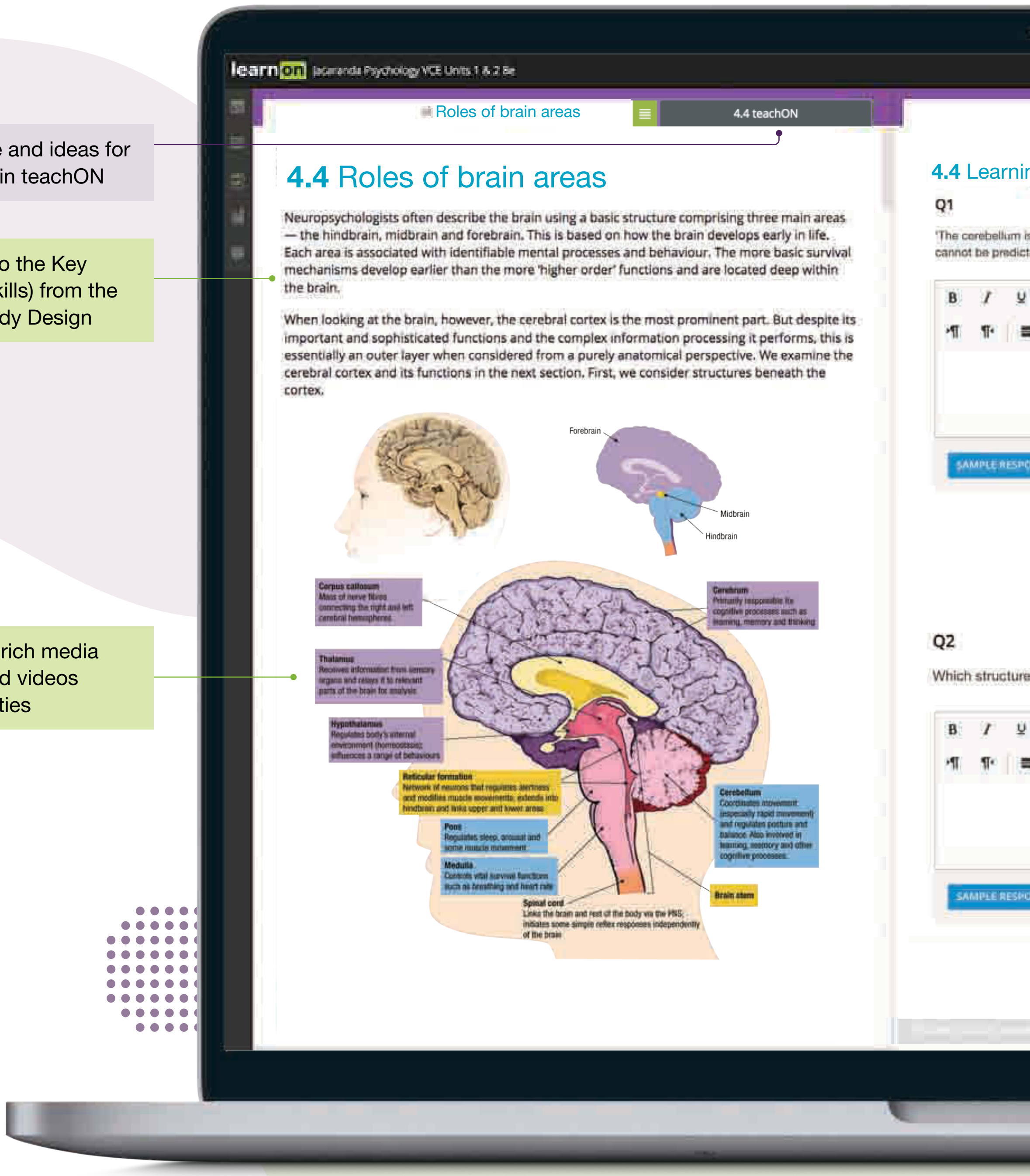

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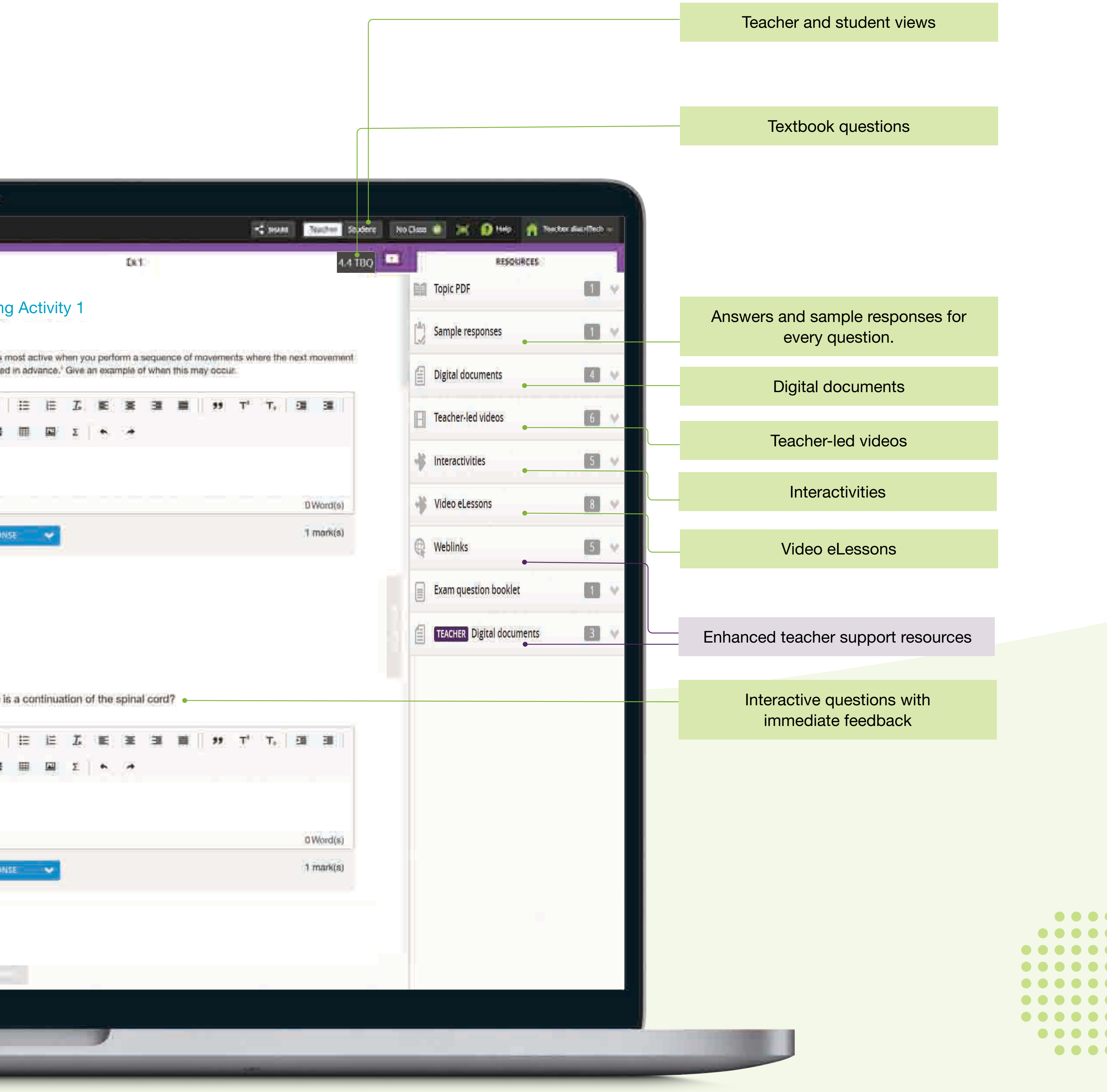

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Trusted Jacaranda theory, plus tools to support teaching and make learning more engaging, personalised and visible.

Each topic is linked to Key Knowledge and Key Skills from the VCE Psychology Study Design.

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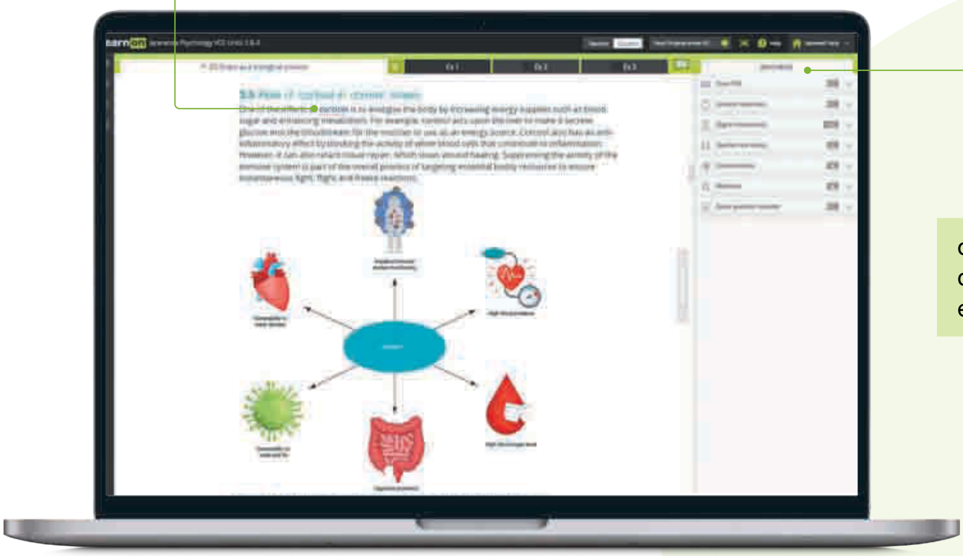

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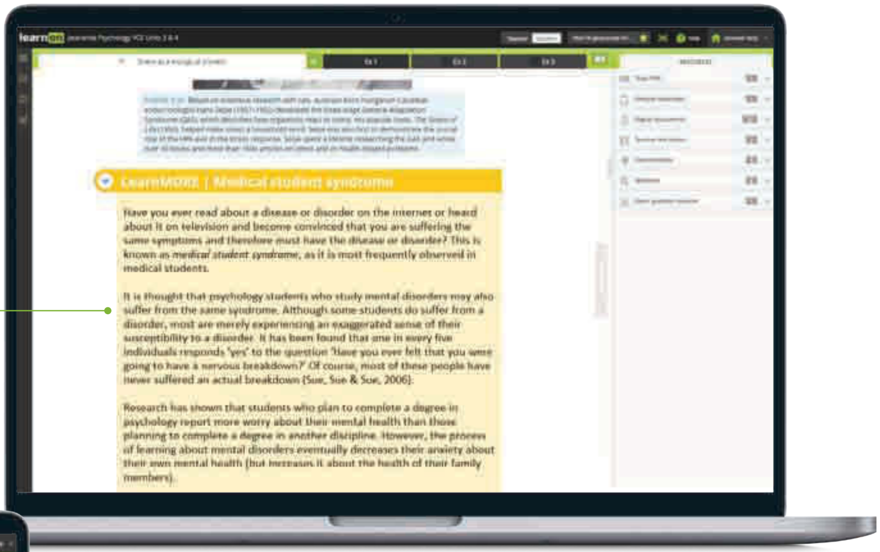

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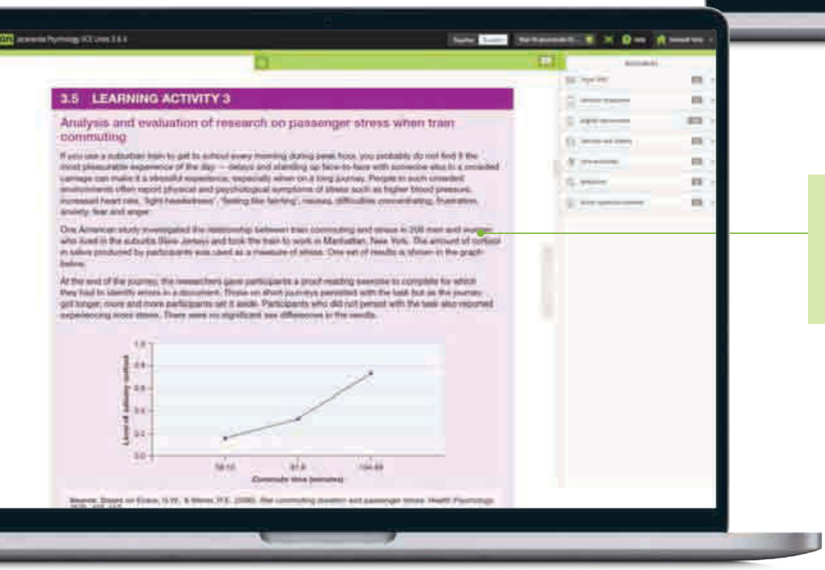
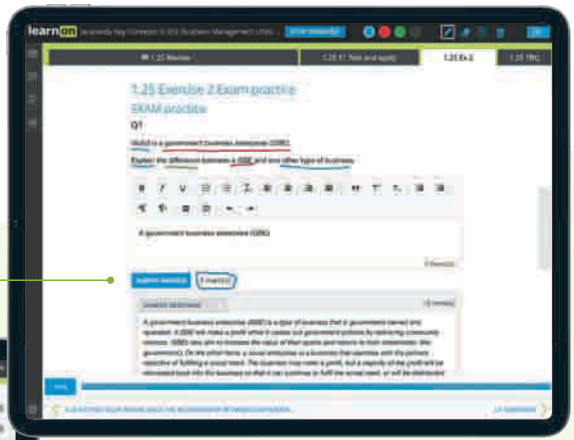
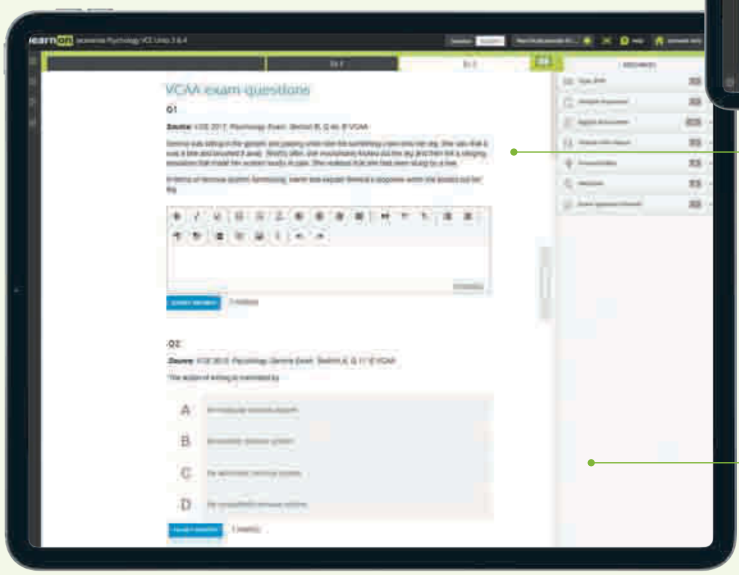


A variety of question sets; Review, Multiple-choice, Analysis and evaluation, and VCAA exam questions encourage students to practise and apply the skills and concepts they are studying.



Teacher-led videos that explain how to approach exam questions, including VCAA exam questions

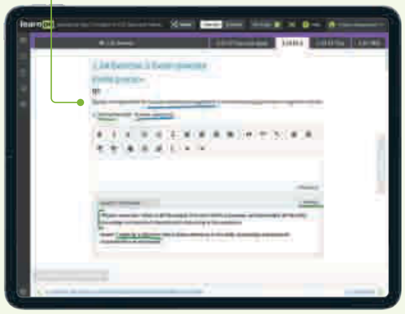


- Online and offline question sets contain practice questions, exam-style questions and past VCAA exam questions with exemplary responses and marking guides.
- Every question has immediate feedback to help students to overcome misconceptions as they occur and to study independently — in class and at home.

Topic reviews

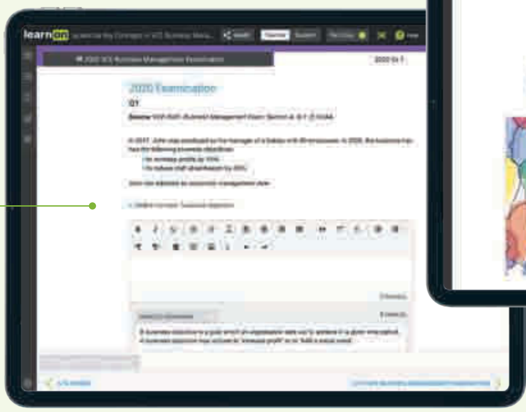
Topic reviews include online summaries and topic level review exercises, including exam questions that cover multiple concepts.

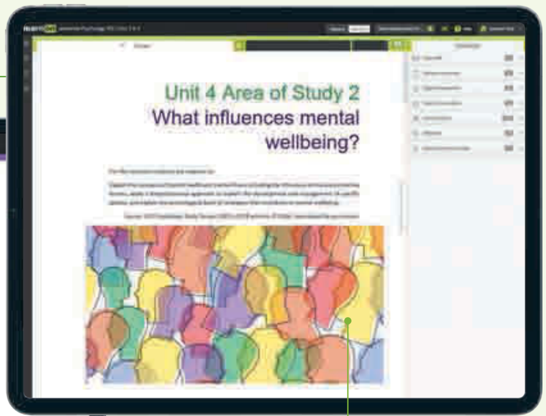
End-of-topic exam questions include relevant past VCE exam questions and are supported by teacher-led videos.



Get exam-ready!

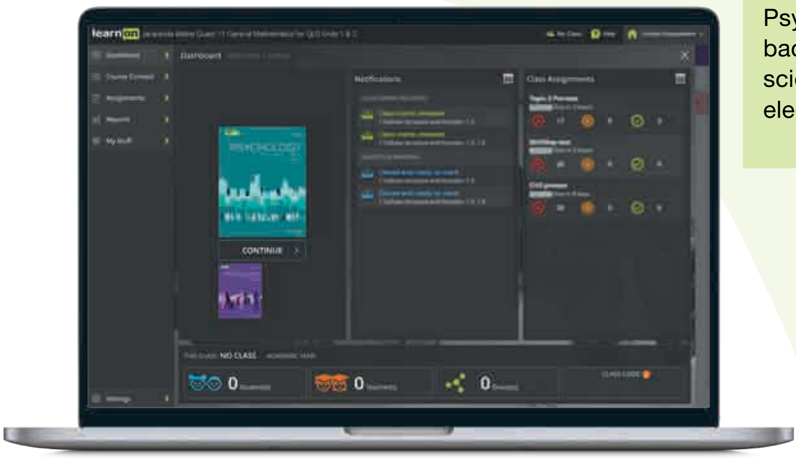
Students can start preparing from lesson one, with exam questions embedded in every lesson — with relevant past VCAA exam questions since 2013.



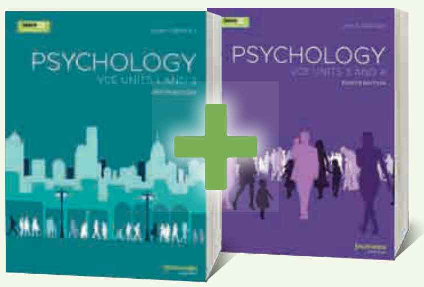


Practice, customisable SACs available to build student competence and confidence.

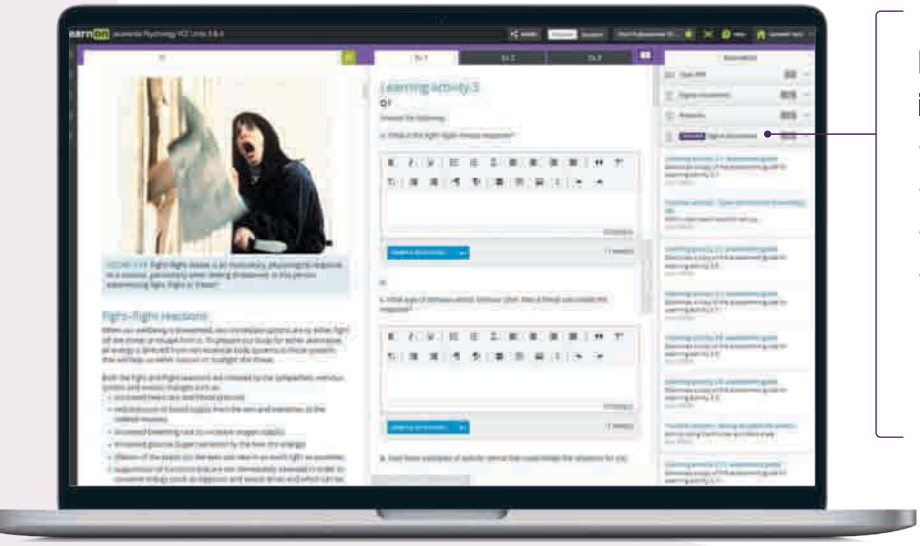
Combine units flexibly with the Jacaranda Supercourse



Build the course you've always wanted with the Jacaranda Supercourse. You can combine all Psychology Units 1 to 4, so students can move backwards and forwards freely. Or combine junior science with Psychology Units 3 & 4 for custom elective courses. The possibilities are endless!



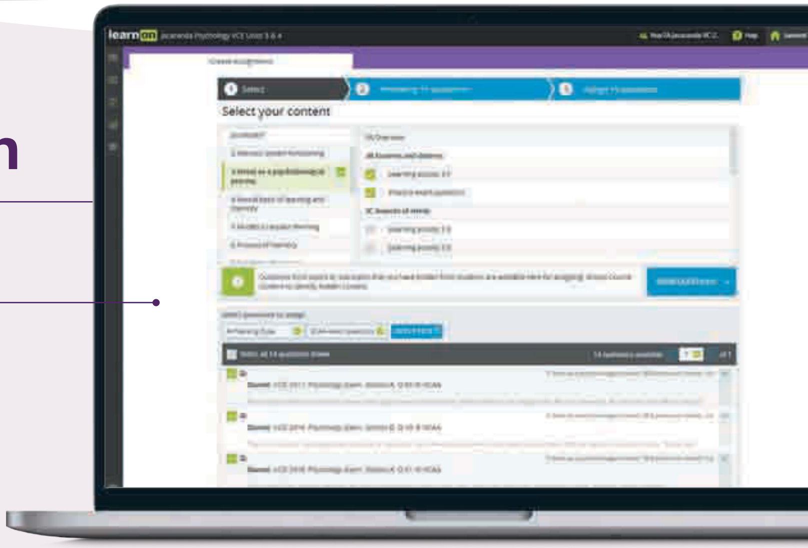
A wealth of teacher resources



Enhanced teacher support resources, including:

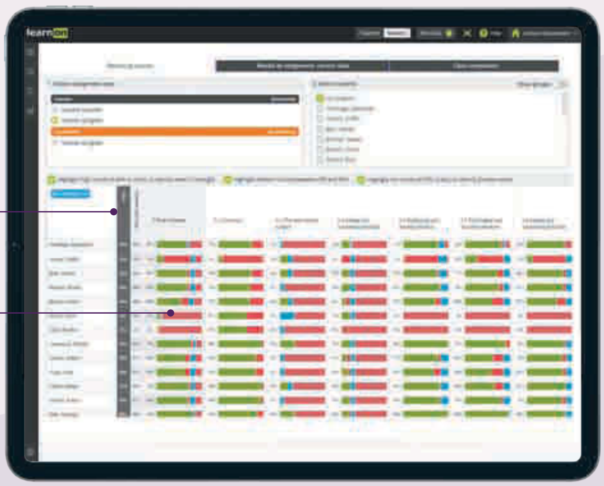
- work programs and curriculum grids
- teaching advice and additional activities
- quarantined topic tests (with solutions)
- quarantined SACs (with worked solutions and marking rubrics).

Customise and assign



A testmaker enables you to create custom tests from the complete bank of thousands of questions (including past VCAA exam questions).

Reports and results



Data analytics and instant reports provide data-driven insights into performance across the entire course.

Show students (and their parents or carers) their own assessment data in fine detail. You can filter their results to identify areas of strength and weakness.

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1 Key science skills and research methods in psychology

TOPIC CONTENT

1.1 Overview

KEY SCIENCE SKILLS

- Develop aims and questions, formulate hypotheses and make predictions
- Plan and conduct investigations
- Comply with safety and ethical guidelines
- Generate, collate and record data
- Analyse and evaluate data and investigation methods
- Construct evidence-based arguments and draw conclusions
- Analyse, evaluate and communicate scientific ideas

Source: *©VCAA, VCE Psychology Study Design: 2023–2027*. pp.12–13.

Psychology is a scientific discipline that seeks to describe, explain, understand and predict human behaviour and mental processes. There are many different approaches to the study of psychology. VCE Psychology applies a biopsychosocial approach to the study of behaviour and mental processes.

The VCE Psychology Study Design also prescribes a set of key science skills that is a core part of the study and applies across all areas of study in all units. In this topic we examine the key science skills and research methodology prescribed for VCE Psychology.

Table 1.1 shows the key science skills specified for study in VCE Psychology. You will be given the opportunity to develop then demonstrate these skills at a progressively higher level throughout Units 3 and 4.

Table 1.1 VCE Psychology Units 1–4 key science skills

Key science skill	VCE Psychology Units 1–4
Develop aims and questions, formulate hypotheses and make predictions	• identify, research and construct aims and questions for investigation • identify independent, dependent and controlled variables in controlled experiments • formulate hypotheses to focus investigations • predict possible outcomes of investigations
Plan and conduct investigations	• determine appropriate investigation methodology: case study; classification and identification; controlled experiment (within subjects, between subjects, mixed design); correlational study; fieldwork; literature review; modelling; product, process or system development; simulation • design and conduct investigations; select and use methods appropriate to the investigation, including consideration of sampling technique (random and stratified) and size to achieve representativeness, and consideration of equipment and procedures, taking into account potential sources of error and uncertainty; determine the type and amount of qualitative and/or quantitative data to be generated or collated • work independently and collaboratively as appropriate and within identified research constraints, adapting or extending processes as required and recording such modifications
Comply with safety and ethical guidelines	• demonstrate ethical conduct and apply ethical guidelines when undertaking and reporting investigations • demonstrate safe laboratory practices when planning and conducting investigations by using risk assessments that are informed by safety data sheets (SDS), and accounting for risks • apply relevant occupational health and safety guidelines while undertaking practical investigations

Key science skill	VCE Psychology Units 1–4
Generate, collate and record data	• systematically generate and record primary data, and collate secondary data, appropriate to the investigation • record and summarise both qualitative and quantitative data, including use of a logbook as an authentication of generated or collated data • organise and present data in useful and meaningful ways, including tables, bar charts and line graphs
Analyse and evaluate data and investigation methods	• process quantitative data using appropriate mathematical relationships and units, including calculations of percentages, percentage change and measures of central tendencies (mean, median, mode), and demonstrate an understanding of standard deviation as a measure of variability • identify and analyse experimental data qualitatively, applying where appropriate concepts of: accuracy, precision, repeatability, reproducibility and validity; errors; and certainty in data, including effects of sample size on the quality of data obtained • identify outliers and contradictory or incomplete data • repeat experiments to ensure findings are robust • evaluate investigation methods and possible sources of error or uncertainty, and suggest improvements to increase validity and to reduce uncertainty
Construct evidence-based arguments and draw conclusions	• distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas • evaluate data to determine the degree to which the evidence supports the aim of the investigation, and make recommendations, as appropriate, for modifying or extending the investigation • evaluate data to determine the degree to which the evidence supports or refutes the initial prediction or hypothesis • use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with evidence base and relevant to the question under investigation • identify, describe and explain the limitations of conclusions, including identification of further evidence required • discuss the implications of research findings and proposals, including appropriateness and application of data to different cultural groups and cultural biases in data and conclusions
Analyse, evaluate and communicate scientific ideas	• use appropriate psychological terminology, representations and conventions, including standard abbreviations, graphing conventions and units of measurement • discuss relevant psychological information, ideas, concepts, theories and models and the connections between them • analyse and explain how models and theories are used to organise and understand observed phenomena and concepts related to psychology, identifying limitations of selected models/theories • critically evaluate and interpret a range of scientific and media texts (including journal articles, mass media communications, opinions, policy documents and reports in the public domain), processes, claims and conclusions related to psychology by considering the quality of available evidence • analyse and evaluate psychological issues using relevant ethical concepts and guidelines, including the influence of social, economic, legal and political factors relevant to the selected issue • use clear, coherent and concise expression to communicate to specific audiences and for specific purposes in appropriate scientific genres, including scientific reports and posters • acknowledge sources of information and assistance, and use standard scientific referencing conventions

Source: VCE Psychology Study Design: 2023–2027. pp.12–13.

All key science skills are evident in the research methods commonly used for psychological investigations. A *research method* is a particular way of conducting an investigation to collect accurate and reliable data on a specific question or problem of interest. For example, experiments, correlational studies and observational studies are different research methods. Collectively, research methods provide the means or 'tools' for observing, measuring, manipulating or controlling what takes place in a psychological investigation.

Each type of research method has its advantages and limitations. Some are more suited to particular research hypotheses and data collection than others. The choice of research method depends on which is most appropriate for the hypothesis being tested and the type of data to be collected.

Most of what psychologists know about behaviour and mental processes is based on empirical evidence. *Empirical evidence* is data collected through systematic observations and/or carefully controlled experiments. This type of evidence allows psychologists to draw accurate conclusions which are more likely to be valid and free from personal biases, as compared to our 'common sense' conclusions based on everyday observations of behaviour.

learnon

learnMORE | Outline of VCE Psychology

Access learnON for a summary of the course and its assessment requirements.

1.1 LEARNING ACTIVITY

Multiple-choice questions

1. Behaviour is best described as
   - **A.** directly observable activity.
   - **B.** psychological activity.
   - **C.** a psychological process.
   - **D.** a mental process.
2. Which of the following is best classified as a mental process?
   - **A.** crying
   - **B.** thinking
   - **C.** breathing
   - **D.** talking
3. Which of the following statements about human behaviour, cognition and emotion is correct?
   - **A.** Behaviour can influence cognition but not emotion.
   - **B.** Emotion may influence behaviour but not cognition.
   - **C.** Cognition may influence behaviour but not emotion.
   - **D.** Behaviour, cognition and emotion may influence each other.
4. A research method Is best described as a/an
   - **A.** experiment.
   - **B.** key science skill.
   - **C.** scientific discipline.
   - **D.** process for planning and conducting an investigation.
5. Empirical evidence is best described as
   - **A.** a carefully controlled experiment.
   - **B.** a combination of scientific discipline and common sense.
   - **C.** data collected through scientific research.
   - **D.** research evidence describing behaviour and mental processes.

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1.2 Aims, hypotheses and variables

There is a virtually endless list of topics of research interest in psychology and many approaches to investigating those topics. An initial step is for the researcher to develop an idea about what to investigate then determine what aspect of the topic they wish to focus on. The specific topic of research interest is often called the research 'question' or 'problem'.

When the topic has been identified and refined, the next step is to construct a research hypothesis that can be tested, taking account of the variables of specific relevance to the investigation.

1.2.1 Aims

It is important that the researcher is clear in their own mind as to what their research question will be. This helps focus their research activities. If they begin with a broad area of interest, they will need to narrow this down to a specific area.

Having chosen their topic area, they will need to determine exactly what their aim is in the research. This involves deciding what the investigation is actually trying to achieve.

The **aim** is a statement outlining the purpose of the investigation. It can range in length from a single sentence to a short paragraph and should be expressed as clearly and precisely as possible. Some examples of appropriate research aims are:

- The aim of this investigation is to compare differences in the amount of sleep obtained by adolescents and very old people.
- The aim of this experiment is to assess the effects of practice on learning.
- To examine the effects of different types of feedback on performance of a novel task.
- To investigate the effectiveness of acronyms in aiding recall.
- To identify sex differences in the use of approach and avoidance strategies for coping with stress.

It is often possible to re-state the research question as the aim. For example, a researcher might be interested in ways of reducing the number of accidents caused by red P-plate drivers. After reading relevant information on the topic, such as reports on other investigations that may have been conducted on P-plater accidents, the researcher may construct the following research question: *'Does defensive driving training help to reduce the number of accidents caused by red P-plate drivers?'* This may be converted into an aim statement such as: *The aim of this investigation is to examine whether defensive driving training helps reduce the number of accidents red P-plate drivers cause.*

When writing the aim for one of your investigations, consider the following points:

- Ensure the aim describes the purpose of your investigation — what you are actually trying to find out from conducting the investigation.
- Make the aim as clear and uncomplicated as possible.
- Try and limit the aim to a single sentence to help focus your thinking.
- It may help to try expressing the aim as a research question to start with.
- If you have both a research question and an aim, ensure your aim clearly and closely relates to the research question.
- If you have more than one aim, ensure the aims are related.

Figure 1.1 The aim defines the purpose of an investigation and helps focus research activities.

1.2.2 Hypotheses

In psychology as in other sciences, different research methods are used to test one or more hypotheses relevant to the question or problem a researcher aims to investigate. The hypothesis formulated for an investigation is commonly called the research hypothesis.

A **research hypothesis** is a testable prediction of the relationship between two or more variables (events or characteristics). For example, it may be a prediction about the relationship between:

- mobile phone conversation while driving (one event) and driving performance (another event)
- biological sex (one characteristic) and oral language skills (another characteristic)
- exposure to a stressor (one event) and heart rate (one characteristic).

The hypothesis formulated for an investigation essentially describes the researcher's expectation about what the results will be. It is usually based on knowledge of other research findings or theories or models on the question of interest. This is why it is sometimes referred to as an 'educated' prediction or even an educated 'guess'.

The hypothesis is formulated before the investigation is conducted and provides a very specific focus for the investigation and its report. A useful research hypothesis typically has the following characteristics:

- refers to events or characteristics that can be observed and measured and is therefore testable (e.g. talking on a mobile phone while driving and driving performance are both measurable in a driving simulator and therefore data can be collected for hypothesis testing; whereas a hypothesis that people see a bright light when they die is not testable because it is not possible to observe or measure human experiences after death)
- can be supported or 'refuted' (denied or shown to be incorrect) by the data collected for the investigation
- states the existence of a relationship between two or more variables (e.g. a relationship between mobile phone conversation and driving performance)
- states the expected relationship between the variables, sometimes referred to as the 'direction of the relationship' (e.g. how talking on a mobile phone will influence or change driving performance)
- states a possible explanation of the results (e.g. impaired driving performance will be attributable to mobile phone conversation while driving)
- based on observations, a theory, model or research findings
- prepared as a carefully worded written statement (rather than a question)
- expressed clearly and precisely (rather than vaguely and generally)
- written as a single sentence.

In some cases, the research hypothesis may also refer to the larger group (or 'population') from which the sample was drawn and therefore about which the researcher intends to draw conclusions and apply the results. The population, however, is most commonly described in the introduction to the report on the investigation.

Research hypotheses for the examples given earlier could be:

- Mobile phone conversation while driving, whether hands-on or hands-off, impairs driving performance.
- Females have better oral language skills than males.
- Heart rate will increase when a person is exposed to a stressor.

There is no preferred writing style for a research hypothesis (nor is there a mandated style for VCE Psychology).

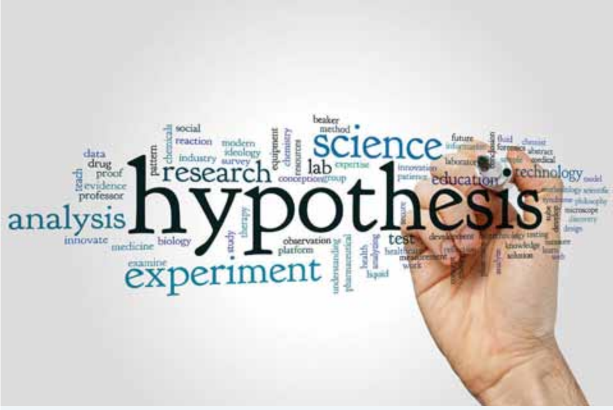

Figure 1.2 A research hypothesis is a testable prediction of the relationship between two or more variables.

Different writing styles can be equally valid. For example, some hypotheses use an 'if-then' style, such as 'if a certain event occurs, then it will cause a certain response'. In relation to the mobile phone conversation and driving performance 'events' (or variables), an if-then hypothesis may be stated as: `If a person engages in a mobile phone conversation when driving, then they will make more driving errors.' A more generally stated prediction such as `Mobile phone conversation while driving impairs driving performance' would also be an appropriate alternative.

Whatever your preferred style, to help ensure the hypothesis is expressed as a statement rather than a question, you can start your hypothesis with a phrase such as 'It was hypothesised that …' when preparing your report (noting that research reports are written in the past tense).

It is not always possible to be entirely certain about the accuracy of a prediction within a hypothesis, especially when the question or problem of research interest has not been widely studied, if at all. This is mainly because the researcher does not necessarily know or can control the influence of the many different variables that can affect the behaviour or mental process being studied. Nonetheless, many researchers would consider it pointless to conduct an investigation when the outcome is certain.

Scientific predictions tend to be more accurate about a large group or people in general than about a specific person. For example, a car insurance company can more accurately predict the percentage of people in a particular age group who are likely to be involved in road accidents this year than it can predict whether any particular individual in that age group will have an accident. Similarly, a psychologist may be able to correctly predict that cigarette smokers will be more *likely* to suffer a heart attack, but they cannot predict with certainty whether a particular cigarette smoker will suffer a heart attack.

This situation is no different in other sciences, which can only make predictions with varying degrees of probability of being correct. For example, your doctor may prescribe an antibiotic that, based on medical research, is *usually* effective in treating pneumonia. Your doctor, however, cannot guarantee that it will cure *your* pneumonia. Similarly, seismologists know that cities lying along geological faults are more likely to experience earthquakes, but they cannot accurately predict the day, or even the year, when one of these cities will experience its next major earthquake (Sdorow, 1995).

Figure 1.3 Scientific predictions tend to be more accurate about a large group or people in general than about a specific person. For example, a psychologist may be able to correctly predict that cigarette smokers will be more *likely* to suffer a heart attack, but they cannot predict with certainty whether a particular cigarette smoker will suffer a heart attack.

Hypothesis versus theory and model

In VCE Psychology you need to be able to develop aims and hypotheses and link these to theories and models.

A research hypothesis is different from a theory and model. A research hypothesis is a specific prediction that guides the collection, analysis, interpretation and evaluation of data that has been collected to test it. In contrast, theories and models are generally broader and far more detailed, with a focus on describing and/or explaining.

A **theory** is a body of interrelated concepts ('ideas') that attempt to explain interrelated observations and make predictions about future events. Some well-known theories in psychology are Freud's theory of personality development, and Piaget's theory of cognitive development. Freud's theory explains personality development in terms of abstract concepts such as the id, ego and superego and describes five psychosexual stages through which we progress from birth to early adulthood.

There are also theories on more specific aspects of behaviour and mental processes such as the restoration and evolutionary theories on why we sleep, psychoanalytic and biological theories on why we dream, and numerous other theories about, why we may develop a specific mental health disorder, how we learn, how we process information when remembering, why memories of emotionally significant events tend to be long-lasting, why we forget, when we are more likely to change an unhealthy behaviour, and so on.

The term model is often used interchangeably with theory, however, a **model** in psychology focuses more on representing how some behaviour and/or a mental process(es) could, should or does occur. It may be a simple graphic or other type of representation of a single concept or a basic observation, such as a cause–effect relationship between two events, how a brain structure may respond to fear or how a new procedure for diagnosing a specific mental health disorder is performed. In particular, a model can be useful in understanding abstract or 'hard to visualise' concepts about behaviour and mental processes.

More complex models are often supported with or presented in the form of a diagram with boxes and arrows to organise and show relationships between different concepts. Figure 1.4 shows an example of a model used to represent the process of how a theory or model may be developed or change. Models specified for study in VCE Psychology Units 3 and 4 include:

- Hans Selye's General Adaptation Syndrome as a biological model of stress
- Lazarus and Folkman's Transactional Model of Stress and Coping which explains stress as a psychological process
- the Atkinson-Shiffrin multi-store model of memory
- the biopsychosocial approach as a model for considering mental wellbeing.

Theories and models vary in scope, complexity and detail. All have one or more limitations. Some are essentially a hypothesis that has been restated. Others explain many interrelated research findings and ideas. Along with explaining existing results, a useful theory or model generates new hypotheses and guides further research.

Many theories or models of child development, mental health, personality, learning, remembering, forgetting and so on, are the products of psychological research and have generated valuable new research. In addition, some theories have generated new models and some models have generated new theories.

Whatever their scope — from tiny to vast — theories and models serve a gap-filling function. They explain how findings and ideas fit together in an organised way and what they mean, thereby making psychology a discipline that does more than report isolated facts. Some can be used to predict behaviour or a mental process in real life settings, thereby helping achieve an important goal of psychology.

Psychologists prefer testable theories and models because they can be confirmed, revised or refuted by further scientific research. Therefore, theories and models tend to not be judged in terms of their accuracy but rather in terms of their usefulness. This means that a theory or model tends to not be considered as right or wrong. Instead, it is simply regarded as more or less useful.

Both theories and models can be refined or changed as further research is conducted. Those that are less useful are often overlooked or discarded.

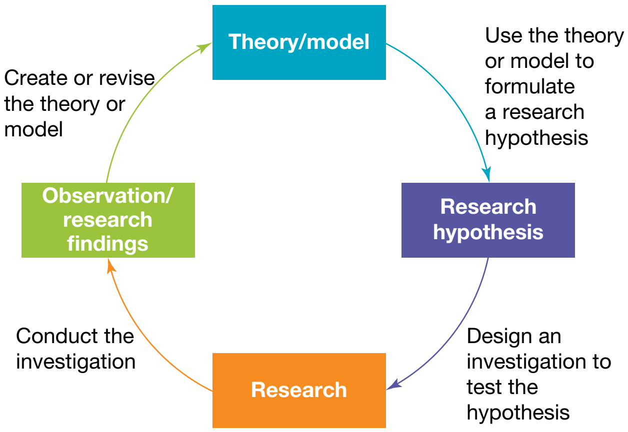

Figure 1.4 Theories and models are revised and expanded to reflect relevant research findings. New or revised theories and models lead to new observations or questions that stimulate new research and hypothesis testing.

1.2 LEARNING ACTIVITY 1

Review

1. Explain the difference between each of the following:
   a. the aim and hypothesis for a psychological investigation
   b. a psychological theory and model
   c. a research hypothesis and a theory or model.
2. Construct a two-column table. In one column, list the characteristics of a useful research hypothesis. In the other column, summarise each characteristic using not more than three words.
3. Explain two possible limitations of the following research question if it were to be used as a hypothesis:
   Do some people have an extrasensory perceptual ability to send and receive mental messages?
4. Consider the following list of research questions. Choose four questions and formulate a hypothesis for each one. One of the hypotheses should be written using the *if–then style*.
   Ensure all your hypotheses have key characteristics referred to in the text.
   a. Lack of attention causes forgetting.
   b. Crowding increases aggression.
   c. Positive thinking leads to success in a job interview.
   d. Does offering an incentive result in greater motivation to succeed?
   e. What is the effect of rote learning of information on a person's ability to recall the information when needed?
   f. Does being permitted to take a bottle of water into an exam improve performance on the exam?

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1.2 LEARNING ACTIVITY 2

Multiple-choice questions

1. Which term best describes the aim of a research investigation?
   A. purpose
   B. prediction
   C. problem
   D. question
2. Which statement about the aim of a research investigation is correct?
   A. The aim must be no longer than one sentence.
   B. The aim must be derived from the hypothesis.
   C. The aim and research question must be related.
   D. A research investigation must have only one aim.
3. *Source: VCAA 2021 Psychology, Section A, Q.17 (adapted); © VCAA*
   A research hypothesis
   A. is a question the research study sets out to answer.
   B. predicts how the researcher will conduct the research study.
   C. is based on scientific knowledge or experience in order to understand and test ideas.
   D. is a method of research based on the researcher's prior knowledge and experience.
4. Which of the following could serve as a research hypothesis?
   A. Regular exercise will improve mental wellbeing.
   B. Does regular exercise improve mental wellbeing?
   C. Regular exercise has improved mental wellbeing.
   D. Regular exercise has not improved mental wellbeing.
5. If a research hypothesis is refuted, then it may be concluded that the hypothesis is
   A. supported by the results obtained.
   B. not supported by the results obtained.
   C. not related to the research question that was studied.
   D. not expressed clearly and precisely.

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1.2.3 Variables

A key science skill in VCE Psychology requires you 'to identify independent, dependent and controlled variables in controlled experiments'.

A **controlled experiment** is an experimental investigation to test the relationship between an independent variable and a dependent variable, whilst controlling all other variables. For example, to test whether talking on a hand-held mobile phone while driving (one variable) causes or influences a change in driver reaction time (another variable), or whether access to a reward (one variable) has an effect on exam performance (another variable).

In this section, we focus on the different types of variables in a controlled experiment and explain how variables being tested or measured are 'operationalised' and why this needs to be done.

A **variable** is something that can change ('vary') in amount or type and is measurable. For example, sleep can change in both amount (e.g. number of hours) and type (e.g. with or without rapid eye movements) and is measurable (e.g. through recordings of bodily activities such as eye movements and brain wave patterns).

There is a virtually endless list of variables that may be studied in psychology. Examples include age, sex, intelligence, mood, problem solving, memory, state of consciousness, sociability, use of social media, diet, exercise, media violence, drug-taking, risk-taking, family environment, religion, culture, work space, crowding, number of errors, and time taken to perform a task.

A variable may be a personal characteristic, either physical or psychological, an object, or an event that can have a specific influence on how an individual may think, feel or behave. Personal characteristics such as biological sex, blood type, genetic make-up and racial or ethnic background are all inborn and therefore 'fixed' and ordinarily unchanging within a person. However, in psychological research they are still considered variables because they can be of different types and are measurable.

For example, 'male' and 'female' are two types of biological sex and 'O', 'A', 'B' and 'AB' are four different blood types. Although a researcher cannot actually change a participant's sex or blood type, they can 'manipulate' (or 'change') them by allocating males and females and/or people with different blood types to different groups or conditions used in their experiment in order to make comparisons.

Similarly, age and intelligence are 'fixed' However, the researcher can manipulate them by comparing naturally occurring variations; for example, the performance of old and young participants, or, more or less intelligent participants (as indicated by IQ scores).

Independent variable

Every controlled experiment has at least one independent variable and one dependent variable. In a simple experiment, one of these variables is manipulated (controlled, selected or changed) by the researcher to observe its effect or influence on another variable.

The variable that is manipulated in order to measure its effect on the dependent variable is called the **independent variable (IV)**. It is sometimes referred to as the 'treatment' or 'treatment variable' to which participants may be exposed (or not exposed).

The IV is assumed to have a direct effect on the dependent variable. Therefore, in terms of cause and effect, the IV is viewed as the cause of any change that may result in the dependent variable.

For example, in an experiment on whether watching a violent TV program increases aggressive behaviour, the IV will be exposure to a violent TV program. Its 'manipulation' will involve exposing or not exposing participants to violence in a TV program to observe the consequential changes in the dependent variable (aggressive behaviour).

The IV is assumed to have a direct effect on the dependent variable so it is also assumed that any measurable change in the dependent variable will be due to the effect of the IV. Therefore, in terms of cause and effect, the IV is viewed as the cause of any change that may result in the dependent variable.

As indicated in the example above, a 'treatment' may also be withheld; for example, to compare its effect(s) on participants who are exposed to it with those who are not. This is why an IV may also be referred to as having different *values* (or *levels*) — the value of the IV is systematically 'manipulated'. In the simplest type of experiment, the IV has two values, such as exposure or non-exposure to violence in a TV program.

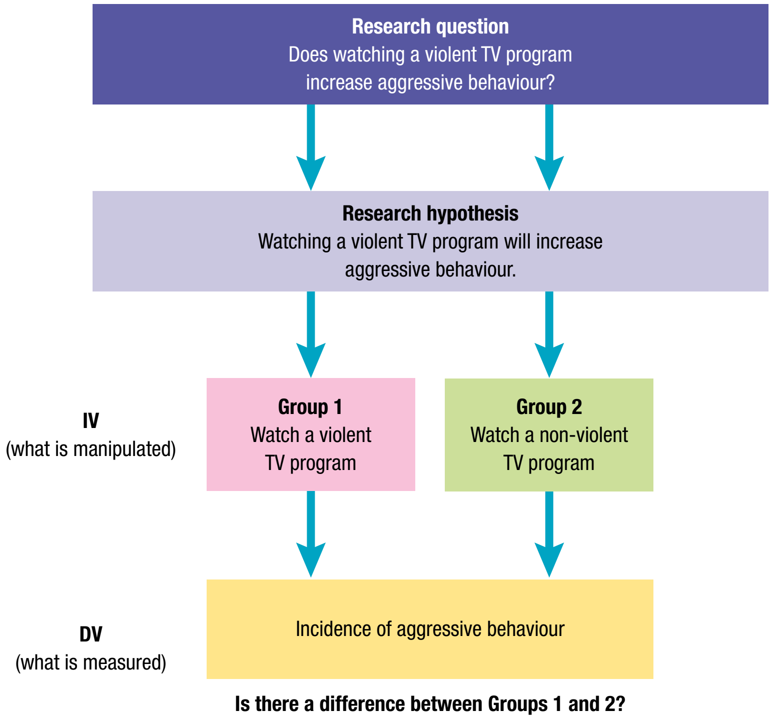

Figure 1.5 The IV and DV in an experiment on whether watching a violent television program increases aggressive behaviour. The IV is assumed to have a direct effect on the DV. Selecting which participants are exposed or not exposed to an IV is one way of manipulating the IV.

An experiment can also have more than one IV. For example, a researcher might test a hypothesis that a child will behave aggressively after watching a violent TV program only if other children are present. In this case, both the violent TV program and the presence of other children would be IVs. A third IV could be drinking a high sugar content cordial during the program. Of course, one or more of these IVs could also have different values.

More complex experiments have three or more values of the IV; for example, non-exposure to a violent TV program, exposure to one violent TV program and exposure to two violent TV programs. In this case, the IV has been manipulated 'quantitatively' by varying its 'amount' — exposure to one or two violent TV programs. Alternatively, the IV may be manipulated 'qualitatively' by varying its 'type'. In this case, the values of the IV may involve exposure or non-exposure to specific types of violent TV programs; for example, to compare the influence of violence by cartoon characters with violence by people in a movie.

An even more complex experiment may compare responses of male and female participants to various types of violent and non-violent male and female characters or people in different types of TV programs (qualitative variables) following different periods of exposure, such as 15 minutes, 30 minutes, 45 minutes, 1 hour, and so on (quantitative variables).

Dependent variable

The variable that the researcher uses to observe and measure the effects of the IV is called the **dependent variable (DV)**. It is the aspect of a participant's behaviour or experience that is assumed and expected to change as a result of the manipulation of the IV selected by the researcher.

The DV is often the responses made by participants and usually has a numerical (quantitative) value. For example, a behaviour such as aggression in young children might be observed and measured by the number of times physical contact is made with another person in a 5-minute period immediately after a child has been exposed to a violent or a non-violent TV program. Aggressive behaviour is the dependent variable, because the participants' responses are believed to be influenced by, or 'dependent on', the effects of the independent variable.

The DV is sometimes referred to as the 'measurement' variable, because it provides a 'measure' of the participants' responses to the independent variable.

In terms of a cause–effect relationship, the IV is viewed as the possible cause, and change in the DV is the possible effect. In experimental research, the research hypothesis states the causal relationship between the independent and dependent variables to be tested; that is, that the IV(s) will cause the DV(s) to change in a particular way.

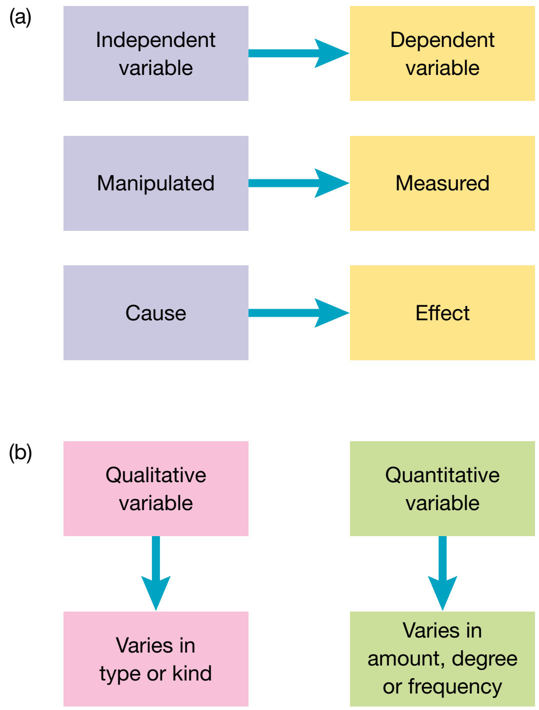

Figure 1.6 Distinguishing between (a) an IV and DV, and (b) a qualitative variable and quantitative variable

Controlled variable

In addition to the independent and dependent variables, there are other variables that the experimenter should anticipate and take account of.

A **controlled variable** is one that is considered to have an effect on the dependent variable in an experiment so it needs to be held constant ('controlled') to remove its potential effects. For example, in an experiment on the effect of caffeine on psychology test performance, one group of VCE Psychology students could drink coffee (the IV) before a psychology test and their scores for the test (the DV) would be compared with those of a group who did not drink coffee.

Variables that would have to be kept constant include caffeine (e.g. type and amount of coffee that participants drink), the test (e.g. everyone sits the same test), the test conditions (e.g. day and time, the room, instructions to participants, noise), the ability of the students (e.g. comparable ability in both groups) and prior experience with the test content.

When planning and conducting an experiment, it is essential that the experimenter is confident that manipulation of the IV is likely to cause the predicted change in the DV, rather than some other variable that is not adequately controlled. Therefore, the experimenter must ensure that a controlled variable maintains that status so that it has no influence on the DV and thereby makes it difficult to isolate the effect of the IV.

Unlike the IV and DV, a controlled variable is not actually part of the experiment in itself. Nor is it a variable of interest in the investigation. For example, it is not relevant to the aim or hypothesis. But it is controlled because it could influence the outcome.

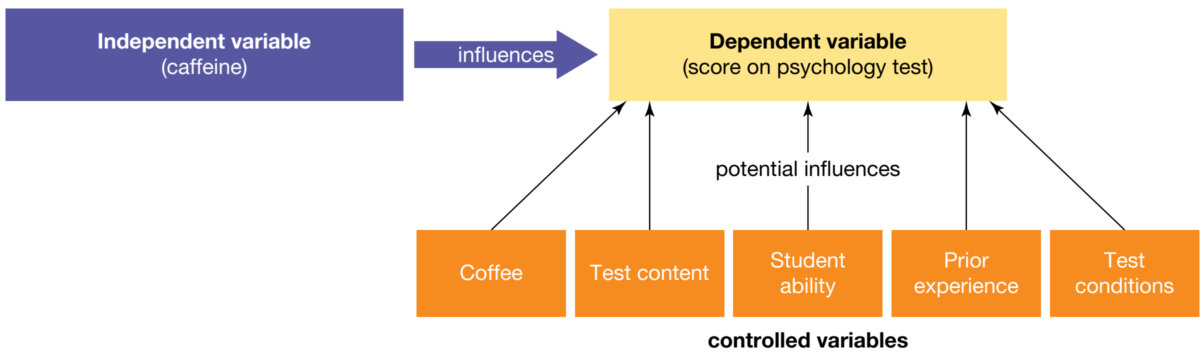

Figure 1.7 Independent, dependent and controlled variables in an experiment that is testing a cause–effect relationship between caffeine and psychology test performance

1.2 LEARNING ACTIVITY 3

Review

1. Write a definition of each of the following terms as they apply to an experiment:
   a. variable
   b. independent variable
   c. dependent variable
   d. quantitative variable
   e. qualitative variable
2. a. Explain the meaning of controlled variable.
   b. Why do all variables in an experiment require 'control'?
3. a. What do researchers expect to happen to DVs when they manipulate IVs?
   b. What does 'manipulation' of an IV actually involve?
   c. Give an example of how each of the following could be manipulated quantitatively and qualitatively if it is an IV in an experiment.
      i. sleep
      ii. lighting
      iii. room temperature
      iv. a word
      v. body weight
4. Identify the IV and DV in each of the following if experimental research were to be conducted.
   a. Receiving a reward for studying will increase the amount of time students engage in studying.
   b. People who are in love perceive each other more positively than other people perceive them.
   c. Recall of information presented early in a list is better than recall of information presented later in a list.
   d. People react faster to sounds than to visual stimuli.
   e. Using adult language when talking to infants improves their vocabulary.
   f. People change their pitch of voice when lying.
   g. Daydreaming occurs more frequently during simple tasks than during complex tasks.
   h. Workers on an assembly line are more productive when working alone than in a small group.
   i. Heart rate and blood pressure increase when viewing a violent movie clip as compared to a non-violent movie clip.
   j. Infants pay attention to a complex stimulus for a longer period of time when compared with a simple stimulus.
5. A researcher noticed that some of her laboratory rats stood on their hind legs for a moment whenever their food was brought into the laboratory. She decided to test whether she could teach the rats to stand on their hind legs when she rang a bell.

   First she measured the exact amount of time the rats spent standing when the food was brought in. Then she rang a bell just before each meal. The rats eventually started to stand on their hind legs when they heard the bell.

   a. What two IVs are being manipulated in the experiment?
   b. What is the DV and how is it measured?
   c. Why did the researcher measure the rats' movements before introducing the ringing bell?
6. A researcher observed helping behaviour in a real-world setting. An actor pretending to be either drunk or blind was required to collapse on a Melbourne underground train platform.

   Sometimes the actor was a First Nations male and sometimes the actor was a non-First Nations male of about the same age.

   The researcher then recorded how long it took for help to be given.

   a. What is the IV and how many values or levels does it have?
   b. How is the IV manipulated?
   c. What is the DV and how is it measured?

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1.2 LEARNING ACTIVITY 4

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.21; © VCAA

Dr Dhanial investigated the effect of leading questions on recall. In the first week of the semester, university students were randomly allocated to two groups (Group A and Group B) and asked to estimate how often they ate chocolate during the summer holidays. Different forms of the question were used for each group:

- 'Did you eat chocolate frequently and, if so, how much per week?'
- 'Did you eat chocolate occasionally and, if so, how much per week?'

The table below represents Dr Dhanial's results.

Group	Leading word	Estimate of chocolate consumption per week
A	frequently	4.1
B	occasionally	0.8

The independent variable in Dr Dhanial's study was the

A. fallibility of memory.
B. wording of the question.
C. reconstruction of memory.
D. estimation of eating chocolate.

Question 2 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.34 (adapted); © VCAA

Parminder compared the effects of consumption of alcohol on reaction times in people at various stages of life.

His sample included participants aged 18 to 70 years. In the within subjects experiment, participants consumed one standard drink of alcohol at half-hourly intervals until they reached 0.10% blood alcohol concentration (BAC). Participants completed a series of computer-based tests for reaction times at BACs of 0.00%, 0.05% and 0.10%.

Additionally, once participants reached 0.10% BAC, Parminder asked all participants to write down on a lined piece of paper their immediate feelings, thoughts and memories, and to provide an estimate of how long they thought the tests ran for.

Which of the following includes both an independent variable and a dependent variable for Parminder's study?

	Independent variable	Dependent variable
A.	age	reaction time
B.	reaction time	BAC
C.	cognitive performance	amount of alcohol consumed
D.	amount of alcohol consumed	BAC

Question 3 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.55 (adapted); © VCAA

Dr Tran conducted a controlled experiment on a technique for remembering nonsense syllables. The experimental group used Dr Tran's learning technique and had a greater recall of nonsense syllables than the control group.

In Dr Tran's experiment, independent variable (IV) and dependent variable (DV) were

A. IV: participant characteristics; DV: learning technique.
B. IV: number of nonsense syllables correctly recalled; DV: learning technique.
C. IV: learning technique; DV: number of nonsense syllables correctly recalled.
D. IV: participant characteristics; DV: number of nonsense syllables correctly recalled.

The following information relates to questions 4 and 5
A researcher was investigating whether the presence of speed cameras had any impact on driving behaviour. She was interested in whether drivers slowed down if they knew speed cameras might be operating. She went to a busy road where there was no evidence of speed cameras and recorded the speed of 100 drivers as they drove past a particular point on the road. She returned to the same road one week later and installed large warning signs saying speed cameras operated in the area. She then recorded the speed of 100 drivers as they drove past the same point on the road that she used in the previous week.

Question 4 (1 mark)

Source: VCAA 2004 Psychology 2, Section A, Q.31 (adapted); © VCAA

What is the likely research hypothesis?

A. Warning signs have an impact on driving behaviour.
B. The more you drive the more likely you are to speed.
C. Warning signs lead to a decrease in speeding behaviour.
D. Warning signs are as effective as actually having visible speed cameras in reducing driving speed.

Question 5 (1 mark)

Source: VCAA 2004 Psychology 2, Section A, Q.32; © VCAA

The independent variable is

A. the presence of the warning signs.
B. paying attention or not to the warning signs.
C. the driving speed when the warning signs were present.
D. the driving speed when there were no warning signs

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Operationalising independent and dependent variables

Operationalising the IV and DV involves defining *how* they will be manipulated or measured in the experiment (or other investigation). This is an important step because many of the behaviours and mental processes psychologists investigate can have different meanings and can therefore be specifically denied, manipulated or measured in more than one way.

For example, consider an experiment to investigate whether exercise provides relief from depression. 'Exercise', which is the IV, might be operationalised as 'walking at a particular pace for a specified period of time on an automated treadmill'. 'Depression', which is the DV to be measured, might be operationalised as 'the number of negative words used in writing a creative story', as it has been found through previous research studies to be related to the severity of depression.

Similarly, consider the way in which each of the following potential variables that can have multiple meanings might be operationalised for the purpose of experimental research.

- *intelligence* — a score on a standardised intelligence test
- *memory* — a score on a test of free recall
- *learning* — the reduction in the number of errors when performing an unfamiliar task
- *anger* — changes in blood pressure, heart rate and respiration rate
- *physical attraction* — the number of times someone touches another person
- *love* — the frequency of expressions of affection such as kissing, touching and cuddling.

Operationalising the IV(s) and DV(s) ensures that these variables are precisely defined and explained in terms of the 'operations' (procedures, actions, or processes) by which they will be manipulated or measured. The resulting definitions are sometimes called *operational definitions*.

There are several important benefits of variables being defined precisely through operationalisation. These include:

- It helps ensure the independent and dependent variables are testable and therefore that the research hypothesis is testable.
- All researchers involved in conducting the experiment know exactly what is being observed and measured and how this will occur. This helps avoid experimenter biases and differences that can affect the results in an unwanted way.

When the variables are defined in a very precise way, another researcher interested in the results, or perhaps even doubting them, will be able to repeat the experiment in order to test ('check') the results obtained for accuracy or to find out if the results are relevant to other groups or situations.

When a study is replicated under the same conditions using a similar sample and similar results are obtained (i.e. the results are 'repeatable'), there is greater confidence in the validity of the results. There is even greater confidence when replication under different conditions achieves very similar results (i.e. the results are 'reproducible'). Alternatively, if replication of a study fails to produce the same basic findings, researchers have less confidence in the findings reported for the original research.

The research hypothesis for an experiment may refer to the operationalised variables (but this is not essential). For example, consider a possible hypothesis for the experiment on exercise and depression:

People with depression who exercise regularly will have fewer symptoms of depression than people who do not exercise.

Note in this research hypothesis that:

- the IV is stated, including both its values i.e. regular exercise and no exercise
- the DV is clear i.e. number of symptoms of depression
- the expected effect of the IV on the DV is also stated, specifically, the direction of the predicted effect — that is, the way in which the two groups (exercise and no exercise) are predicted to differ (not simply that there would be a difference).

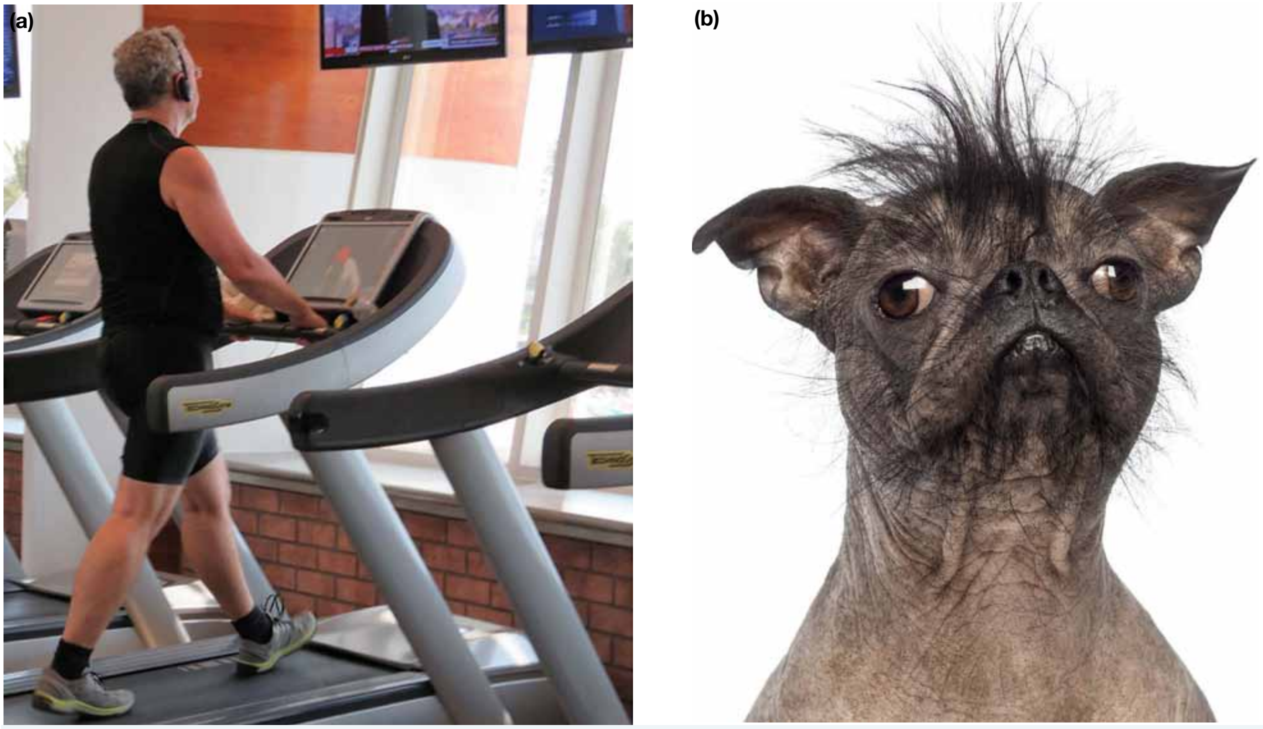


Figure 1.8 (a) Exercise might be defined as walking at 7 km/h for 30 minutes on an automated treadmill. (b) Does this dog look ferocious? The answer depends on how you operationalise ferocious.

Table 1.2 Ways in which IVs and DVs can be operationalised

Research question	IV example	DV example
Do students learn more effectively in early morning or late afternoon classroom lessons?	• time of lesson	• score on a test of recall (amount of information remembered)
If a teacher ignores a student's attention-seeking behaviour in class, will this strategy reduce the student's attention-seeking behaviour?	• teacher not paying attention to attention-seeking behaviours	• frequency of attention-seeking behaviours
Does playing violent video games cause aggressive behaviour?	• a video game classified by the Commonwealth Government censors as violent	• number of presses of a button that administers a shock to another student
Does allowing a child to sleep in the same bed as their parents result in the child being overly attached to the parents?	• child sharing bed with both parents over a specified period of time	• frequency of separation anxiety behaviours when either or both parents leave the child alone with a stranger
What types of jokes are funny to people of different cultural backgrounds?	• different types of jokes	• number of audible laughs detected by an audiometer and number of smiles detected by an electromyograph (measures facial muscle contractions)

learnon

learnMORE | Operational definitions

Access learnON to read more about the importance of operationalisation through the use of operational definitions when conducting research.

1.2 LEARNING ACTIVITY 5

Review

1. What does operationalisation of an experiment's independent and dependent variables involve?
2. List three potential benefits of operationalising variables.
3. Suggest how the IV and DV could be operationalised for an experiment on each of the following research hypotheses.
   a. Anxiety causes forgetting.
   b. Crowding increases aggression
   c. Relaxation minimises stress.
   d. Practice assists learning.
   e. Girls talk more than boys.
4. Suggest an operationalised IV and DV for each of the following research questions.
   a. Does offering an incentive result in greater motivation to succeed?
   b. What is the effect of rote learning of information on a person's ability to recall the information when needed?
   c. Does being permitted to take a bottle of water into an exam improve performance in the exam?
   d. Does parental attention increase the incidence of tantrum behaviour by toddlers?
   e. Does sleep deprivation time cause an increase in reaction time when riding a bike?

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

1.2 LEARNING ACTIVITY 6

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.63; © VCAA

Dr Terrence is running an experiment to investigate the effect that room temperature has on the time taken for people to fall asleep.

In this experiment, the independent variable is

A. room temperature.
B. time taken for people to fall asleep.
C. body temperature when people fall asleep.
D. time taken by people to adapt to room temperature.

Question 2 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.48; © VCAA

Dr Gregory wanted to test the effects of different methods of learning on memory retention. Equal numbers of participants were randomly allocated to three different learning groups. Each group learnt the same list of words that were presented on a computer screen, one at a time, in random order. For all groups, half of the words were printed in upper-case letters and half were printed in lower-case letters.

Each group was given a different method of learning the words, as follows:

- Group A – For each word presented, participants were asked to report whether the word was printed in upper-case letters or in lower-case letters.
- Group B – For each word presented, participants were asked to report whether the word rhymed with the word 'stop'.
- Group C – For each word presented, participants were asked to report whether the word was a kind of animal.

After learning the list of words, participants were asked to recall as many words from the studied list as possible.

Dr Gregory then compared the mean number of words correctly recalled between the groups.

For Dr Gregory's study, the independent variable and the dependent variable were, respectively, the

A. method of learning the word list, time taken to learn the words.
B. method of learning the word list, number of words recalled.
C. number of words recalled, method of learning the word list.
D. number of words in each list, number of words recalled.

Question 3 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.63; © VCAA

Dr Nguyen is a psychologist interested in investigating the effect of age on the cycling ability of Victorians. He recruits 93 Victorian bike riders who responded to an advertisement that he placed in a newspaper.

The bike riders are divided into two groups:

- Group 1 consists of riders aged 20-39 years old.
- Group 2 consists of riders aged 40-59 years old.

The independent and the dependent variables in this study were, respectively,

A. cycling ability, age.
B. age, cycling ability.
C. cycling ability, 93 Victorian bike riders.
D. 93 Victorian bike riders, cycling ability.

Question 4 (1 mark)

Source: VCAA 2004 Psychology 2, Section A, Q.33; © VCAA

A researcher was investigating whether the presence of speed cameras had any impact on driving behaviour. She was interested in whether drivers slowed down if they knew speed cameras might be operating. She went to a busy road where there was no evidence of speed cameras and recorded the speed of 100 drivers as they drove past a particular point on the road. She returned to the same road one week later and installed large warning signs saying speed cameras operated in the area. She then recorded the speed of 100 drivers as they drove past the same point on the road that she used in the previous week.

The dependent variable is

A. driving speed.
B. the presence of the warning signs.
C. the location of the warning signs.
D. driving speed when there were no warning signs.

Question 5 (2 marks)

Source: VCAA 2006 Psychology 2, Section B, Q.9; © VCAA

Testing the Mozart effect

Previous research has shown that listening to certain types of classical music (for example, a Mozart concerto) may increase performance on spatial-temporal tasks for a short period of time. However, this research has been disputed.

Professor Williams aims to investigate the effect of classical music on a spatial-temporal task that involves paper folding and cutting. He plans to find out if the effect exists for VCE students at Lake Hilltop Secondary College, a coeducational country school.

Professor Williams recruits participants who are studying VCE at the school. He asks the first 40 students that visit the library to participate. All 40 students provide signed informed consent.

The participants sit quietly for 20 minutes and then attempt the first paper folding and cutting test (Condition 1).

The same participants then listen to classical music for the next 20 minutes. Immediately afterwards they complete a similar paper folding and cutting test (Condition 2).

Professor Williams asks a teacher, who does not know which test relates to which condition, to mark the tests.

The results are as follows.

Condition 1 (control): Mean test score = 8

Condition 2 (listening to classical music): Mean test score = 12

A statistical test on these results found that $p < 0.05$

For this study, what is the

i. independent variable? 1 mark
ii. dependent variable? 1 mark

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

1.3 Scientific investigation methodologies

1.3.1 Types of research methods

Scientific investigation methodology refers to the specific techniques used to collect and analyse data in an investigation; that is, *what* research method is used to conduct a scientific investigation.

In contrast, the scientific method refers to the steps that are followed to conduct the investigation; that is, *how* the investigation is conducted. As you would expect, each research method is based on, is a part of, and reflects the scientific method.

The VCE Psychology Study Design (p.14) describes the different types of research methods you should consider when planning your own investigations. The Study Design refers to them as 'scientific investigation methodologies'. Descriptions can also be found in the Types of scientific investigation methodologies learnMORE section in learnON.

Note that some of these methodologies require you to collect data directly through your own experiments or from first-hand observation, whereas others are based on data that was not gathered directly by you but rather was obtained by someone else. Furthermore, some may be conducted within the classroom and others in the field outside the classroom.

This resource focuses on research methods involving observing and interacting with participants, either within the classroom or in fieldwork in a selected environment beyond the classroom. Figure 1.9 shows how these methods may be classified into types.

Sample selection is common to all investigations. It is undertaken early in the research process and is as important as choosing a research method. We consider key aspects of sample selection before examining different types of research methods and the specific features that distinguish them from each other.

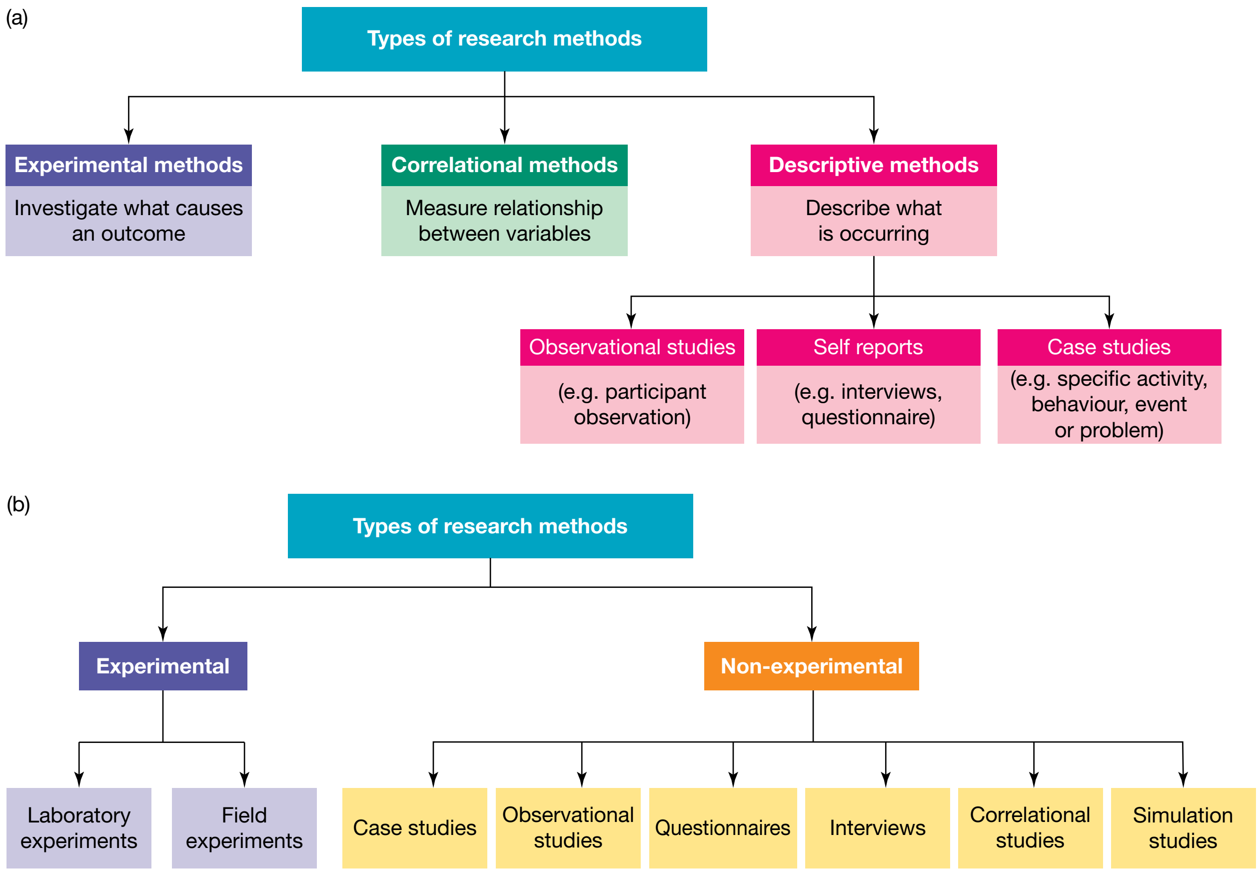


Figure 1.9 Types of research methods. (a) The classification system may vary according to criteria such as the purpose of the research, its specific procedures, the type of data that is collected and how the data are used. (b) Sometimes research methods are classified more simply as experimental and non-experimental.

learnON

learnMORE | Types of scientific investigation methodologies

Access learnON for the Study Design's description of the different methodologies you could use in your own investigations.

1.3.2 Population, sample and sampling

When planning an investigation, the researcher needs to decide who (or what) will be targeted for study in order to test their hypothesis. Decisions also need to be made about the sample composition, the sample size and how the sample will be selected.

Population

In scientific research, the population does not necessarily refer to all people (or animals) in the world, in a country, or even in a particular city or area. The term **population** refers to the entire group of research interest from which a sample is drawn and to which the researcher will seek to generalise (apply) the results of their investigation.

A population targeted for research typically has one or more characteristics in common; for example, all VCE Psychology students enrolled at a particular school, all VCE students in all schools, all females, all females who have been diagnosed with schizophrenia and are patients in a hospital, all left-handed males, all registered nurses aged 25 to 30 years, all cigarette smokers, all twins, all 4-year-old twins, or all 4-year-old identical twins born at a particular hospital.

However, a population used for research does not always involve living things. A population could also be measurable objects or events such as all public hospitals in Victoria providing adolescent mental health services, all drug-related deaths reported by the coroner in the previous 12 months, all EEG (brain wave) recordings for an individual during a certain period of time, the IQ scores of all students in a particular school , all absences from a workplace in a 10-year period due to a stress-related problem, all the days on which the temperature exceeded 30 °C, all the words in the English language, or all of any other specific source of data.

Sample

A **sample** is a subset or part of the population that is selected for research purposes. For example, suppose that a researcher is interested in conducting an experiment to find out whether children who attended a child care centre during their preschool years have better language skills than children who did not attend a child care centre. It would be impractical to test every child who attended a child care centre and every preschool child who did not. The researcher would therefore select a sample with whom they conduct their investigation.

A sample is always smaller than a population. When studying people, psychologists can rarely be certain about any behaviour or mental process that occurs in a population because they can rarely study all its members — it's usually too large a group.

Consequently, researchers draw a sample that is appropriate for testing their hypothesis and attempt to generalise the results obtained for the sample to the population from which it is drawn, or even other groups or situations. This is why it is important that the sample accurately reflect the entire population of interest, although this is not always possible.

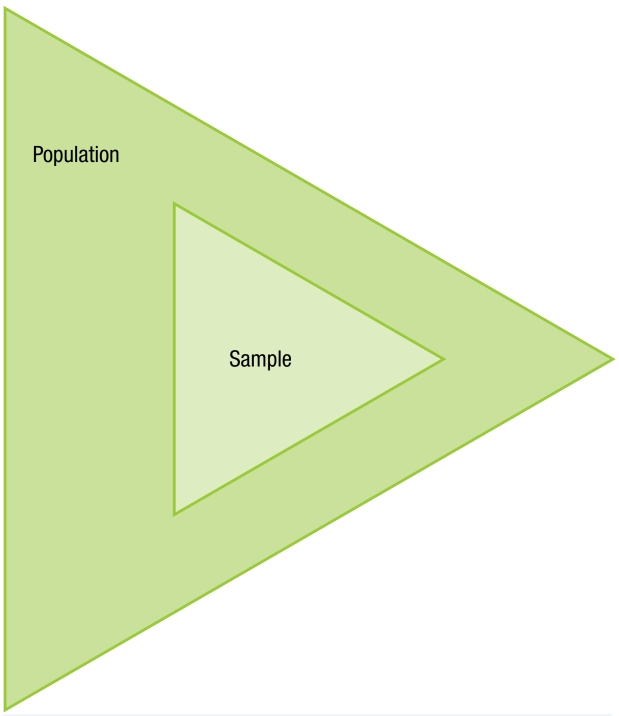


Figure 1.10 A sample is a part of the population chosen for study so it is always smaller than the population.

Sampling

Suppose a psychology lecturer at a university wanted to find out which of two teaching methods is more effective. The lecturer teaches two first-year psychology classes, one that starts at 8 am and one that starts at 4 pm. The lecturer uses one teaching method for the morning class and a different method for the afternoon class. At the end of the semester, the lecturer finds that the final examination scores are higher for the morning class. The researcher concludes that from now on all lecturers will use that particular teaching method for all classes. Is this a valid or legitimate conclusion to draw on the basis of the results obtained from the research?

The problem is that the two groups of participants may not be sufficiently alike in personal characteristics of relevance to the study and which may therefore have influenced the results. For example, people who enrol for lectures that start at 8 am may differ in some ways from those who enrol for a 4 pm lecture. Some people prefer to get up early, while others like to sleep late. Perhaps some students had commitments, such as casual work or other activities scheduled late in the afternoon, that prevented them from enrolling in the 4 pm class.

This example highlights the importance of participant sampling. Given the use of an inappropriate sampling technique at the outset (and the failure to allocate to groups in an appropriate way), it cannot be concluded with confidence that the differences in the two groups' examination scores were caused solely by the difference in teaching methods.

Sampling is the process by which a subset or part of the population is selected for an investigation. The population of research interest is often referred to as the *target population*.

In psychology, sampling most often involves selection of participants for inclusion in experiments, observational studies, case studies, interviews, or other research. Given that a population is not always people, sampling can also involve selecting a specific activity or process to study, time points at which to observe individuals, data from a set of data, and so on.

Sampling is usually undertaken with the goal of being able to use the sample to draw conclusions about the larger population. This is not unlike the goal of a medical researcher who analyses a sample of someone's blood to draw one or more conclusions about all of that person's blood.

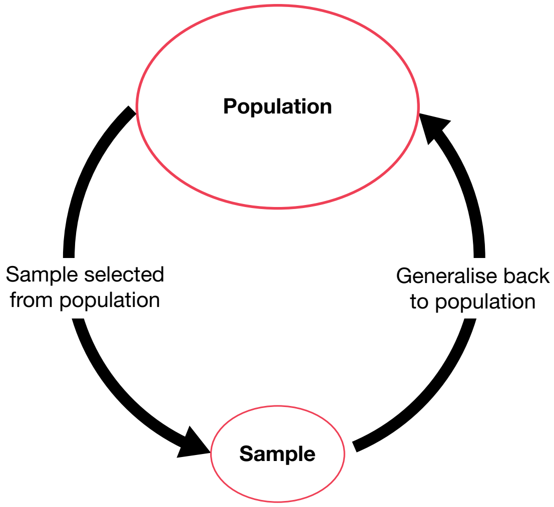


Figure 1.11 A sample is usually selected with the goal of generalising back to the larger population. A representative sample closely matches the population in the distribution of key characteristics

Therefore, a sample should be selected in a scientific way so that the results obtained can be legitimately applied to its population. When sampling, it is important to ensure that the sample lacks bias and is like the larger population in as many ways as possible so the results can be generalised to that group. It must reflect its population in all the characteristics that are important in the investigation.

For example, when selecting a sample for an investigation involving people, the researcher will consider personal characteristics of participants (or subjects) that are important in the study.

'Participant variables' (or 'subject' variables) that are considered important are those that can influence the results of the study to be conducted. For example, in an investigation on the soft drink and fast-food preferences of adolescents, personal characteristics of participants such as their age, sex, income, access to retail outlets and cultural background are among the variables that could be assumed to be important. Variables such as height, hair colour, intelligence and spatial abilities may be assumed to be not important.

When a researcher selects a sample that mirrors or is approximately the same as its population, the sample is called a representative sample. A **representative sample** is a sample that closely resembles the population from which it is drawn in key characteristics. It is assumed the sample has the minimum amount of possible errors in representing the population. When a sample does not adequately represent the key characteristics of its population it is called a **biased sample**.

Sample size and representativeness

Sample size can impact on representativeness. Some researchers have described the law of large numbers in relation to sampling.

The *law of large numbers* suggests that as sample size increases, the attributes (characteristics) of the sample more closely reflect the attributes of the population from which the sample was drawn. For example, the more people who are selected for an experiment, the more likely it is that they will reflect and therefore be representative of the population.

Larger samples also minimise the likelihood of an unexpected sampling error resulting in a sample which does not represent its population well and would therefore make it difficult to apply the results to that population.

To apply the law of large numbers in an everyday situation, suppose you are deciding which of two universities to attend. To help you make this decision, you spend one open day at one of the universities and one open day at the other. At each open day, you attend a demonstration lecture for the course you are most interested in studying. You like one presentation much better than the other. Should this sample of small lecturers and lectures influence your decision about which university to attend? Can you see how results from such a very small sample could be very misleading? (Gazzaniga et al., 2011).

Although a relatively large sample may be preferred for an investigation, this is not always possible, especially for research with human participants. For example, the required number of participants may not be readily accessible or available, there may be budgetary or time constraints, there may be inadequate space available and other practical considerations may limit sample size.

It should also be noted that bigger does not necessarily mean better. The quality and usefulness of the sample will be influenced by the sampling technique used for its selection. In addition, for some investigations, such as a case study, the researcher may only be interested in a very small sample, possibly only one person to study a single case.

There is nothing wrong with conducting well-planned small investigations with small samples. The results just need to be interpreted carefully and it is also important to draw tentative ('cautious') rather than firm conclusions, whether the results support or refute the hypothesis.

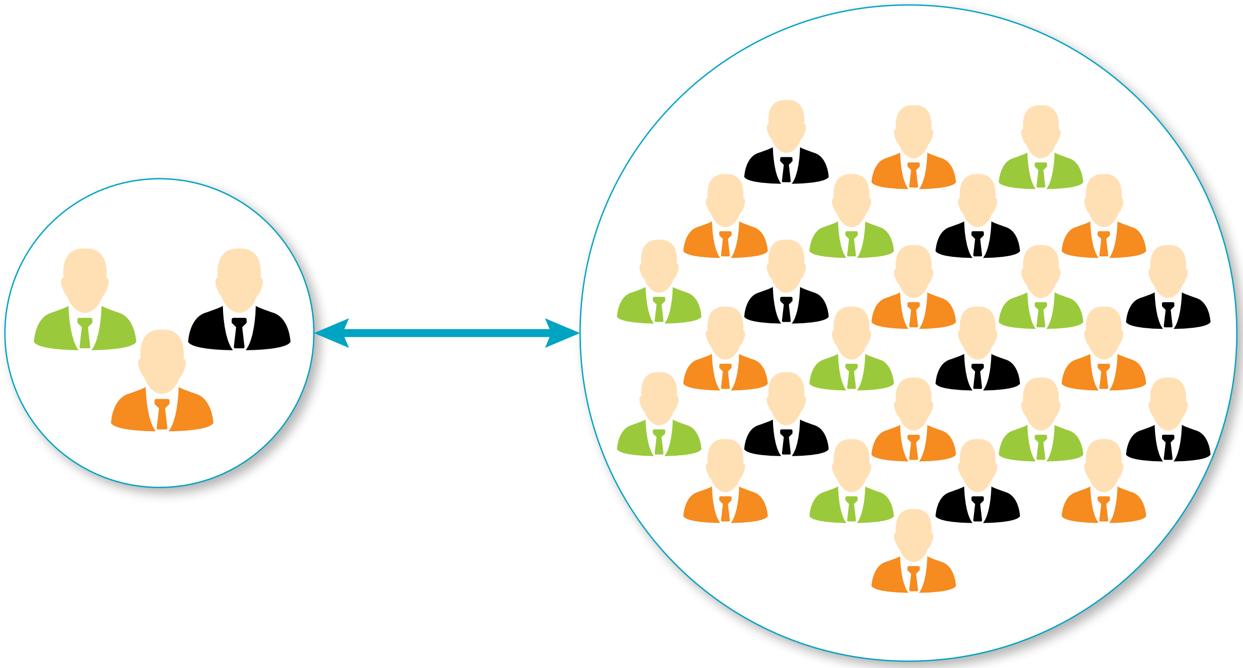
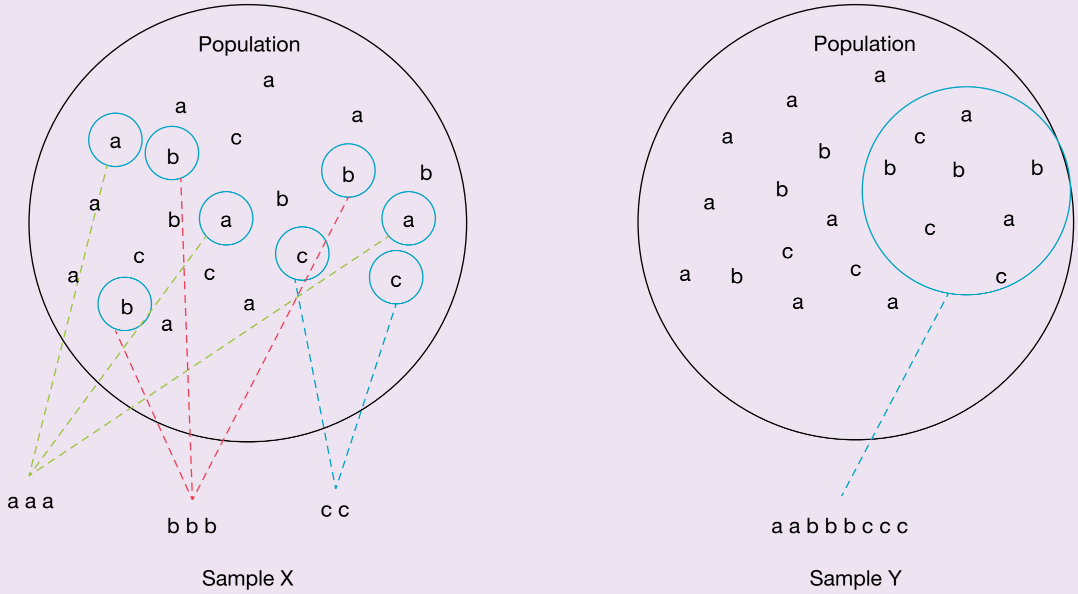


Figure 1.12 A representative sample closely matches the population of research interest in the distribution of key participant characteristics. Generally, the larger the number selected, the more likely it is to be a representative sample rather than a biased sample, depending on the sampling technique used to select them.

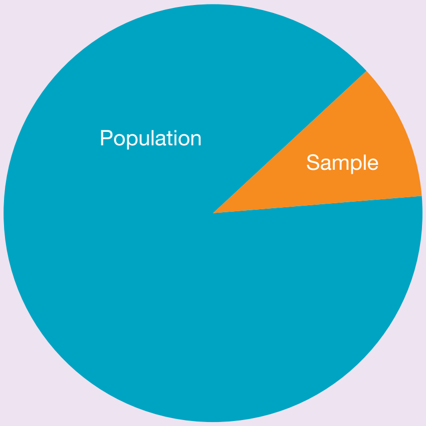
1.3 LEARNING ACTIVITY 1

Review

1. Define the terms sample and population as they are used in research.
2. Distinguish between a representative sample and a biased sample with reference to Samples X and Y shown below.



3. Explain whether the sample shown below is biased.



4. For the following research samples, identify two different populations from which each sample could be drawn.
   a. 20 Year 10 girls and 20 Year 10 boys
   b. 40 teachers who have been teaching for more than 10 years
   c. 100 employees on leave from work because of stress-related reasons
   d. 30 adults diagnosed as having an anxiety disorder
5. For the following research questions, identify a sample that might be used to conduct the investigation and a population from which the sample could be drawn.
   a. How can people with a fear of flying be assisted to overcome their fear?
   b. Are children born to mothers aged over 40 years at greater risk of developing a mental health disorder?
6. What are two potential limitations of small sample size in an investigation where a larger sample was required?

7. *Source: VCAA 2021 Psychology, Section B, Q.3d; © VCAA*

> **Effect of caffeine on Parkinson's disease**
>
> by F. Marrow
>
> Drinking caffeinated drinks has been associated with reduced tremors in people with Parkinson's disease. A recent study of 284 newly diagnosed Parkinson's disease patients has gone one step further to explore if the gender of a person changes the effects of caffeine on the severity of tremors. The researchers interviewed the patients to understand their motor and non-motor symptoms and their caffeine consumption history.
>
> Of the patients, 204 were classified as caffeine drinkers (three or more cups per day, including coffee, tea and energy drinks) and 80 were classified as non-caffeine drinkers (0 cups per day).
>
> Results showed that, compared to non-caffeine drinkers, caffeine drinkers:
>
> - had early onset of symptoms
> - were younger
> - had fewer motor and non-motor symptoms
> - had lower resting tremor scores.
>
> Interestingly, the relationship between caffeine consumption and tremor severity was only significant in males.

Source: Bang-Hoon Cho, Seong-Min Choi and Byeong C Kim, 'Gender-dependent effect of coffee consumption on tremor severity in de novo Parkinson's disease', BMC Neurology, (2019) 19:194, https://doi.org/10.1186/s12883-019-1427-y

Identify one factor that these researchers should have considered when making generalisations about their findings and outline how this factor can affect generalisability.

8. *Source: VCAA 2008 Psychology 2, Section B, Q.14 (adapted); © VCAA*

   A researcher asked all the first year Psychology students (100 males and 100 females) from Kookaburra University to participate in a study. Students were offered extra marks in their Psychology final score if they agreed to participate.

   Of the 200 students, 40 volunteered for the study (20 males and 20 females). The researcher wanted to investigate whether the memories of first year Psychology students at Kookaburra University were increased by sugar intake.

   Identify the population and the sample in this study.

9. List three considerations when deciding on a target population and sample for your own investigation involving participants.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

1.3 LEARNING ACTIVITY 2

Multiple-choice questions

1. The research sample is best described as a _____ that is selected from a _____ targeted for study.
   A. participant; population
   B. participant; group
   C. subset; group
   D. subset; population
2. There are 200 employees at an organisation where a researcher conducted an experiment to test a new work stress management program. The researcher selected 50 participants from the 100 employees who volunteered to be in the experiment.
   In this experiment, there were _____ employees in the sample, and _____ employees in the population.
   A. 50; 100
   B. 50; 150
   C. 50; 200
   D. 100; 200

3. *Source: VCAA 2019 Psychology, Section A, Q.39 (adapted); © VCAA*
Cora, a university student, conducts an experiment in a classroom to test the effectiveness of a therapy on adolescent boys with a circadian sleep phase disorder. She recruits nine 16-year-old boys from a suburban boys' school to participate in her experiment.

If Cora were to replicate the experiment, what could she do to improve the likelihood of being able to generalise her results?

A. Conduct the experiment in a controlled sleep clinic.
B. Use both male and female adolescents in the sample.
C. Use a control group to control for extraneous variables.
D. Include a larger sample of adolescent boys from both suburban and rural schools.

4. *Source: VCAA 2015 Psychology, Section A, Q.65; © VCAA*
Dr Nguyen is a psychologist interested in investigating the effect of age on the cycling ability of Victorians.

He recruits 93 Victorian bike riders who responded to an advertisement that he placed in a newspaper.

The bike riders are divided into two groups:

- Group 1 consists of riders aged 20–39 years old.
- Group 2 consists of riders aged 40–59 years old.

The population and the sample for this study were, respectively

A. Victorians, 93 Victorian bike riders.
B. 93 Victorian bike riders, Victorians.
C. 93 Victorian bike riders, Victorian bike riders.
D. Victorians who responded to the advertisement, 93 Victorian bike riders.

5. Representative sampling would involve

A. unexpected sampling errors.
B. participant selection in an unbiased way.
C. the law of large numbers.
D. generalising back to the population.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

1.3.3 Sampling techniques

There are different ways of obtaining a sample. Two common sampling techniques are called random sampling and stratified sampling.

Random sampling

When used in relation to sampling and samples, 'random' does not mean 'hit-or-miss', which is a common usage of the term. If fact, it is anything but 'hit-or-miss' or 'haphazard'. Nor does random mean

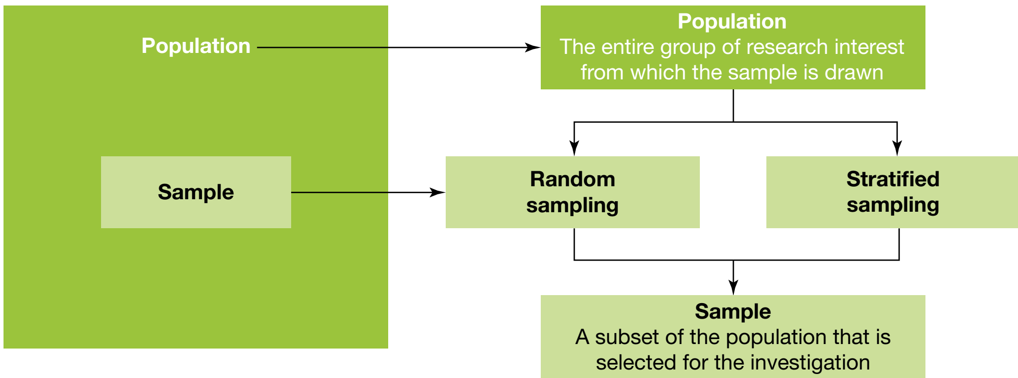


Figure 1.13 The sampling techniques that are specified in the VCE Psychology Study Design. A stratified sample may also be randomly selected using a third technique called stratified random sampling.

selecting participants (or allocating them to different groups or conditions) according to the whims of the researcher. Using a random sampling technique actually involves using a very careful, methodical approach or plan.

Random sampling is a sampling technique that ensures every member of the population of research interest has an equal chance of being selected to be part of the sample. A group selected in this way is known as a *random sample* and the selection process helps achieve a representative sample.

Although no sampling technique can produce a completely unbiased sample, random sampling achieves a good approximation, as it introduces the minimum possible amount of error in representing the population.

Random sampling can be conducted in a number of different ways.

One way is to obtain a complete list of all members in the target population (with appropriate contact information). This list or source material is commonly called a *sampling frame*. For example, an electoral roll may be used as a sampling frame, or the telephone numbers of all the people in a relevant and current database may be used. If you were conducting an investigation in your school, class rolls could be used, but only those with the names of students in the target population.

Other sampling frames can include a list of employees in an organisation of research interest, a list of members of an AFL club, patient files in a hospital, and so on. Ideally, the sampling frame will be in an electronic format so that it can be used on a computer or tablet.

After the sampling frame is obtained, the researcher could obtain a random sample using a simple lottery procedure to select the required number of names. The lottery procedure could involve drawing names out of a box or tossing a coin. For example, if a sheet of paper had all the names of the people in the population on it, the sheet would be cut up into slips of paper equal in size, with one name on each slip of paper. The names would then be thoroughly mixed in the box to help ensure their distribution throughout the box. Then, names of sample members (or research participants) could be drawn out 'blindly', one at a time.

Figure 1.14 Under certain conditions, the lottery procedure of drawing names of research participants from a box is an appropriate random sampling procedure because each member of the target population has a genuinely equal chance of being selected.

As a result of this simple but systematic procedure, the likelihood that the sample is representative of the population is increased, and so is the ability of the researcher to generalise the results to the sample's population.

For example, if this procedure was used to select a sample of five students from a small box with the names of all 20 students in a psychology class, any group of five names is equally likely to be selected as any other group of five names.

A commonly used method when a large number of participants is required is to assign a number to each member of the target population, then use a digitally generated list of random numbers to select sample members.

Suppose you are interested in studying some aspect of student behaviour at your school and you want a random sample of 20 students. You would begin with a list of all students currently enrolled at your school. Then, each student is assigned a number. If, for example, there are 1000 students, the first student in the list is assigned number 1 and the last student assigned 1000. A random number generator (available for free online, at app stores, and in scientific calculators) could then be used to produce 20 numbers that fall between 1 and 1000. The students whose numbers are selected become the sample.

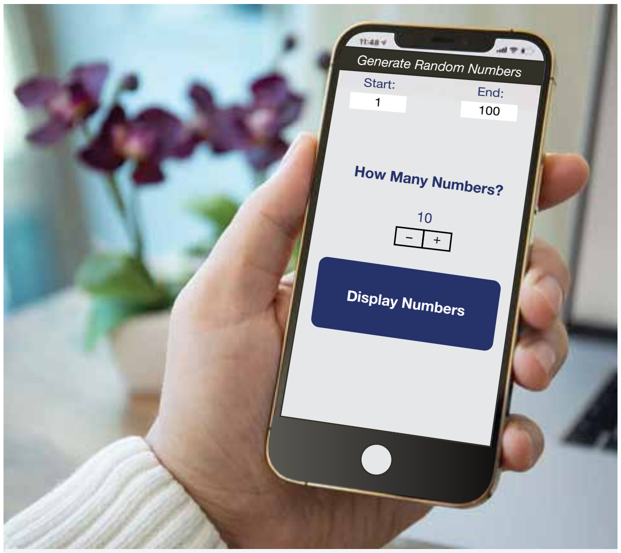


Figure 1.15 One of many random number generator apps that are freely available

For example, if the first random number is 47, then the 47th person in the list is included in the sample; if the second random number is 10, then the 10th person in the list is selected, and so on until the 20th participant has been selected.

If everyone in a target population does not have an equal chance of being selected as a participant, then *sampling bias* is said to occur. Sampling bias increases the likelihood of a biased sample being obtained.

For example, a researcher might conduct a study on stress management strategies used by Victoria Police. A random sample could be obtained by allocating a number to all Victorian police officers and then selecting participants' names using a lottery method. However, sampling police officers 'at random' in a 'hit-or-miss' way in the street or at a nearby police station would achieve a biased sample rather than a truly random sample, because not all Victorian police officers (the target population) will have an equal chance of being selected into the sample at these sampling locations or when the sampling is done.

Sometimes a researcher may not find it necessary or even desirable to use a random sample that is fairly representative of a population of interest. For example, a researcher interested in the language development of children may intentionally undertake a case study of a child raised in a harsh, deprived environment where there is little or no opportunity to learn language, rather than studying a sample of 'average' children from a 'normal' home environment.

The most important advantage of random sampling is that it helps ensure a highly representative sample, thereby enabling generalisations with greater confidence. The larger the sample, the more likely it is that this will occur, but there is no guarantee that the sample will be representative. For example, not all those who have been selected may be contactable, available or agree to participate, which can be a problem when the sample size is small. Others may agree to participate then refuse to do so or withdraw (dropout) after the study commences.

The main limitation of random sampling is that it can only truly be carried out if a complete list of the target population is available. If available, it may be difficult to gain access. For example, the list may be protected by privacy policies or require a lengthy process for permission to access. If accessed, the process of random selection may be time-consuming.

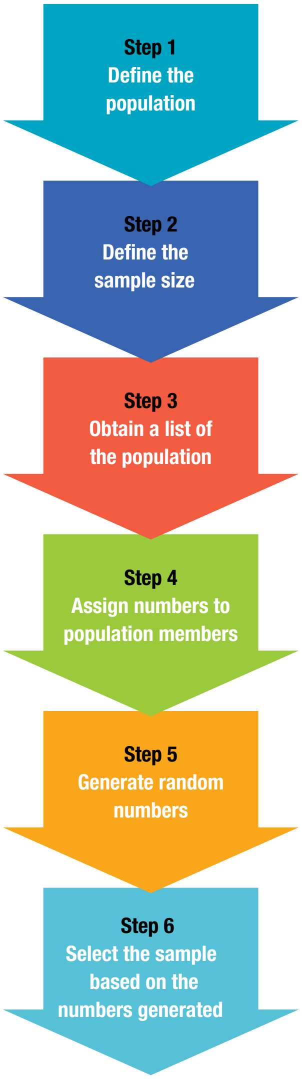


Figure 1.16 A random sampling technique using a randomly generated number sequence

Table 1.3 100 randomly-generated numbers

47	113	958	780	970	553	464	936	767	23
10	220	410	818	167	792	578	197	935	188
963	389	990	846	10	673	537	790	300	577
323	362	597	32	518	232	665	802	298	103
404	860	252	631	401	191	414	624	770	26
559	193	861	383	917	650	972	997	358	878
120	459	448	472	489	823	703	871	400	671
821	617	883	21	62	130	169	274	746	84
284	981	605	372	393	656	16	516	809	610
451	141	799	687	490	628	90	155	533	912

These are 100 randomly-generated numbers (unsorted) to select a sample of 20 from a school's student population of 1000. The first participant selected for the sample would be the 47th student in the school list, the second selected would be the 10th in the list, and so on.

Stratified sampling

In some research studies it is important to ensure that particular subgroups in a population of interest are represented in their known proportions in that population.

For example, if a psychologist wanted to determine the attitudes of Australian voters to asylum seekers, they could reasonably expect that people's attitudes would differ depending on their age, sex, religion and cultural or ethnic background. Consequently, the psychologist would want to ensure that each of these groups was represented in the final sample in the same proportions that they were known to exist in the voting population. This can be achieved by using the sampling technique called stratified sampling.

Stratified sampling is the process of selecting a sample from a population comprised of various subgroups in such a way that each subgroup is represented. It involves dividing the population to be sampled into different subgroups (called *strata*), then selecting a separate sample from each subgroup (called *stratum*) in the same proportions as they occur in the population of interest.

Socio-cultural factors such as residential area, type of accommodation, age, sex, income level, income type (e.g. wages or pension), educational qualifications, language spoken or preferred, and cultural background are examples of characteristics that may be used as the basis of dividing a population into strata.

The stratified sampling technique is commonly used to study behaviour and mental processes that tend to vary greatly among different subgroups within a population. For example, suppose you were going to undertake an investigation on the attitudes of students in your school towards the use of rewards and punishments by teachers. If you expect that attitudes may differ among students in different year levels, you would want to ensure each year level (stratum) is proportionally represented in your sample.

In this case, you could first obtain separate lists of the students in each year level and then randomly sample from each list. If, for example, about 10% of all students in your school are enrolled in year 12 and about 15% in year 11, then your sample would consist of about 10% year 12 students and about 15% year 11 students. This would ensure students from each year level are represented in about the same proportions in the sample as they are in the population (the school).

Using this **stratified random sampling** procedure would help ensure that the sample is highly representative of the population and therefore not biased in a way you consider to be important. For example, it would be biased if everyone in the target population does not have an equal chance of being a participant or if one or more groups are significantly under- or over-represented in the sample.

An important advantage of stratified sampling is that it enables the researcher to sample specific groups (strata) within populations for comparison purposes; for example, males vs females, adolescents above or below a certain age, people who work in different departments of an organisations, or people of different ages and cultural backgrounds who have been diagnosed as having a phobia and will be exposed to a new type of relaxation therapy to help manage their anxiety.

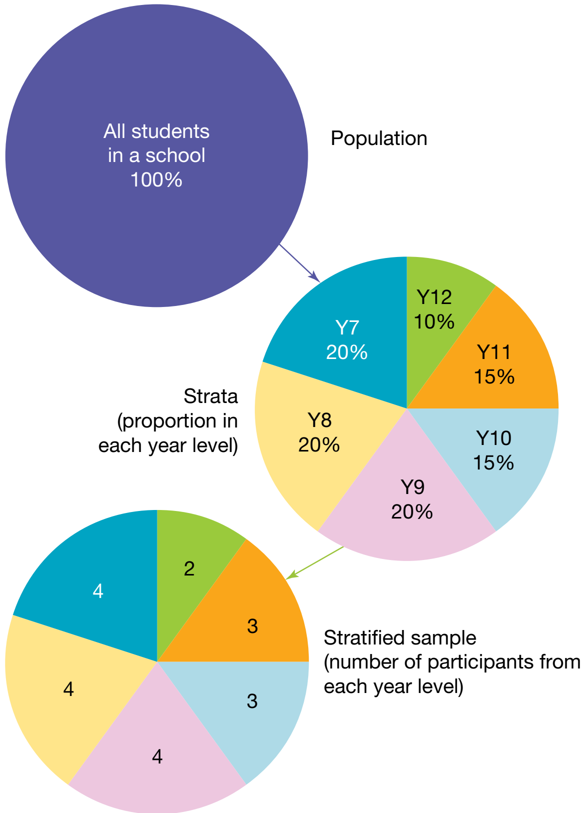


Figure 1.17 An example of stratified sampling for a school-based investigation. Note how the proportions in the sample match the percentages in the population.

In addition, when there is random sampling from appropriately sized proportions of the strata, this helps ensure a high degree of representativeness of all the strata, which means that there can be greater precision in the study and its findings when compared to the standard random sample taken from one larger group. However, obtaining a stratified random sample using set proportions is usually very time-consuming and difficult to achieve so the procedure is not often used.

A major limitation of stratified sampling is that, like random sampling, it can be carried out only if complete lists of the target populations are available and accessible. However, if accessed, a representative sample cannot be obtained unless stratified random sampling is used. Either way, stratified sampling can be a very time-consuming and complex procedure, and therefore expensive procedure, more so than standard random sampling.

Figure 1.18 Steps in stratified random sampling. The technique involves identifying all of the people within each stratum of research interest, then randomly selecting samples from within each stratum. using set proportions.

Figure 1.19 Convenience sampling is another sampling technique that is used in psychology, but the one which is least likely to achieve a random sample and most likely to produce a biased sample. The technique involves selecting participants who are readily or easily available. For example, a researcher may be interested in strategies of buskers (street performers) that are more or less likely to promote audience donations, such as eye contact, verbal interaction, and involvement of audience members as active participants. Different buskers at known locations may simply be entered into the sample and observed, and, if required, their voluntary participation may be sought (e.g. for an interview).

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1.3 LEARNING ACTIVITY 3

Review

1. Complete the table below to summarise key features of the sampling techniques.

Sampling technique	Description	Advantages	Limitations
random sampling			
stratified sampling			

2 Suppose that you are required to determine the typical amount of nightly sleep of students at your school or college.
   a. Briefly describe a random sampling and stratified sampling procedure for selecting research participants.
   b. Explain which of the sampling techniques would result in the most highly representative sample.
   c. Consider the sampling technique described in Figure 1.19.
      i. How could you select a convenience sample?
      ii. What would be a significant limitation of this sample when compared to a random sample?
3. You want to compare the lifestyles of VCE students in Melbourne and Mildura.
   a. Define your population.
   b. How could you obtain a random sample from each of these populations?

4. You want to test short-term memory capacity in preschool children, teenagers and people aged over 65 years.
   a. Define your population.
   b. How could you obtain a random sample from each of these populations?
5. a. A researcher investigating variables that influence consumer decision-making will conduct a brief, three-item survey outside a Myer store in a shopping mall on a Friday evening. The researcher will toss a 20 cent coin when ready to interview someone. If the coin shows heads, the person exiting the store will be interviewed. If the coin shows tails, the person will not be interviewed.
   Explain whether the researcher will obtain a random sample.
   b. Another researcher will conduct the same survey at the same location but will vary the sampling technique. Instead of tossing a coin, the researcher will interview every twentieth person who exits the store.
   Explain whether the researcher will obtain a random sample.
6. Explain why each of the following research studies is likely to have sample bias.
   a. a survey on binge-drinking behaviour in a popular teenager's magazine
   b. a television or radio call-in survey
   c. a telephone survey of aged pensioners at 6 pm on weeknights using landlines to their homes
   d. a survey based on the number of 'likes' for a Facebook post
   e. a psychologist working at a rehabilitation centre for people with a brain injury accesses some of their relatives for a study on their coping strategies
   f. a researcher interested in the age and sex of gamblers who play the pokies interviews people entering a local gaming venue during a 4-hour period on a weekday afternoon
7. Consider the newspaper advertisement below, then answer the following questions.

How does long-term cannabis use affect your brain and memory?

The University of Melbourne is conducting a study examining how heavy, long-term cannabis use (daily or almost daily use for 10+ years) affects the brain. There are two parts to the study: a memory testing session and a brain scanning session. Each session takes approx. two hours and participants receive $50 in Coles Myer vouchers for each session. Participants should be betw. 18–35 years old, not using other drugs or alcohol regularly, and NOT have a diagnosed mental illness.

   a. Identify the target population for the sample.
   b. A sample obtained through an advertisement is sometimes described as a 'self-selected' sample. In what way is this type of sample self-selecting?
   c. Will advertising for research participants and using a gift voucher or incentive payment result in sample bias? Explain your answer.
   d. Will exclusion of some respondents from the sample result in sample bias? Explain your answer.
   e. How representative is the sample obtained using the advertisement likely to be?
   f. Will the researcher be able to generalise their results from the study described in the advertisement? Explain your answer.

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1.3 LEARNING ACTIVITY 4

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2010 Psychology 1, Section A, Q.31 (adapted); © VCAA

A researcher wishing to repeat Bugelski and Alampay's study believes that the age and gender of participants may influence the results. The researcher ensures that these characteristics are represented in the sample in the same proportion as in the population of research interest.

This is known as

A. random sampling.
B. stratified sampling.
C. representative sampling.
D. proportional sampling.

Question 2 (1 mark)

Source: VCAA 2008 Psychology 1, Section A, Q.30; © VCAA

Alex is conducting an experiment on visual perception and wishes to use random sampling to select her participants from the population of VCE students at her school.

An appropriate method would involve

A. calling for volunteers.
B. selecting every fourth student who enters the VCE common room.
C. organising participants alphabetically by surname and selecting every second participant.
D. assigning each VCE student a number and putting all numbers into a box and drawing out 20 numbers.

Question 3 (1 mark)

Source: VCAA 2006 Psychology 1, Section A, Q.31; © VCAA

Christopher would like to carry out an experiment that tests the effect of context on perceptual set. He wishes to test a sample of students and then generalise the results to all the VCE students at his school.

Which of the following methods for selecting participants is most likely to produce a sample that is representative of the population?

A. using the first 25 VCE students who respond to an advertisement in the school's newsletter
B. selecting the first 25 VCE students who walk into the library during lunchtime
C. testing everyone in his VCE psychology class (25 students)
D. generating a random list of 25 names from a list of all VCE students in the school

Question 4 (1 mark)

Source: VCAA 2002 Psychology 2, Section A, Q.43; © VCAA

Which of the following best describes a stratified sample?

A. a sample that is made up of people from different cultures
B. a sample of people who are selected for certain characteristics
C. a sample that equally represents all members of a population
D. a sample that includes both an experimental and a control group

Question 5 (3 marks)

Source: VCAA 2016 Psychology 1, Section B, Q.9; © VCAA

The Sunnydown Basketball League has 1500 players aged 12–18.

Explain how a researcher could design a random sampling procedure to investigate the effect of sports drinks on the performance of under-16 basketball players in the Sunnydown Basketball League.

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1.4 Controlled experiments

The VCE Psychology Study Design emphasises the **controlled experiment** — an experimental investigation of the relationship between one or more IVs and a DV, controlling all other variables. In particular, the researcher can investigate whether there is a cause-effect relationship between an IV and DV.

A properly conducted controlled experiment depends on rigorous control. This essentially involves taking steps to prevent or minimise the possibility that anything other than the IV(s) will affect the DV and therefore the results.

In this section, we consider key features of the controlled experiment and why it can be used to investigate causes of behaviour and links between behaviour and mental processes.

1.4.1 Experimental and control groups

In a relatively simple experiment, the participants are allocated to one of two groups. One group of participants, called the **experimental group**, is exposed to the IV under investigation. This group is often said to be in the *experimental condition*. A second group of participants, called the **control group**, is not exposed to the IV under investigation. This group is said to be in the **control condition**. The responses of those in the control group are compared with the responses of participants in the experimental group who are exposed to the IV under investigation.

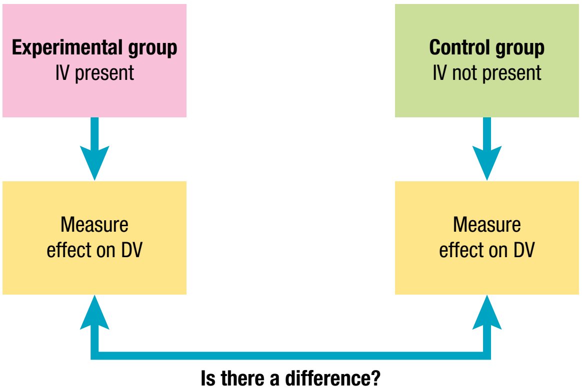

Figure 1.20 A simple experiment with one experimental group and one control group

For example, consider an experiment to investigate whether displaying posters of rock stars wearing a particular brand of jeans increases sales of that brand. The experimental group is exposed to a condition whereby posters showing rock stars wearing the jeans are displayed prominently in a jeans store, while the control group is not exposed to the posters. The DV might be the number of pairs of that brand of jeans sold (this experiment is shown in Figure 1.21 on the next page).

The control group provides a standard or baseline ('reference point') against which the performance of the experimental group can be compared to determine whether the IV has caused some change in, or affected in some way, the behaviour or event being measured (the DV). Without a control condition in this experiment, it would not be possible to assess the influence of an IV; for example, whether the posters of rock stars wearing the jeans affected the number of pairs of jeans purchased.

If a significantly greater number of these jeans are purchased by participants in the experimental group, the experimenter may assume that the difference between the two groups was caused by the exposure of the experimental group to the posters of rock stars (IV). However, in order to make this assumption, the experimenter must be confident that no variable other than the IV being tested had an excessive influence on the purchase of jeans.

It is important that the experimental group and the control group are as similar as possible in personal characteristics that might cause a change in the DV. For example, one group should not have significantly more participants who have access to more spending money so that this doesn't become a possible reason for the difference in jeans purchased that may be recorded. It is also necessary to treat the two groups the same, except for exposure of the experimental group to the IV. For example, one group should not receive more or better quality customer service than the other.

Both of these conditions are necessary so that if a large enough change occurs in the experimental group and does not occur in the control group, the researcher can be more confident in concluding that it was the IV that most likely caused the change and not some other variable.

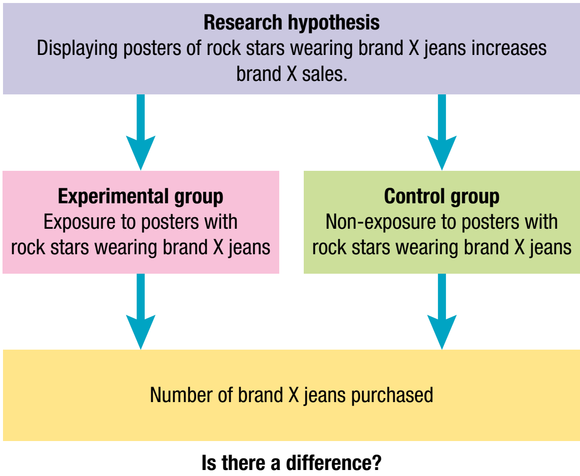

Figure 1.21 Experimental design to test whether displaying posters of rock stars wearing a particular brand of jeans increases sales of that brand

Some controlled experiments do not have an experimental group and a control group with different participants. Instead, they have one group of participants who are exposed to both the control condition and the experimental condition. For example, to study the influence of rock music on people's concentration while driving, a group of participants could have their driving abilities tested in a simulator while no rock music was playing (control condition). The same group would later be tested again in the simulator while there was rock music playing (experimental condition). The test results of the same group under the two different conditions would then be compared.

A researcher may also conduct a controlled experiment with multiple experimental groups; for example, to compare different levels of an IV. In such cases, there may or may not be a control group.

Sometimes the experimental condition and control condition are collectively called *experimental conditions*, which literally means 'all the conditions of the experiment'. When this expression is used, the condition in which the IV is present is often referred to as the 'treatment condition' because the IV is the 'treatment' to which the participants are exposed.

1.4.2 Random allocation

The method of selecting the sample is important in ensuring it is unbiased and representative of the population being studied. Equally important is the way in which participants are placed in the experimental and control groups (or conditions).

In an ideal research world, when a control group is used, everything about the experimental and control groups would be identical except for the IV. In reality, however, it is to be expected that there will be individual participant differences that may be uncontrolled variables and make it difficult to isolate the effects of the IV on the DV. Consequently, it is important to ensure that participant-related variables that might affect the results of the experiment are evenly spread in the experimental and control groups.

One way of minimising differences in the composition or make-up of the experimental and control groups is to randomly allocate participants to these groups.

Random allocation, also called *random assignment*, is a procedure used to place participants in groups (or conditions) so that they are as likely to be in one group as the other. This means that every participant has an equal chance of being selected for any of the groups to be used. Participants are just as likely to be in the experimental group as the control group.

As with random selection, random allocation can be achieved using a lottery procedure in which chance alone will determine the group to which each participant is assigned. For example, tossing a coin and drawing 'names out of a hat' are also appropriate ways of randomly allocating participants to groups.

With a sufficiently large number of participants, it is reasonable to assume that each group will end up with the same kind of spread of participant characteristics, abilities and backgrounds that may affect the DV and therefore the results.

The purpose of random allocation of participants is to obtain groups that are as alike as possible in terms of participant variables *before* introducing the IV. With random allocation of participants to the experimental and control groups, researchers can more confidently conclude that if there is a significant difference in

Figure 1.22 Coin tossing and drawing names from a container can be used for random allocation to groups.

the responses of the experimental group to the DV when compared with the control group, then it most likely had something to do with the effect of the IV. Consequently, random allocation is an important means of experimental control.

For a classroom experiment, placing all males in one group (or condition) and all females in the other group would *not* be a random allocation procedure. Similarly, assigning the people seated in the front half of the room to one group and the people seated in the back half to the other group is not random allocation. There could be a difference in one or more personal characteristics of participants who prefer to sit at the front or back of the classroom.

Random allocation does not guarantee that participants in the different groups or conditions are entirely equivalent before the experiment begins. However, it does reduce the likelihood of differences being present due to 'chance' factors, which helps rule out possible alternative explanations of the change measured in the DV. The likelihood of chance differences in participant variables between or even within groups tends to be reduced further as the sample size of each group increases.

Random allocation is different from random sampling. Random allocation is used to place participants in groups whereas random sampling is one of the methods that can be used to select participants for an experiment. Random sampling, however, is based on the same principle of 'equal opportunity for all participants'.

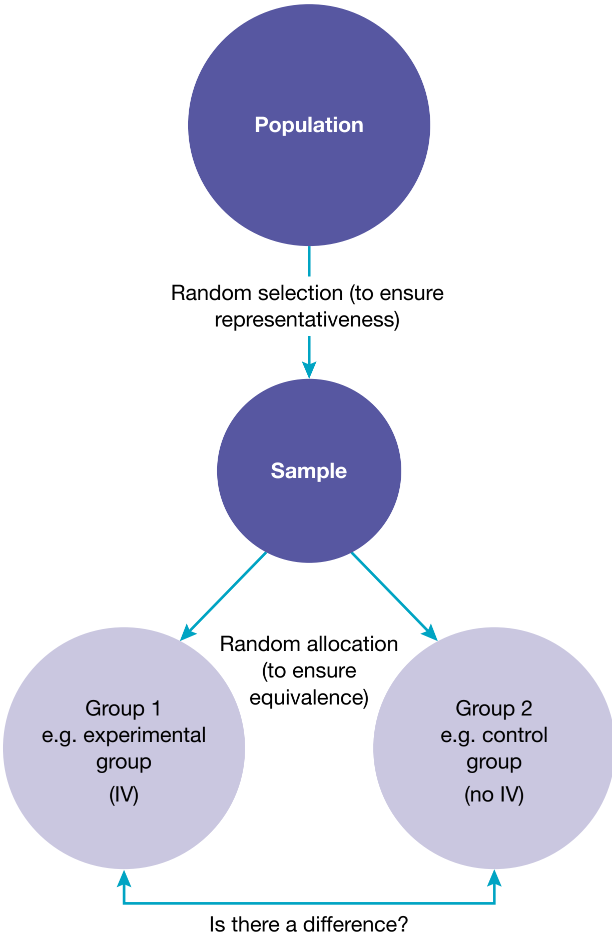

Figure 1.23 A simple experimental design with two groups that uses random sampling to select participants and random allocation to assign them to either condition

Random sampling and random allocation can also be distinguished in relation to the internal and external validity of the experiment (or any other research study).

Since random sampling involves selection of participants from a target population, it is crucial for the generalisability of the results and therefore *external validity*. After all, random sampling is used so that the participants will better represent the population from which they are drawn — the goal being to generalise the results for the sample to its population.

In contrast, random allocation is more related to the research itself. It is used with the goal of being able to draw conclusions about the causal effect of the IV on the DV. After all, participants are randomly allocated in order to help ensure that the experimental and control groups are as similar to each other as possible (i.e. equivalent) prior to manipulation of the IV. Non-random allocation usually leads to non-equivalent groups, meaning that any change in the DV might be due to the groups being different in participant variables rather than the IV alone. Therefore, random allocation is most related to *internal validity*.

The consequences of random selection and random allocation are clearly very different, and a good research design will use both whenever possible to help ensure both internal and external validity (see section 1.15.5).

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Teacher digital document Practical activity — Testing random allocation

1.4 LEARNING ACTIVITY 1

Review

1. List three key features that distinguish a controlled experiment from other research methods.
2. a. Distinguish between experimental and control groups (or conditions) in relation to the IV.
   b. Why is it important for the experimental and control groups to be as similar as possible in personal characteristics that may affect the DV?
   c. In what other way must the experimental and control groups be alike?
3. What is the purpose of using a control group in an experiment?
4. What is random allocation?
5. What does random allocation achieve in relation to groups selected for an experiment and why is it assumed that this is possible?
6. Why is random allocation considered to be a crucial feature of good experimental design? Give an example of a random allocation procedure that could be used for a class experiment at school.
7. How do random sampling and random allocation relate to the validity of an experiment?
8. A researcher will conduct an experiment to find out whether people get a better score on a video game when cheered or jeered ('booed') by an audience of peers about the same age rather than when they play the game by themselves.
   a. Suggest how the IVs and DVs could be operationalised for the experiment.
   b. What are the experimental and control groups and how are their conditions different?
   c. Suggest three variables other than the IV that have the potential to influence the DV and would need to be controlled so that the effects of the IV can be isolated.

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1.4 LEARNING ACTIVITY 2

Multiple-choice questions

1. All controlled experiments use
   - **A.** random sampling.
   - **B.** a control group.
   - **C.** independent and dependent variables.
   - **D.** All of the above are correct.
2. *Source: VCAA 2013 Psychology, Section A, Q.22; © VCAA*
   In an experiment studying the impact of meditation on stress, the control group should
   - **A.** not meditate at all.
   - **B.** meditate as often as the experimental group.
   - **C.** be able to choose whether to meditate or not.
   - **D.** meditate more often than the experimental group.
3. *Source:* VCAA 2008 *Psychology 1, Section A, Q.31 (adapted)*; © VCAA
   In an experiment, the group that is not exposed to the independent variable is known as the
   - **A.** experimental group.
   - **B.** experimental condition.
   - **C.** random group.
   - **D.** control group.
4. Being randomly allocated to a condition in an experiment involves being
   - **A.** assigned to one of the conditions on the basis of chance alone.
   - **B.** randomly chosen as a participant from a population of research interest.
   - **C.** assigned to a group on the basis of specific characteristics of research interest.
   - **D.** randomly assigned to the experimental group.
5. Random allocation is used in experimental research to help ensure
   - **A.** all participant variables can be measured.
   - **B.** control of participant variables that can influence the DV and therefore the results.
   - **C.** an equivalent number of participants are in the experimental and control groups.
   - **D.** participants remain unaware of the group to which they have been allocated.

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1.4.3 Experimental designs

There are different types of experimental designs that vary in terms of their specific procedures and complexity. Three of these designs are the between subjects, within subjects and mixed design. As with all research methods, each design has advantages and limitations.

Between subjects

In an experiment with a **between subjects** design, also called *independent groups*, each participant (or 'subject') is randomly allocated to one of two (or more) groups or conditions and provides one score for data analysis.

The simplest between subjects design uses two groups — most often one group as the experimental group and the other as the control group, but a control group is not always used.

For example, suppose a researcher is interested in investigating the effects of loud music (an IV) on problem solving (a DV). The experimental group could be given a problem-solving task to complete while loud music is playing and the control group would be given the task to complete without any music playing. Performance of participants under each condition would then be compared with reference to scores achieved on the problem-solving task. For example, a mean score could be calculated for each group to enable a quick comparison.

As with all controlled experiments, random allocation is an essential feature of the between subjects design in order to control individual participant differences. Random allocation to the different conditions will help ensure groups are well matched on participant variables and therefore fairly equivalent. For example, in the problem-solving experiment, each group would have a similar spread of relevant variables such as problem-solving ability, motivation, educational background, prior experience with the type of problem-solving task used in the experiment, mood, and so on.

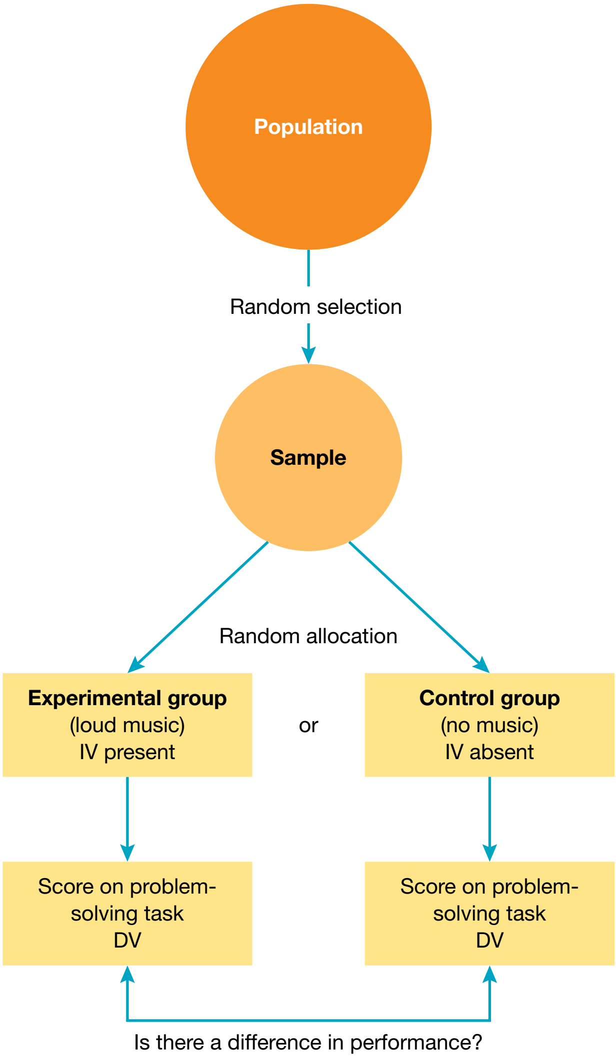

Figure 1.24 In a controlled experiment with a between subjects design, participants are randomly allocated to the different groups (conditions) to help ensure participant variables that can cause a change in the DV are uniformly distributed across the groups.

The bigger the groups, the more likely it is that a uniform spread of characteristics and abilities will be achieved. Although random allocation does not guarantee that different conditions are entirely equivalent in the spread of participant variables, it does greatly reduce the likelihood of differences so that the effect(s) of the IV on the DV can be isolated.

The between subjects design is very common in experimental research. An advantage is that, unlike the within subjects design which uses the same participants in the experimental and control groups, there is not often a need to spread out the time period between the different experimental conditions. This means that the experiment can usually be completed on one occasion, which also helps ensure participant attrition ('dropout' rate) is negligible. There are also no order effects between conditions to control.

However, there is often a need for a larger number of participants to help ensure the spread of participant variables within the sample will match the distribution within the population. In addition, there is less control over participant variables than in other designs, especially when a small sample is used.

Within subjects

In a **within subjects** design, also called *repeated measures*, each participant ('subject') is in both the experimental and control groups or all the treatment conditions (if there is no control group). The groups (or conditions) are therefore identical in composition so individual participant differences may be controlled.

For example, consider the researcher interested in loud music and problem-solving. Using the within subjects design, a group of participants would be given a problem-solving task to complete while loud music was playing, and the same group would then be tested on a similar, equally difficult, problem-solving task but without any music playing. This means each participant would experience both the loud music and no music conditions while solving similar problems. How well all participants solved problems would be measured twice, once after each condition of loud music and no music respectively (hence the term 'repeated measures' that is also used to describe this experimental design).

This design would give the experimenter strict control over all the possible participant variables that could influence problem-solving ability, such as individual differences in problem-solving ability, levels of motivation, and so on.

Participant differences that could influence the DV in an unwanted way but which may not have been identified by the experimenter will also be controlled because the participants in both conditions are identical in every respect.

When planning a within subjects experiment, the experimenter has to consider *order effects* that are likely to arise for this type of design. For example, performance on a problem-solving task that is completed second may be better because of the experience gained in completing the first task. Participants may perform better because they have practised the task or have gained other useful knowledge about the task or the experiment. Alternatively, participants' performance may be impaired by effects such as fatigue or boredom, and they may not perform as well on the second occasion.

In either case, the order effect is an unwanted variable that needs to be controlled because the experimenter cannot be confident about whether the IV or order effect caused the change in the DV. Procedures for controlling order effects are explained in subtopic 1.10 on sources of error.

The main advantage of the within subjects design is that it can effectively control the unwanted influence of variables arising from individual participant differences. For instance, it can be assumed that any difference in performance on the DV in each condition of the experiment is unlikely to be due to individual participant differences because each participant is in every condition.

Another advantage is that this design also tends to require a relatively smaller number of participants when compared with other designs because the same participants are in all conditions.

However, the within subjects design also has limitations. Although this design keeps individual participant differences constant, it does not necessarily control all participant variables that can influence the results. For example, some participants may guess what the experiment is about as they compare the two conditions, creating expectations and beliefs that lead to unnatural responses. Other order effects in addition to practice and fatigue are also more likely to occur with this design.

The within subjects design can also result in unwanted participant attrition (loss) before the experiment is completed. It is most common when the repeated measurement of the DV requires a considerable amount of time per participant, so that, to reduce fatigue or overload, the researcher spreads out the time between the different conditions over several days. Then, participants show up for the first session but do not return for the second one. It is also possible for some participants to find the first condition boring and not attend the second simply because they don't want to.

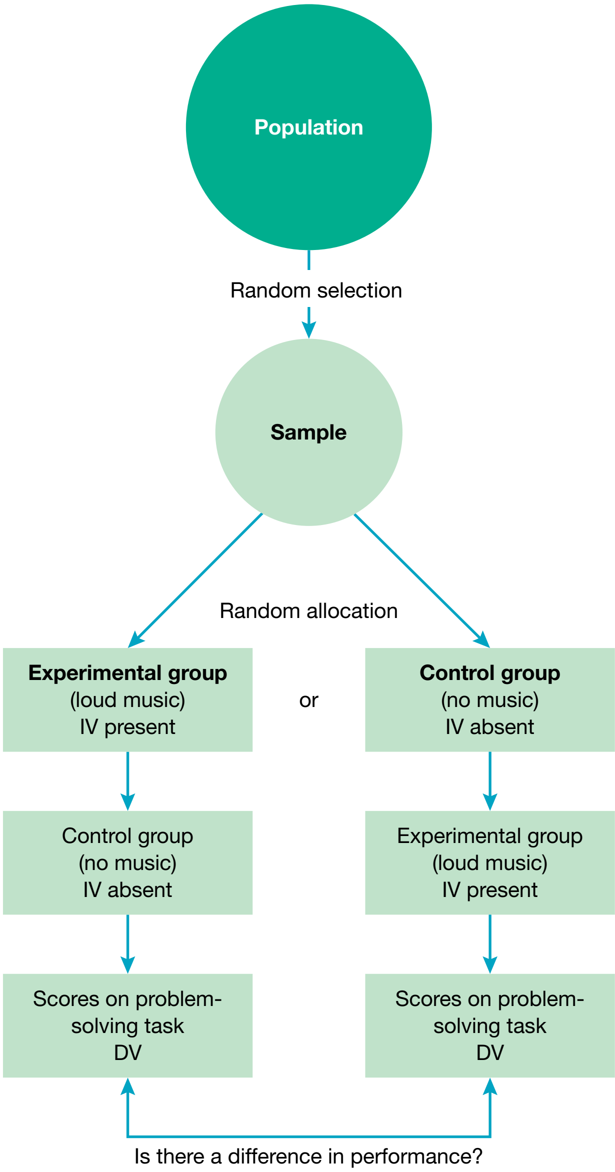

Figure 1.25 In a controlled experiment with a within subjects design, the same participants are in both the experimental and the control groups (or all experimental groups if no control group).

Mixed design

A **mixed design** experiment combines features of both a between subjects design and a within subjects design. This means that the researcher can assess the potential differences between two or more separate groups of participants (i.e. between subjects) as well as change in the individual members of each group over time (i.e. within subjects).

For example, suppose that a researcher is interested in studying how lack of sleep might affect the performance of air traffic controllers who work in towers with the responsibility of managing aircraft arriving and departing from airports.

Sleep deprivation time will be the IV and the amount of time will be varied for different groups of participants. For the DV, the researcher decides to use a task for which participants have to detect targets on a computer screen. The targets are presented like the blips of light representing planes they track on a radar screen. A participant's score will be the number of targets detected during a 90-minute session.

Fifteen volunteer participants will be randomly allocated to one of three groups: Group 1 who have been awake for 2 hours, Group 2 who have been awake for 12 hours, or Group 3 who have stayed awake and therefore had had no sleep for 24 hours. This will be the between subjects feature of the experiment.

Because an air traffic controller's job during an 8 hour shift involves a number of sessions separated by breaks, the researcher decides to test each participant during 4 sessions, with a 30-minute break between each. This will be the within subjects feature of the experiment.

In sum, different participants will be initially allocated to different groups to assess the effect of one level of the IV for each group (the between subjects variable), then all the participants will be assessed under all the levels of the IV to study change in performance over time (the within subjects variable). The researcher's data will comprise three sets of scores for each of four sessions, with four scores for each participant. Note that in the mixed design there are two or more IVs, one of which is a between subjects variable and one of which is a within subjects variable.

An experimenter might also use a mixed design to study the influence of different types of music on relaxation. Participants could be randomly allocated to either a control group (listening to no music) or one of two experimental groups (one listening to classical music and one listening to rock music).

The experimenter could then administer a pretest to participants in all groups in order to determine the baseline level of physiological arousal prior to hearing any music and then introduce the music and test participants while they listen. After stopping the music, the experimenter could administer another test (a post-test) to determine what specific reduction in arousal may have occurred throughout the listening period.

In this experiment, music type is a between subjects variable (each participant hears only a single genre of music) and physiological arousal is a within subjects variable (each participant is assessed on this variable on multiple occasions and the different assessments compared) (American Psychological Association [APA], 2022).

The main advantage of the mixed design is that the researcher can capitalise on the strengths of the between subjects and within subjects designs. In particular, fewer participants are needed for the experiment and there is greater sensitivity in the results; that is, they tend to be more precise and detailed.

Table 1.4 Three experimental designs

Experimental design	Key feature
between subjects	Each participant is randomly allocated to one condition (group) only and each participant provides only one score for data analysis.
within subjects	Each participant is involved in all conditions and provides multiple scores
mixed design	Combines features of both the between subjects and within subjects designs

1.4.4 Experimental settings

Psychological experiments can be conducted in a *laboratory setting* called a **laboratory experiment**, or outside the laboratory in a *field setting* and therefore called a **field experiment**.

A laboratory setting usually enables stricter control of variables but is sometimes criticised because of its artificiality, depending on what is studied. In a field setting, the conditions of the experiment are usually less strictly controlled, but it has the advantage of being able to make observations of participants' behaviour in a real world environment where their behaviour is likely to occur more naturally.

Some experiments conducted in field settings are called natural experiments. A *natural experiment* takes advantage of a naturally occurring event — the IV is naturally occurring and is not manipulated by the experimenter, often because it is impossible or unethical to do so.

For example, a researcher may study the effect of a catastrophic event such as bushfire or flood on stress-related ill health. In this case, the IV is a bushfire or flood, a naturally occurring event. However, the IV is not controlled by the experimenter and there may be many uncontrolled variables. For example, in a bushfire study, it may be difficult to determine whether stress-related ill health (the DV) is caused by fire, smoke or stress due to loss of one's house.

In a true experiment, the researcher can manipulate the IV, so a natural experiment is often described as a *quasi-experiment* because it looks like an experimental design ('quasi' means 'resemble') but the researcher does not actually manipulate anything and it lacks random allocation.

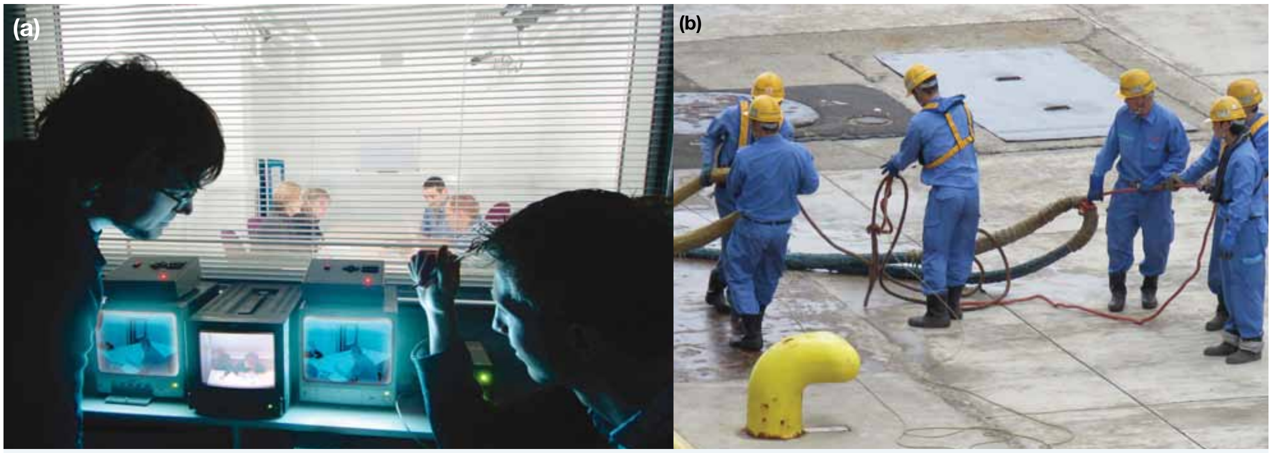

Figure 1.26 Experiments in psychology can be conducted in both laboratory and field settings. (a) In a laboratory setting, team work may be observed and measured in a controlled situation established by the experimenter. (b) In a field setting, team work may be observed in a real-world situation, but less control of conditions is possible.

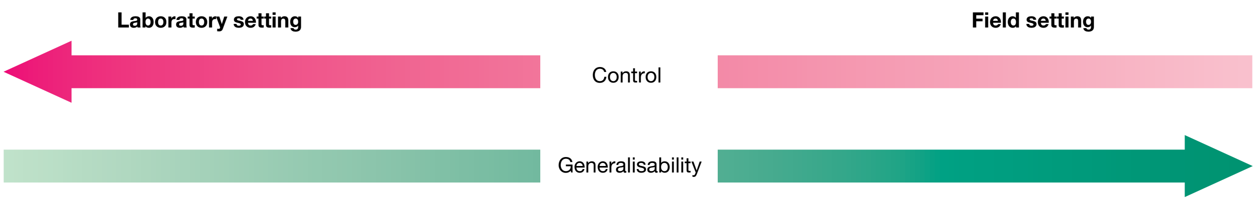

Figure 1.27 The trade-off between experiments conducted in a laboratory or field setting. Control increases in a lab setting but artificiality reduces generalisability and vice versa in a field setting.

1.4.5 Advantages and limitations of experiments

A key feature of a typical psychological experiment is the experimenter's attempts to control the conditions in which a behaviour or event of interest occurs, whether the experiment is conducted in a laboratory setting or in a real-life setting. As well as controlling the IV and using a suitable measure for the DV, the experimenter also attempts to minimise or eliminate the influence of unwanted variables to concentrate entirely on the effect the IV has on the DV.

Elimination of all such variables is not always possible, but control is usually greater than in other research methods, especially if the experiment is conducted in a laboratory setting. For example, if an unwanted variable is identified when designing the experiment and that variable cannot be removed, then the experimenter may attempt to minimise its effects to an acceptable level or monitor its effects and take account of those effects when interpreting the results and drawing conclusions. Consequently, the experiment has several advantages when compared to other research methods.

An important advantage is that the IV can be manipulated under controlled conditions in order to observe the effect on the DV, therefore making it possible to test if there is a cause-and-effect relationship between the IV and DV.

In addition, because controlled conditions are known conditions, the experimenter can set up the experiment a second time and repeat it to test (or 'check') the results. Alternatively, the experimenter can report the details of an experiment in such a precise way that others can replicate the experiment and test the results. Replication is very important because when an experiment is repeated and similar results are obtained, there can be greater confidence in the consistency (reliability) and (accuracy) validity of the results obtained.

Although experimental research has the distinct advantage of being able to provide information about causal relationships between variables, experiments also have limitations. For instance, some research questions of importance in society cannot be studied experimentally for ethical or practical reasons.

These include questions relating to mental health, racism, poverty and homelessness. For example, it is not ethically permissible nor possible to manipulate or control a person's mental wellbeing or whether they are poor, homeless or abused. Similarly, the experimenter cannot break up families to measure the effects of family separation. Nor would the laboratory always be the best setting for testing variables such as grief, hate or love. It may be difficult for participants to express these emotions very realistically in a laboratory setting.

The experimenter can randomly select participants from a target population to measure characteristics that already exist, but they cannot administer a 'treatment' such as mental health, race or grief. Personal characteristics of individuals cannot actually be manipulated. The experimenter cannot, for example, randomly assign a person to be a male and another to be 18 years old, or to make someone have dementia, a particular personality type or a higher level of self-esteem than someone else.

When the artificiality of a laboratory setting is a significant limitation, it may be possible to conduct the experiment in the field. But this may expose another limitation. Although a field experiment occurs in a real-life setting and therefore has a relationship to the real world, it is often difficult to strictly control all variables because of the unpredictability of that type of setting.

The ability to more strictly control variables is an advantage of the laboratory setting, however, it can be too dissimilar to real life. In some cases, bringing someone into the unfamiliar environment of a psychology laboratory can change their behaviour to the point where it is not appropriate to generalise the observed behaviour to situations outside the laboratory.

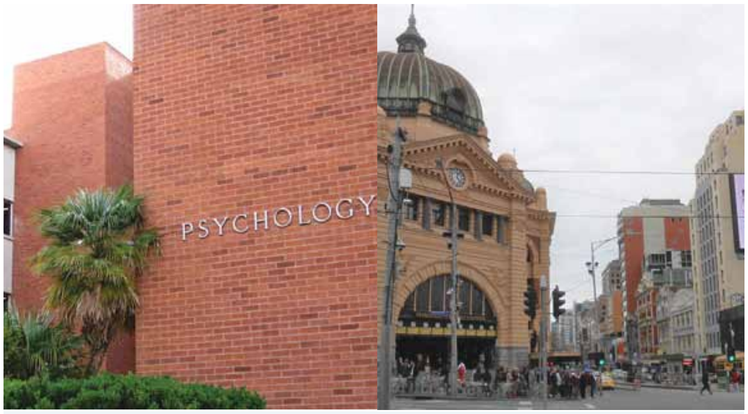

Figure 1.28 Participants may behave differently in the controlled conditions of the laboratory compared to how they behave in the real world.

1.4 LEARNING ACTIVITY 3

Review

1. Complete the following table to further compare the three experimental designs.

Experimental design	Key feature	Advantages	Limitations
between subjects	Each participant is randomly allocated to one condition (group) only and each participant provides only one score for data analysis.		
within subjects	Each participant is involved in all conditions and provides multiple scores		
mixed design	Combines features of both the between subjects and within subjects designs		

2. Explain the meaning of experimental design.
3. What two crucial features do all three experimental designs have in common when variables are controlled?
4. Consider all three experimental designs. Which one(s)
   a. provides one score only for each participant?
   b. uses each participant as his or her own control?
   c. exposes all participants to the same IV(s)?
   d. targets comparison of a participant's behaviour both before and after exposure to a treatment?
5. Sometimes participants in a between subjects experiment may be naturally better at performing an experimental task. For example, in a study on attention, some people might happen to be better at concentrating than others. Which procedure would be used to control this unwanted variable?
6. Name the type of experimental design most likely to have been used in each of the following research studies.
   a. To compare the effects of inspirational message types A and B, participants listened to message A for one week then completed an assessment on their personal wellbeing. The next day they started listening to message B for two weeks after which they completed the wellbeing assessment.
   b. A study on whether males and females are persuaded differently by a female car salesperson.
   c. To investigate the effects of new drug for treating motor symptoms of Parkinson's disease, participants diagnosed with the disease were tested before and after they were given the medication.
   d. A researcher is interested in the effectiveness of a particular treatment for insomnia. Fifty adult insomnia sufferers are contacted from a newspaper advertisement, and each is given a pill with instructions to take it before going to sleep that night. The pill actually contains milk powder (a placebo). The participants are randomly allocated to receive one of two instructions about the pill: half are told that the pill will make them feel 'sleepy' and the other half are told that the pill will make them feel 'awake and alert'. The next day, all the participants meet with researcher and are asked how long it took them to fall asleep after taking the pill. The participants who were told the pill would make them feel sleepy reported having fallen asleep significantly faster than the participants who were told the pill would make them feel awake and alert.
   e. A researcher studied how having previously seen an image of an object may influence the ability to name it again when it reappears later. Participants are first shown pictures of common objects such as a purse, a wristwatch and keys on a computer monitor. The participants then leave and return one week later. At this time, they are shown some of the original pictures they had seen in the first session, some similar but not identical pictures, and some entirely new ones. They are then asked to name the objects as quickly as possible. The researcher found that the original objects were named significantly faster than the new objects, but that the similar objects were named more slowly than the new ones.

f. A researcher wants to examine the effects of massed practice versus distributed practice on the learning of nonsense words such as qoh, nal and fub. The researcher randomly allocates first-year university students studying psychology into one of three groups.

Group 1 is required to learn a list of 20 nonsense words in one 90-minute session on one day.
Group 2 learns the same list for 45 minutes per day for two successive days.
Group 3 practises the same list for 30 minutes per day for three successive days.

The researcher assesses each group's performance with a test of free recall of the nonsense words after each group completes the designated number of sessions. The mean recall of the 20 words for Group 1 is 6.2; for Group 2, 11.1; and for Group 3, 14.9. These mean scores are found to be significantly different from one another, and the researcher concludes that distributed practice is more effective than massed practice.

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1.4 LEARNING ACTIVITY 4

Analysis and evaluation of a controlled experiment

Read the following summary of a controlled experiment and answer the questions about the design.

A researcher conducted an experiment to test the effectiveness of Mnemonica — a simple technique designed to improve memory, especially for middle school students. There were 24 volunteer Year 10 participants from a local secondary school whose parents had given written consent. All were assigned to Group 1 or 2. Each participant had an equal chance of being in either group. Group 1 were taught the Mnemonica technique using a 10-minute video tutorial on a TV at the front of the classroom. Group 2 watched a compilation of music videos TV for 10 minutes. All participants then learnt the same list of words and completed a test of recall for the words.

a. Identify the population and sample.
b. What was the purpose of Group 2 in this particular experiment?
c. Identify the experimental design.
d. Identify the independent and dependent variables.
e. Describe two features of the procedure that identifies this investigation as a controlled experiment.
f. What is an advantage of using an experimental design for this investigation?

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1.4 LEARNING ACTIVITY 5

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.38 (adapted); © VCAA

Professor Dominique wants to test an intervention for stress management. She plans to recruit participants from the university community and randomly allocate them to groups of four. Participants will be told that they will be locked in an escape room until they either solve the puzzles in there or an hour passes.

The groups in the experimental condition will be given a 30-minute presentation by one of her research assistants on effective coping strategies to help alleviate stress, then put into the escape room. The groups in the control condition will immediately go into the escape room after providing consent.

Immediately after leaving the escape room, the participants will rate their feelings of stress across the study period. The groups will be assessed on how long it took them to escape and their self-reported stress. The key outcome will be the difference between the two conditions.

Which experimental research design and sampling procedure is Professor Dominique adopting?

A. within subjects
B. mixed subjects
C. between subjects
D. mixed design

Question 2 (1 mark)

Source: VCAA 2019 *Psychology, Section A, Q.23 (adapted);* © VCAA

Dimitri conducted a within subjects experiment. He used lists of 15 four-letter words as the stimuli. In the first condition, after a list of 15 words was presented, a beep signalled the end of the list and the time for participants to start writing the words down using free recall.

In the second condition later that day, using a different list of words, Dimitri added a distractor task for 30 seconds before the beep signalled that participants were to start writing down the words they remembered.

Which one of the following identifies an independent variable in this experiment?

A. the four-letter words used as stimuli
B. the number of words presented prior to recall
C. the number of words remembered in each serial position
D. the use or absence of the 30-second distractor task prior to recall

Question 3 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.30 (adapted); © VCAA

Dr Chan investigated the effects of caffeine on an individual's response to a physical stressor. She designed and administered an experiment involving 20 individuals (10 male and 10 female), aged between 20 and 40 years old, with no existing medical conditions.

In Condition 1 of the experiment, participants were required to drink a 100 mL cola drink that contained no caffeine. In Condition 2 of the experiment, the same participants were then required to drink a 100 mL cola drink that contained 20 mg of caffeine.

What type of research design has Dr Chan used in her experiment?

A. mixed subjects
B. within subjects
C. between subjects
D. mixed design

Question 4 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.10 (adapted); © VCAA

In a within subjects experiment

A. different participants are used in both the control and experimental conditions.
B. the same participants are used in both the control and experimental conditions.
C. the same participants are used in one trial of both the control and experimental conditions, and different participants are used in subsequent trials.
D. participants are put into pairs and one member of each pair is placed in the control condition and the other member is placed in the experimental condition.

Question 5 (1 mark)

Source: VCAA 2003 Psychology 2, Section A, Q.2 (adapted); © VCAA

In a within subjects experiment

A. different participants are used in both the control and experimental conditions.
B. the same participants are used in both the control and experimental conditions.
C. different participants with similar characteristics are used in both the control and experimental conditions.
D. the same participants are used in one trial of both the control and experimental conditions and different participants are then used in subsequent trials.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

1.5 Correlational studies

A **correlational study** is used to investigate the relationship that exists between variables without any control over the setting in which the relationship occurs or any manipulation by the researcher. There are no IVs or DVs, or control groups, nor can the researcher randomly assign participants to different conditions. The researcher merely measures the relationship between the variables of interest with no intervention.

This is usually done by applying a statistical technique to data that have been collected on each variable. The statistics allow the researcher to determine the strength and type of relationship between the variables. The researcher may also be able to identify which variable may be of greater importance and to make predictions.

The researcher may investigate the relationship between or among any two or more variables, as long as the variables are measurable. The variables may involve anything — behaviour, mental processes, physical characteristics, physiological processes, objects or events. The study may involve data that already exist or the researcher may collect their own data on one or more of the variables.

For example, a researcher may be interested in understanding the relationship between types of weather and incidence of violent crimes, self-esteem and body image, job satisfaction and pay rate, birth order and personality type, stress and ill-health, nail biting and anxiety, the physical attractiveness of a person and how much help they receive from strangers or whether the types of fear people have change with age.

Figure 1.29 Is testosterone associated with aggressive behaviour? A researcher could conduct a correlational study to examine differences in testosterone concentrations between groups known to differ in aggressiveness, such as criminals imprisoned for violent vs non-violent offences.

To study the relationship between hot or cold weather and incidence of violent crimes, the researcher could obtain existing data on both the daily air temperature (such as maximum and minimum temperatures) during a period and violent crimes committed over this period of time in a particular area, then determine the number of violent crimes committed on very hot days and very cold days.

Alternatively, a researcher could conduct an investigation to generate and collect their own data on variables of interest. For example, a researcher could test a hypothesis on the relationship between nail biting and anxiety by assessing participants' self-reported nail biting frequency and their scores on a test for measuring anxiety. Or to study the relationship between alertness and the speed and accuracy of visual perception, a researcher could ask participants to complete a self-rating scale of alertness and then a 5-minute, pencil and paper word search task. Scores on both tasks would then be compiled and assessed to help understand the relationship between the two variables.

Correlational studies are widely used in psychology. They are particularly useful when an experiment is inappropriate or impractical. For example, it would be unethical to raise a group of children who were only allowed to watch violent TV programs to investigate whether this made them more aggressive.

Similarly, suppose a researcher wanted to find out how a severe psychological trauma affects learning. It would be unethical to set up two similar groups of participants and expose one of these groups to some kind of traumatic event that would trigger a severe emotional reaction so that its effects on a measure of learning could be assessed.

Instead, the researcher might compare the performance of soldiers returning from combat duties. The participants could be soldiers who have returned home with varying degrees of traumatic combat experiences, ranging from little to severe, either self-assessed and/or assessed by a mental health professional. All would complete a learning task with which they have had no prior experience, such as learning how to create a list of step-by-step 'coding' instructions for a computer to perform a simple task. The results could then be assessed to find out the relationship between level of trauma and how well the learning task is performed.

Correlational studies are also a useful alternative when time, costs or other practical constraints prevent experimentation (or another research method). For example, the effects of psychological therapies, treatment programs and developmental changes can take a long time and therefore require long-term study. In such cases it would be impractical or unethical (or both) to restrict participants to the controlled environment of a psychology laboratory for the duration of the investigation.

Correlational studies are a non-experimental method. Therefore, the existence of a correlation does not establish whether one variable (such as air temperature) *causes* another (such as violent crimes).

The term **correlation** is used to describe the degree of a relationship between two variables; that is, how strongly two variables are 'co-related', associated or co-vary. When describing a correlation, reference may be made to the direction of the relationship between the variables and the strength of the relationship.

Direction of correlation

For any two variables which are measured in a correlational study, there are three possible relationships between them — positive, negative and zero (no relationship).

A **positive correlation** means that two variables change ('vary') in the same direction — as one variable increases, the other variable tends to increase (and vice versa). For example, as job satisfaction increases, work productivity tends to increase (and as work productivity increases, job satisfaction tends to increase, or, the lower the level of job satisfaction, the lower the level of productivity). Similarly, there is a positive correlation between hours of exam study and exam marks. So, the more time you spend studying for an exam, the better the marks you are likely to achieve (and the less time you spend studying, the lower the marks). Note that both examples are positive correlations. The variables change in the same direction — upward or downward.

In contrast, a **negative correlation** means that two variables change in opposite directions — as one variable increases, the other variable tends to decrease (and vice versa). A negative correlation is like a seesaw. For example, as the amount of alcohol in the blood increases, reaction time tends to decrease, and the more hours you spend on non-exam study activities, the lower the exam marks you are likely to achieve (and vice versa in both cases).

A **zero correlation** means that there is no relationship between two variables. For example, there is no relationship between the amount of coffee drunk and VCE grades. These two variables can change entirely independently of each other. Similarly, there is no relationship between your birthday and exam grades.

A correlation is usually described 'quantitatively' by a number known as a **correlation coefficient**. When calculated, this is expressed as a decimal number which can range from +1.00 to –1.00. The plus or minus sign describes the *direction* of the relationship between the two variables; that is, positive or negative.

A correlation coefficient with a *plus* sign indicates a positive correlation. This means that high scores for one variable tend to go with high scores on the other, middle scores with middle scores, and low scores with low. For example, if there is a high positive correlation (say +0.75) between the rate of pupil dilation and problem-solving ability, then people with rapid pupil dilation will tend to be good problem-solvers (e.g. they would solve many problems in a 20-minute period) and people with slow dilation would tend to be poor problem-solvers (e.g. they solved fewer problems in a 20-minute period).

A correlation coefficient preceded by a *minus* sign indicates a negative correlation. This means that when a score on one variable is high, the score on the other tends to be low, and middle scores tend to go with middle scores. For example, if a high negative correlation (say –0.75) is found between the rate of pupil dilation and problem-solving ability, then people with rapid pupil dilation would tend to be poor problem-solvers and those with slow dilation would tend to be good problem-solvers.

When reporting correlation coefficients for positive correlations, researchers usually omit the plus sign from the front of the score. However, the minus sign is always included for a negative correlation.

Strength of correlation

The decimal number of the correlation coefficient describes the *strength* of the relationship between the sets of scores for two variables; that is, whether the relationship is strong, moderate or weak. A correlation coefficient which is close to +1.00 indicates a very strong positive correlation between two variables. A correlation coefficient which is close to –1.00 indicates a very strong negative correlation between two variables.

Correlation coefficients of 1.00 and –1.00 indicate perfect correlations but these rarely occur in psychology. A correlation coefficient which is close to 0.00 indicates little or no relationship between two variables. For example, 0.13 and –0.13 would be considered a very weak positive and very weak negative correlation respectively.

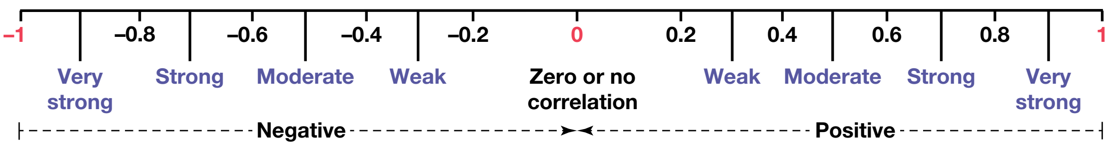

Figure 1.30 How correlation coefficients may be interpreted. There is no formally stated rule for determining the exact values at which a correlation is considered strong (high), moderate (medium) or weak (low).

1.5.1 Correlation and causation

Correlations show the existence and extent of relationships between variables but they do not necessarily indicate that one variable causes the other. For example, people get older as the world rotates on its axis. There is an extremely strong correlation between these two variables, but it would be incorrect to assume that the Earth's rotation *causes* people to age or that people's ageing *causes* the Earth to rotate.

There are also many instances when strong correlations suggest a logical cause–effect relationship. For example, the number of friends a person has may be closely related to how happy they are. Or, conversely, a person's happiness may be influenced by the number of friends they have, especially if they suddenly lost most of their friends. But a very strong correlation doesn't necessarily mean that there is a cause–effect relationship because both variables may be correlated with a third variable.

For example, there is a positive correlation between the number of ice creams sold and the number of arrests for physical assault on the Gold Coast during schoolies week. It cannot be assumed, however, that ice cream sales or eating ice cream causes assault. The correlation is strong because a third variable such as the presence of more people or hot weather temperature may account for both ice cream sales and the number of aggravated assaults.

Similarly, there is a very high correlation between the number of years spent in schooling and income as an adult. Both of these variables, however, have also been found to correlate not only with each other but also with a third variable — parents' income.

When an alternative third variable may account for a correlation, in addition to the two variables that have the correlation, it may be referred to as the *third variable problem.*

When two variables are strongly correlated, this is not accepted by researchers as evidence of causation in the absence of other research evidence. In such cases, researchers may test the possible cause–effect relationship by conducting a controlled experiment.

Figure 1.31 Sleeping with shoes on and waking up with a headache have a strong positive correlation. Does this mean that sleeping with shoes on causes a headache? Of course not. Both variables also correlate with and are affected by a third variable — going to bed after drinking too much alcohol.

on Resources

Weblink TEDx Video: The danger of mixing up causality and correlation 5 m 57 s

1.5.2 Using correlations to identify important factors and to make predictions

Even though causality cannot be concluded from the results of correlational research, however strong the correlation, correlational studies are still valuable regardless of the fact that one variable does not necessarily cause the other.

First, correlational studies can be used to rule out some variables and identify other factors that are important or worthwhile for further study and investigation. For example, correlational studies have been used to investigate numerous behavioural and psychological factors thought to be associated with the incidence of heart attacks. Some factors have been found to have a strong (high) correlation with heart attack whereas others have a weak or negligible correlation. Consequently, correlational studies have been of value in identifying which factors contribute the most or least to heart attacks.

In much the same way, correlations have been used to identify more or less important factors in a diverse range of other areas of psychological interest. Furthermore, this approach has enabled researchers to target those factors with high correlations and select them as variables for further investigation through controlled experiments. With this research method, the researcher can assess whether they actually cause a change in the thought, feeling or behaviour of interest.

Second, it is sometimes possible to use the results of correlational studies to make meaningful predictions. Very strong or high correlations enable researchers to make quite accurate predictions about the scores on one variable when the scores on the other variable are known. This applies to both positive and negative correlations.

For example, there is considerable evidence demonstrating a strong positive correlation between stress and susceptibility to colds and infections. Thus, how much stress a person perceives they are under is a good predictor of susceptibility to colds and infections.

Of course, it cannot be concluded that stress causes colds and infections. Although the accuracy of a prediction increases as the strength of the correlation increases, only a perfect correlation between two variables would allow you to predict the exact value or outcome of one from knowledge of the other.

There are statistical procedures that can be used with correlational data to identify one or more 'predictor' variables and 'outcome' variables to predict the score of one from the other. These procedures can also take account of or rule out the potential influence of other variables.

This means that when the performance of an individual on one of two variables is known, then their performance on the second variable can be predicted quite accurately. At a personal level, knowing this type of information can allow us to reliably predict specific risks in important areas of our lives and make informed choices about our lives and behaviour.

Of course, there will always be people who are exceptions to a prediction when a correlation is not perfect. When a correlation is less than perfect, as it usually is in the real world, then a prediction will also be less than perfect. Predictions therefore refer to the likely effect of one variable on the other. For instance, in relation to the stress example described previously, it would be predicted that stress increases the *likelihood* of colds and infections. Similarly, if correlational data shows that ATAR scores can reliably predict success in tertiary courses, it does not mean that you are guaranteed to succeed in your tertiary studies if you choose that career path.

1.5.3 Advantages and limitations of correlational studies

Correlational studies examine how variables are naturally related in the real world, without any attempt to change them or test for a cause–effect relationship. They can be used to test hypotheses in cases where it is not desirable or possible to experimentally manipulate the IV of interest.

For example, they may be a suitable alternative when an experiment is inappropriate for ethical reasons or impractical. Variables such as trauma, physical, sexual and emotional abuse, drug misuse and abuse, criminal offending and self-harm are among those of psychological importance. However, for ethical reasons, these cannot be studied experimentally by asking people to experience them in a true experiment. In many cases, researchers can rely on existing information available on the variables of research interest.

Likewise, an experimenter can't actually change a person's age, gender, cultural background, intelligence, personality, prejudices, mental health, self-esteem and so on. However, such variables and behaviours do occur in the real world so they can be studied through correlational research.

An associated advantage is that, unlike many psychological experiments, correlational studies on such variables can be conducted outside an artificial laboratory situation where the results may also be more realistic.

Correlational studies are also useful for discovering relationships between variables, even if not causal. In particular, they can identify variables that are more or less important or worthwhile for further study and investigation. When strong relationships are discovered between variables, researchers can often make worthwhile predictions. The 'quantification' of relationships between and among variables so that they are expressed as numbers is also useful for describing, analysing and interpreting results.

Finally, correlations can indicate patterns or trends, thereby contributing to the development and testing of theories and models. In some cases, correlations can also suggest likely causal relationships that may be tested experimentally.

The major limitation of correlational studies is that they do not permit the researcher to draw firm conclusions about cause-and-effect relationships. Correlational studies may suggest or point to possible causes but they cannot demonstrate cause. They are not a legitimate research method for studying causality. Only controlled experiments can be used to clearly establish that one variable causes another. Furthermore, unlike controlled experiments, it can be difficult or impossible to control unwanted variables, such as a third variable (or others) that may offer a possible alternative explanation.

Figure 1.32 Prediction is possible when two variables are correlated, such as ATAR scores and success in tertiary studies. The stronger (or higher) the correlation between the variables, the better the prediction. However, predictions are estimates that refer to likelihoods, not guaranteed outcomes. Although ATAR scores can reliably predict success in certain tertiary courses, it does not mean that you are guaranteed to succeed in your tertiary studies if you choose that career path.

1.5 LEARNING ACTIVITY 1

Review

1. What is a correlational study? Explain with reference to a psychological example different from those in the text.
2. What is the main distinction between the findings of an experiment and those of a correlational study?
3. What primarily determines the researcher's choice of correlational research instead of experimental research?
4. Name and briefly describe the three possible general types of relationships found between variables measured in a correlational study. Give a psychological example of each type of correlation, different from those used in the text.
5. What do the terms direction and strength of correlation refer to and how are they identified?

6. Explain whether a correlation coefficient with a positive value indicates a stronger degree of relationship than does a coefficient with a negative value.
7. What conclusion could be drawn from the following correlation coefficients?
   a. number of hours spent studying for an exam and exam grade achieved: 0.78
   b. number of close friends and level of aggressiveness: –0.51
   c. maternal cigarette smoking during pregnancy and birth weight of their infant (–0.28)
   d. job satisfaction and pay rate (0.39)
   e. amount of energy drink consumed during an exam and grade achieved: 0.06
8. a. For (a) and (b) in question 7, suggest a third alternative variable that could account for either of the two variables.
   b. Is the third variable problem possible for negative correlations?
9. Write a research hypothesis that could be tested in a correlational study investigating the association between each of the following pairs of variables.
   a. intelligence and achievement
   b. car drivers' use of mobile phones and car accidents
   c. days absent from school and hours spent video game playing
10. Briefly describe two advantages and two limitations of correlational studies.

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1.5 LEARNING ACTIVITY 2

Multiple-choice questions

1. A correlation coefficient is
   A. a numerical value between –1.00 and 1.00.
   B. any variable in a correlational study.
   C. the variable manipulated by the researcher.
   D. the variable not manipulated by the researcher.
2. A researcher found that knowing an individual's score for Test A gives no information whatsoever about their score for Test B. This suggests that the correlation between Test A and Test B is close to
   A. –1.00.
   B. –0.50.
   C. 0.50.
   D. 0.00.
3. The direction of a correlation refers to
   A. whether a prediction can be made from one of the scores.
   B. whether the association is positive or negative.
   C. whether one variable is likely to have caused a change in another variable.
   D. where to look for possible third variables.
4. A university lecturer evaluated the first-year results and found that students in her class who got a good result had also achieved high grades for their VCE and those who hadn't done well had achieved low VCE grades. This suggests a
   A. causal relationship.
   B. low correlation.
   C. negative correlation.
   D. positive correlation.
5. Which of the following statements about correlation studies is correct?
   A. Correlational studies enable strict control of all variables of research interest.
   B. Correlational studies cannot be conducted in real-life field settings.
   C. Correlational studies can be used to make tentative predictions.
   D. Correlational studies enable manipulation of two variables to measure how they may be associated.

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1.5 LEARNING ACTIVITY 3

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2004 Psychology 2, Section A, Q.35; © VCAA

Research has shown that as the temperature increases in summer, fewer people attend gymnasiums.

What relationship would this indicate between the variables?

A. no correlation
B. null correlation
C. a positive correlation
D. a negative correlation

Question 2 (1 mark)

Source: VCAA 2004 Psychology 2, Section A, Q.39; © VCAA

In correlational research

A. the larger the correlation, the more likely there is to be a cause and effect relationship between the two variables.
B. a correlation coefficient of 1.6 would represent a remarkably strong relationship.
C. a large negative correlation can be interpreted in the same way as a large positive correlation.
D. a large negative correlation can be just as significant as a large positive correlation.

Question 3 (1 mark)

Source: VCAA 2003 Psychology 2, Section A, Q.34; © VCAA

Which of the following statements can be most accurately concluded from a correlation of –0.85 between hours of television watched and level of happiness?

A. Happy people watch a lot of television.
B. Unhappy people watch a lot of television.
C. Watching television makes people happy.
D. Watching television makes people unhappy.

Question 4 (1 mark)

Source: VCAA 2002 Psychology 2, Section A, Q.45; © VCAA

A correlation of .2 indicates

A. a strong relationship between two variables; one of which increases while the other decreases.
B. a weak relationship between two variables; one of which increases while the other also increases.
C. a weak relationship between two variables; one of which increases while the other decreases.
D. a strong relationship between two variables; one of which decreases while the other also decreases.

Question 5 (1 mark)

Source: VCAA 2004 Psychology 2, Section A, Q.44 (adapted); © VCAA

Professor Von Trapp is studying how the length of time that a stimulus is exposed to a participant affects the participant's ability to recall the shape of the stimulus. She recruits 30 first-year university students, 15 male and 15 female. Each participant is presented with three sets of 10 shapes, which are exposed for: four seconds for the first set of 10 shapes, two seconds for the second set of 10 shapes and one second for the third set of 10 shapes. She then asks each participant to perform a memory recognition task for 50 different shapes, the 30 shapes previously seen and 20 distracters.

What research design was used in the professor's study?

A. within subjects
B. between subjects
C. mixed design
D. correlational

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1.6 Self-reports

For some investigations, it may be more appropriate to ask people about their thoughts, feelings or behaviour. For example, a researcher may be interested in studying what people dream about, how often they have nightmares, thoughts and feelings that accompany a stressful experience, why people jump queues, why people with a spider phobia react as they do when they see a spider, or what people do to cope with the fear or anxiety triggered by a phobic event. To ask people how they think, feel or behave when conducting scientific research involves using a measure or technique that will prompt self-reports.

A **self-report** is a participant's answers to questions presented by the researcher. For example, a self-report may be responses to questions about their beliefs or attitudes, feelings when experiencing certain emotions, how they behave in different situations, and so on. Answers may be spoken, in writing, or both. In some cases, a self-report may take the form of daily diary or journal records that are recorded by participants over a period of time.

Overall, self-report methods rely on research participants' accounts of their own experiences and behaviours. For many investigations, one person's self-report is compared with those of others responding to the same questions.

Assuming that the participants are honest, understand the questions, can accurately recall what they have been asked about and are able to give sufficiently detailed accounts of the behaviour or mental process under investigation, self-reports can provide useful data on virtually any topic of research interest.

Interviews and questionnaires are the most commonly used self-report methods. Both use questions requiring participant responses, but they are often distinguished in terms of how the questions are asked and answered. For example, a questionnaire usually involves asking and answering questions in writing, whereas an interview usually involves asking and answering questions orally. However, this is not a fixed 'rule'. Sometimes, a researcher may prefer to orally ask the questions in their questionnaire.

Although interviews and questionnaires can be used exclusively or in combination to collect self-reports, they are often used to collect additional data as a part of investigations using other research methods. For example, interviews and questionnaires are commonly used for correlational studies.

Free-response and fixed-response questions

When using an interview or questionnaire to collect self-report data, the researcher may choose to use free-response or fixed-response questions.

Free-response questions (also called *open-ended questions*) allow participants to answer entirely as they want to. They answer 'freely' in their own words, rather than choosing from options determined by the researcher. For example, the researcher might ask a question such as

> *What thoughts influence your decision to ask a friend if they are OK?*
>
> *How do you feel when stressed?*
>
> *How do you usually react when this happens?*

These kinds of questions enable participants to provide detailed responses without being restricted to giving answers that fit into pre-determined categories. Furthermore, in an interview, free-response questions enable the researcher to ask questions of clarification or follow-up questions as participants give information about the behaviour or mental process under investigation.

Figure 1.33 Free- or fixed-response questions can be used in a questionnaire to collect self-report data from a large number of people in a relatively short period of time.

With this, however, comes a limitation. Answers to free-response questions are often difficult to summarise or score. This makes it harder for researchers to statistically analyse, describe and interpret the data obtained.

To avoid or overcome this limitation, researchers may ask fixed-response questions. **Fixed-response questions** (also called *fixed alternative* and *fixed-choice*) present a number of 'fixed' alternative answers from which participants are required to choose. Like multiple-choice questions, the participant is asked to pick the correct response or the one that best matches their preference. Examples of this type of question are

> *'Do you dream in colour? Yes, No, Not sure'*
>
> *'How often you remember your dreams on awakening? Always, Often, Sometimes, Not often, Never'*
>
> *'How much time does it usually take to fall asleep when you go to bed at night? 0–10 minutes, 11–20 minutes, 21–30 minutes, 31–60 minutes, 1–2 hours, More than 2 hours'*

Answers to fixed-response questions are usually easier to interpret than are answers to free-response questions. In addition, because fixed-response questions provide specific alternatives from which the participant chooses, the researcher can accurately and concisely summarise and describe the responses numerically. For example, a '0–10 minutes' response to the question about the time taken to fall asleep can be assigned a score of 1, '11–20 minutes' a score of 2, and so on. Furthermore, the same scores can be reliably assigned to all other participants who give these responses and all responses can be efficiently analysed, described and interpreted using statistical procedures and tests.

Fixed-response questions are sometimes called 'closed-ended questions'. Although a closed-ended question may present a set of answer options for selection, the term may also be used to describe questions requesting a short definite answer, such as *'How old are you?', 'Do you get anxious when unexpectedly asked a question in class?'* and *'What is the name of the medication you take?'* (APA, 2022).

1.6.1 Interviews

An **interview** involves questions that are asked by the researcher with the intention of prompting and obtaining specific information from an individual participant (the 'interviewee').

Interviews are most often conducted in a face-to-face meeting but sometimes online or by mobile phone using an app like Zoom, Microsoft Teams and FaceTime. They involve talking and usually require spoken answers to questions. They are rarely used with large samples as data collection would require a considerable amount of time. Unlike questionnaires, which are usually structured, interviews may be structured, unstructured or semi-structured (National Health and Research Council [NHMRC], 2007).

In a **structured interview** (also called *standardised interview*), the participant is asked specific, pre-determined questions in a controlled manner. The choice of answers tends to be fixed and determined in advance as well. The most structured interview is when the interviewer simply reads fixed-response questions to participants in a set order and records their answers, for example, *Have you ever been awoken by a nightmare?* with a predetermined answer such as *'Yes'*, *'No'* or *'Not sure'*.

The interviewer follows a script and the questions are read in a neutral manner with no comments or cues such as facial expressions. This is done to ensure that all participants are treated in the same way and thereby helping maintain standardised procedures. A less structured interview may use free-response questions (such as *'How do you feel immediately after waking from a nightmare?'*), but the researcher will follow a script to ensure consistency across all participants.

Figure 1.34 An interview is often a face-to-face discussion between a researcher and an individual for the purpose of obtaining detailed information.

In an **unstructured interview** (also called *nondirective interview*), the researcher has an overall aim of what data should be collected but the questions asked may be generated spontaneously and the types of answers given can vary widely from participant to participant. The interview is highly flexible and may even be driven by the participant. There is also freedom of discussion and interaction between the interviewer and participant. For example, the interviewer may ask additional questions to follow up on a participant's response and a participant may ask questions (NHMRC, 2007).

The unstructured interview is sometimes described as 'conversational', or 'interactional', to suggest that it is somewhat like the way in which a job interview may be conducted by a human resources professional.

A goal of unstructured interviews is to allow people to describe their thoughts, feelings and behaviour in their own way using their own words and to give more or less emphasis to relevant issues. This is different from structured interviews (and questionnaires) for which participants have to use the questioner's terms and concepts to describe how they think, feel or behave. However, this also means that the data collected through unstructured interviews is much more detailed, has far less structure, and is therefore more difficult to analyse, summarise and describe for reporting purposes.

In a **semi-structured interview**, the researcher uses an interview guide listing a set of issues to be explored. The researcher aims to cover all issues but there are no set questions to be asked. As with the unstructured interview, there is spontaneous generation of questions through interaction with the participant (NHMRC, 2007).

1.6.2 Questionnaires

A **questionnaire** is a written set of questions or other prompts designed to draw out self-report information from participants on a topic of research interest. It has a structured format and can be administered via surface mail, over the phone, in a face-to-face interview, in an app or over the Internet.

Questionnaires are most often used when responses are required from a large number of participants; for example, as part of a survey. In such cases, they are an efficient way of collecting self-reports because a researcher can administer the questionnaire at the same time to a group who are located in the one place, such as in a school or workplace. For these types of investigations, the questions are usually answered by participants in writing, at their own pace and without supervision.

Written questionnaires are also a means of guaranteeing anonymity to participants. They can therefore be a useful way of collecting self-report data that people are not willing to disclose publicly, such as ambitions, motivations, fantasies, recreational drug use, sexual behaviour, addictive behaviour, socially unacceptable behaviour and illegal behaviour.

Questionnaires may also include prompts in the form of a rating scale. A **rating scale** uses fixed-response questions or statements for which participants rank ('rate') each item on a numerical scale by selecting from a number of choices. For example, participants may be asked to rate their level of fear or anxiety when making an oral presentation to a large group, how often they use social media just before going to sleep, their level of tiredness after completing homework on a weeknight, their level of confidence before sitting a test for which they have done the right amount of study, or the strength of their attitudes to racist comments by competitors in sports matches.

The items to which participants respond are usually related as they have been devised by the researcher for the topic or issue under investigation. Responses are typically assigned scores which enables answers to be quantified (converted to numbers) for summary, analysis and interpretation.

Figure 1.35 Surveys can be conducted electronically to administer a questionnaire to large numbers of people anywhere in the world.

The rating scale is like a multiple-choice test, but the answer options represent levels or degrees of a particular characteristic rather than a series of possibly correct answers. Furthermore, there is no correct answer for a rating scale item, other than what the participant decides to give.

The best-known and most commonly used rating scale is the *Likert scale*. This consists of about 20 questions or statements to which the participant responds using a 5-point scale. It is most commonly used to measure attitudes. For example, in a study on attitudes to parenting practices, a Likert scale statement could be '*Punishment is sometimes necessary to maintain obedience*'. Participants may then be required to rate their answers by selecting one response from five options ranging in strength, such as *strongly agree, agree, neither agree nor disagree, disagree* or *strongly disagree*.

Researchers have several choices in selecting how answers should be indicated on the five-point scale — for example, ticking or crossing a blank space, circling a number or underlining a response. Each of the responses has a numerical value (e.g. from 1 to 5) and the respondent's attitude is defined as the sum (total) of these values. A Likert scale for measuring attitudes towards recreational drugs could include statements such as those below shown in Figure 1.36.

When developing a Likert scale, half the attitude statements are worded in a positive way and half are worded negatively. For statements 1, 3 and 5, the answers would be scored as follows: SA = 1, A = 2, N = 3, D = 4 and SD = 5. For statements 2, 4 and 6, the answers would be scored in reverse: SA = 5, A = 4, N = 3, D = 2 and SD = 1.

In a true Likert scale, however, positive and negative statements are distributed in a random order. Figure 1.36 has an example of a 7-point scale with statements in a random order. For this scale, the higher the score the greater the level of anxiety experienced in a romantic relationship.

When a respondent has completed the Likert scale, all of the responses are scored and a total is calculated. The result is a score on the attitude or whatever else was measured. Generally, the higher the score, the more favourable the attitude.

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Access learnON for a step-by-step description of how to construct a Likert scale.

Questionnaire on attitudes towards recreational drugs

Recreational drugs are legal and illegal drugs used for enjoyment without medical justification for their effects on the mind, mood or behaviour. The following statements are about the use of recreational drugs.

Circle your response to each statement below.

1. The use of recreational drugs is a major social problem in Australia today.	SA A N D SD
2. There should be no restrictions on using recreational drugs as long as the individual using them does not harm anyone else.	SA A N D SD
3. Laws should be strictly enforced regarding the use of recreational drugs.	SA A N D SD
4. It is an invasion of privacy when law enforcement authorities search people suspected of carrying recreational drugs.	SA A N D SD
5. Individuals using recreational drugs should be punished severely.	SA A N D SD
6. In the privacy of their own homes, individuals should be allowed to use any recreational drug they desire.	SA A N D SD

SA = Strongly agree A = Agree N = Neither agree nor disagree D = Disagree SD = Strongly disagree

Figure 1.36 Sample questionnaire and items in a Likert scale for measuring attitudes towards the use of recreational drugs. Note the questionnaire gives an overview of what it is about and instructions on how to answer.

Questionnaire on romantic relationships

Please rate your agreement with each of these statements using a 1 to 7 scale, with 1 meaning 'Strongly disagree' and 7 meaning 'Strongly agree'.

1.	I'm afraid that I will lose my partner's love.	_______
2.	I often worry that my partner will not want to stay with me.	_______
3.	I often worry that my partner doesn't really love me.	_______
4.	I worry that romantic partners won't care about me as much as I care about them.	_______
5.	I often wish that my partner's feelings for me were as strong as my feelings for them.	_______
6.	I worry a lot about my relationships.	_______
7.	When my partner is out of sight, I worry that they might become interested in someone else.	_______
8.	When I show my feelings for romantic partners, I'm afraid they will not feel the same about me.	_______
9.	My romantic partner makes me doubt myself.	_______
10.	I find that my partners don't want to get as close as I would like.	_______

Source: Based on Fraley, R.C., Waller, N.G., & Brennan, K.A.(2000). An item–response theory analysis of self-report measures of adult attachment. *Journal of Personality and Social Psychology*, *78*, 350–365.

Figure 1.37 Example of a questionnaire and items in a Likert scale for measuring attachment in a romantic relationship. Note the use of 7-point rating scale.

1.6.3 Focus groups

A **focus group** is a small set of people, typically 8 to 12 in number, who share characteristics and are selected to discuss a topic of which they have personal experience. A leader conducts the discussion and keeps it on target while also encouraging free-flowing, open-ended debate (APA, 2022).

Participants are encouraged to talk to one another, ask questions, exchange personal experiences and points of view and comment on each other's experiences and opinions. This is different from a conventional group interview in which the researcher asks each person to respond to a question in turn.

Focus groups can be used to obtain information on all types of behaviour and experiences. For example, access to youth mental health services, sleep habits, study habits, online learning, dating apps, the experience of being caught in a natural disaster, strategies for coping with stress, exercise preferences, the lived experience of having a disability, the attitudes and needs of staff in a workplace, and so on. A focus group may also be used to generate a hypothesis or refine a questionnaire or rating scale for another research study.

A key idea behind the focus group method is that interacting with others in a group situation can help people to explore and clarify their own views in ways that would be far less possible in a one-to-one interview or a conventional group interview. To promote group discussion, the researcher (called a 'facilitator') uses free-response questions and encourages participants to discuss issues of importance to them in relation to the research topic, and even to generate questions for discussion with the rest of the group.

A research study using multiple focus groups can consist of anything from a few to over 50 groups, depending on the aims of the research and the resources available. Even just a few groups can generate a large amount of data. For this reason, many studies using focus groups rely on a small number of groups.

Focus group sessions may last for around one or two hours or extend into a whole afternoon or a series of meetings. Sessions are relaxed, in a comfortable setting, with participants usually sitting in a circle to help establish an atmosphere that encourages open discussion.

Some studies combine the focus group method with other data collection techniques; for example, focus group discussion is useful when seeking to explain or explore survey results or to analyse observed behaviour that participants engaged in.

The main advantage of focus groups is the richness of the data that can be generated about the research topic. The groups are generally easy to organise and sessions are relatively inexpensive to conduct when compared to other research methods.

Focus groups are also useful for collecting information from people who have difficulty reading

FIGURE 1.38 Group discussion and interaction are important features of focus groups.

or writing, or have other communication difficulties. Communication difficulties may be a disadvantage in some studies or situations.

However, the 'safety in numbers' factor may also be an advantage within a group situation. It can encourage the participation of those who may normally be uncomfortable or anxious about revealing information about themselves to an interviewer in a one-to-one interview situation. Co-participants in the focus group can also provide support through their expression of feelings that are common to their group, but which they may consider to be very different or abnormal from those of people not in the group.

This is particularly important when researching very sensitive or 'taboo' experiences such as abuse, the death of a loved one or sexual violence. One limitation of focus groups related to this is that the presence of other research participants does not enable the confidentiality of more conventional research settings.

Of course, the process of analysing, summarising and reporting focus group data can be a painstaking and time-consuming process, especially when multiple groups are use. Some psychologists have also expressed concerns about the *reliability* of the results obtained from these types of focus group studies; that is, the same body of raw data can be interpreted differently by different researchers. For example, two different researchers working with the same data may not necessarily extract the same themes and key points, resulting in different conclusions.

1.6.4 Advantages and limitations of self-reports

Self-report measures, such as interviews and questionnaires, are widely regarded as useful techniques for collecting any type of data on how people think, feel and behave. In particular, they are especially useful for measuring behaviours or other characteristics that cannot easily be directly observed.

Another advantage of self-reports is that they can be an efficient means of collecting data from a large number of people in a relatively short period of time. When doing so, they can be cost-effective and relatively easy and quick to administer. They also have the advantages of making it relatively easy to compare responses among participants and to replicate a study, especially when structured measures (or 'measurement tools') such as surveys with fixed-response questions are used.

When anonymity of responses is guaranteed, questionnaires in particular provide a means of collecting self-report data on 'sensitive' or controversial topics that many people are not willing to disclose publicly, such as in an unstructured oral interview.

However, like other self-reports, they rely on the assumptions that people are self-aware of their personal experiences and behaviour, actually willing to answer all questions and that they will give honest answers. We cannot always reliably recall or communicate information about how we think, feel or behave.

Another limitation of self-reports is that participants can introduce bias into their self-reports. One type of bias involves a *social desirability* effect. Participants may intentionally give false or misleading answers to create a favourable impression of themselves. For example, with socially sensitive issues such as attitudes to 'boat people', Aboriginal land rights, same-sex marriage and animal research, people sometimes give socially desirable responses instead of reporting their true attitudes. They want to appear likeable, to have a 'social conscience', or to look good, so they present attitudes, beliefs and the like which encourage others to see them in a positive way.

Alternatively, the participants may be embarrassed to report their true attitudes or beliefs, especially for very personal topics. Furthermore, in self-reports based on interviews, especially face-to-face interviews, the interview situation and/or the presence of the interviewer can influence how questions are asked and how the respondent answers them.

Even when researchers make careful use of random sampling, they need to consider the possibility of a type of sampling bias known as *non-response bias*. For example, if only a small percentage of randomly sampled people agree to respond to a questionnaire, it is possible that those who did respond will be different than those who refused or did not bother to participate.

Self-reports are language dependent so there are limitations when used with young children, adults with English speaking backgrounds but with weak literacy skills, people from non-English speaking backgrounds who have yet to learn English well (unless translated) and people with a severe intellectual disability. Generally, they are best used with people who have well-developed language skills, although interpreters and skilful interviewing can help overcome communication barriers.

When comparing the advantages and limitations of different self-reports, it is important to take account of the type of data that will be collected and the type of question used. Generally, questions that allow free, open-ended descriptive responses give answers that are richer in detail. However, these answers are often difficult to summarise and statistically analyse. Questions with scoreable fixed responses enable more precise and efficient statistical summaries and analyses.

Figure 1.39 Self-report methods of data collection provide useful information about how people think, feel and behave. However, they rely typically on participants having well-developed language skills and being able to accurately recall and state the information required of them.

1.6 LEARNING ACTIVITY 1

Review

1. Complete the following table. Ensure you describe and review the interview method in general.

Self-report	Description	Advantages	Limitations
Interview • structured • unstructured			
Questionnaire			
Focus group			

2. *Source: VCAA 2017 Psychology Sample Exam, Section B, Q.6c; © VCAA*
In a different mental health study, the researchers were interested in comparing the effectiveness of three evidence-based interventions (biological, psychological, social) for a particular mental health disorder. Each participant completed a self-report prior to treatment, after four weeks of treatment and again after seven weeks of treatment. Participants rated their improvement on a scale of one to 10 (the higher the score, the more they felt they had improved). The results are shown in the table below.

	Biological intervention (Chloromidiside)	Psychological intervention (psychotherapy)	Social intervention (family support)
Mean self-report score prior to treatment	3.3	3.2	3.4
Mean self-report score after four weeks	5.8	3.9	6.5
Mean self-report score after seven weeks	6.1	7.5	5.9

i. Identify one strength and one limitation of self-reports.

ii. Use the data in the table to compare the effectiveness of the three evidence-based interventions.

3. *Source: VCAA 2007 Psychology 1, Section B, Q.2; © VCAA*
Case studies are used in brain research. Outline one value and one limitation of using case studies for brain research.

4. For two of the following research aims, write an example of a free-response question and an example of a fixed-response question that could be used for self-report data collection.

a. To determine the type and amount of social media use by adolescents prior to their nightly sleep episode during the school week.
b. The aim of this research is to compare sex differences in strategies used for coping with stress.
c. This research aims to investigate personal experience of stigma by people with a phobia.

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1.6 LEARNING ACTIVITY 2

Multiple-choice questions

1. Data from self-reports are best described as participant responses
   A. that are anonymous.
   B. that are unprocessed.
   C. that are socially desirable.
   D. to researcher questions.
2. Which of the following is not a self-report data collection technique?
   A. rating scale
   B. interview
   C. experiment
   D. focus group
3. Self-report methods primarily rely on
   A. control of all variables that may affect the results.
   B. research participants' accounts of their own experiences and behaviours.
   C. comparison of research participants' responses to questions.
   D. free-response and fixed-response questions.
4. Which type of question in a test or exam is likely to be a free-response question?
   A. essay
   B. true–false
   C. multiple-choice
   D. fill-in-the blank
5. Which of the following is a fixed-response question?
   A. How would you feel if unfriended on Facebook by a close friend?
   B. What do you usually do on weekends for rest and relaxation?
   C. How would you rate your sleep quality on scale of 1–10?
   D. What are your five favourite foods?

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1.7 Observational studies

An **observational study** involves collection of data by carefully watching and recording behaviour as it occurs without any intervention or manipulation of the behaviour being observed. The method is used to collect data in research when the behaviour under investigation is clearly visible and can be easily recorded. As you would expect for a scientific investigation, specially trained individuals record activities, events, or processes as precisely and completely as possible without personal interpretation (APA, 2022).

For example, the checklist shown in Figure 1.40 below was used by a researcher to observe and record data on how children (5 boys and 3 girls) react to the aggressiveness of their peers in a play situation. As shown in the top row, each child was assigned a number from #1 to #8, their sex if identified (M or F) and the checklist allows for three aggressive acts per child. Note, for example, that child #1, a male, initiated acts of aggression against one male and two females, specifically #5, #6, and #8. Child #5 showed little or no emotion, #6 responded by tears, and #8 also cried, and got the attention of other children and the supervisor. Of course, not all checklists need to be complicated in terms of the number of participants who are observed and the number and types of behaviours.

The observational study as a research method should not be confused with the use of observation as a *technique* to collect data. For example, an experiment may use the observational technique to watch and record data of participants' responses following exposure or non-exposure to an IV.

One of the best-known examples is the series of Bobo doll experiments conducted by Canadian psychologist Albert Bandura in the 1960s to investigate whether young children can learn to be aggressive by watching adults behaving that way. Bandura observed children's responses after watching a movie showing an adult treating a Bobo doll aggressively (experimental group) with a group of children who had not (control group).

Initiation of aggressive act, shown by child and sex

	#	1	M	#	2	M	#	3	M	#	4	M	#	5	M	#	6	F	#	7	F	#	8	F
Aggressive act against whom (shown by child's assigned number)*	**5**	**6**	**8**				**6**	**7**	**2**	**1**	**3**	**5**	**1**	**6**	**8**	**2**	**2**	**4**				**6**	**3**	**5**

Response

Anger												x		x		x								
Surprise													x			x								x
Hurt. tears		x	x				x	x							x		x					x	x	x
Little or no emotion shown	x								x	x	x													
Help from other children			x				x	x					x									x		
Help from adult supervisor			x					x							x	x								x

*The observer assigned numbers to the children, keyed to clothing. The child in the red sweater was #1, the one in the blue shirt was #2, and so on.

Figure 1.40 An example of a checklist used for an observational study on how children react to the aggressiveness of their peers in a play situation

Source: Based on Wiseman, J.P., & Aron, M.S. (1970). *Field projects for sociology students*. Cambridge, Massachusetts: Schenkman. p.21.

Generally, data collection in an observational study may be:

- *structured:* a prepared system is used to guide and record observations; for example, a checklist of items to precisely guide what to look for and to record or exclude
- *unstructured:* observations are made without a predetermined format
- *semi-structured:* a part of the observational study involves use of a predetermined format.

Most observational studies conducted in psychology are structured and use systematic data collection techniques in controlled settings, such as the checklist with predetermined criteria shown in Figure 1.40. These may also be referred to as *controlled observations* because of their systematic nature and because the researcher is exercising control over the setting (APA, 2022).

A structured study typically involves operationalising the behaviour of interest and variables that are involved. For example, observing aggression outside nightclubs in Chapel Street, Prahran, must define aggression precisely in terms of the variables to be measured and devise a list of the specific behaviours to be observed and recorded.

In preparing their observation checklist, the researcher will determine whether, for example, aggression includes shouting or only physical contact and whether an accidental push or shove is to be recorded along with a deliberate push or shove. It is important to clearly define the characteristics of each behaviour so that observers all agree and can record the occurrence and frequency of these targeted behaviours.

Sometimes an observational study might resemble an experiment. For example, to investigate creative problem-solving processes in a group, a researcher might present a friendship group with a problem requiring its members to come up with as many uses for a house brick as they possibly can in 10 minutes. The researcher could then observe and record who suggests answers and how often; who records answers and how the recorder is selected; how correct and incorrect answers are dealt with; whether judgments about answers are immediate or postponed; who gives or doesn't give feedback; who stays on task; who is time-conscious, and so on.

The researcher might also observe problem-solving in a group comprising strangers in order to make comparisons with the friendship group. This study could occur in a controlled laboratory setting, or in a field setting such as a place where the group normally meets and interacts; for example, the school canteen or an area of the school grounds.

Although a particular observational study might use a between or within subjects design and all experiments actually involve observation of responses, an observational study is *not* a true experiment.

An observational study can reveal a relationship between two variables (e.g. group type and creative problem-solving), but only a true controlled experiment can establish a cause–effect relationship because there is an IV that is manipulated along with the use of random allocation and strict control of other variables that can impact on the results.

In an observational study, there may be naturally occurring variables of interest but the researcher passively observes the behaviour of the participants without any attempt at intervention or manipulation of the behaviours (APA, 2022).

Sampling observations

One of the difficulties in observing and recording ongoing target behaviour is that there can be so much of it and/or it may be occurring within the context of lots of other behaviour. The researcher must therefore also decide in advance whether to record all occurrences of the behaviour and when observations are actually made during the study. For example, three behaviour sampling decisions for an observational study may involve:

1. *event sampling*: The researcher decides to focus on one or more specific types of behaviour ('events') and record all occurrences. All other types of behaviour are ignored. For example, in a study of bullying in the school grounds, only those acts involving intentional physical contact initiated by the bully. In some studies where relevant, the researcher may also record the antecedent (actions immediately prior to the event) and/or the consequences (what happens immediately after the event).

2. *time sampling*: The researcher decides that observation will take place only during specified time periods (e.g. 1 minute every 5 minutes per hour, or 10 minutes every hour, 1 hour per day) and records the occurrence of the specified behaviour during that period only.
3. *individual sampling*: Rather than trying to record the behaviour of all individuals at once, the researcher decides to focus on observing one individual (or group) at a time while ignoring the behaviour of others during the time period. One individual may be randomly selected to be the focus of an observational period and all others are ignored during that period. Over the entire period of the study, however, each individual may be observed. And, when dealing with a group's behaviour, the researcher might observe the entire group all at once, or only one group member for a certain time, then observe another, and so on.

Key features of a structured observation

- The researcher has some degree of control over the setting in which the targeted behaviours occur
- The researcher selects which behaviours are of interest and which are not
- The researcher clearly defines the characteristics of each behaviour so that observers all agree on the classification
- Observers record the occurrence and frequency of these targeted behaviours

Source: American Psychological Association (2022). *APA dictionary of psychology.* Retrieved from https://dictionary.apa.org

1.7.1 Natural and contrived settings

Observations may be conducted within a participant's natural environment or in a contrived, 'unnatural' environment. In both settings, the researchers would passively wait for the target behaviour to occur voluntarily and to unfold as it usually does.

When observations are conducted within the participant's *natural* environment, the method is commonly called naturalistic observation. In **naturalistic observation**, the researcher watches and records behaviour in the natural, 'real-life' environment where it would ordinarily occur without manipulation of variables or other controls that occur in a laboratory setting. This is a situation where behaviour in its genuine form is most likely to be observed. In addition, the researcher conducts their observations in an inconspicuous or 'unnoticeable' manner so that their presence does not influence the behaviour of interest.

For example, in a study on the development of social behaviour, a researcher might observe children at play in a preschool centre's outside area at lunchtime. They would do so from the 'sidelines' so that the children are not aware that they are being observed to help ensure their presence does not interfere with the naturally occurring, voluntary play behaviour. The researcher may observe that younger children tend to play alongside other children but not actually interact with them, whereas older children tend to interact more in their play with other children.

On the basis of these observations, the researcher may assume that there are different types of play in which children may engage and that these types of play are age-related or age-dependent.

Similarly, a researcher studying how paramedics respond to traumatic events might observe paramedics in action by riding along with them on duty. In doing so, the researcher would be as unobtrusive as possible, trying to 'shadow' the paramedics as they respond to various types of trauma, communicating with them only when essential.

Generally, with this type of observational study, the researcher decides where the observations will take place, at what time, with which participants and in what circumstances. There may also be observations of different groups for which an IV may be present or absent.

A *contrived* environment is one that the researcher creates or sets up for the specific purpose of conducting an observational study. It is an artificial 'non-naturalistic', 'controlled' environment for the behaviour of interest and may be referred to as a *controlled, structured* or *laboratory* environment because of the degree of control the researcher has over it or where the observations are made. It may also be referred to as a *controlled observation* in contrast to a naturalistic observation.

For example, the researcher conducting the study on social behaviour may decide to observe children at play in a room set up for that purpose at a venue outside the preschool centre. Specific playthings may be made available and strategically located together with a table and chairs. Observations could then be made from behind a one-way mirror so that the children are not aware that they are being observed. The children's behaviour might also be video recorded so that researchers can also record observations to help ensure reliability of the data.

However, despite the use of such control over the environment and observational procedures, the researchers must still wait for the behaviours of interest to occur naturally.

Figure 1.41 (a) An observational study may be conducted in a natural, 'real-life' environment or (b) a formal contrived environment such as a formal laboratory setting.

1.7.2 Participant and non-participant observation

Sometimes, a researcher actually takes part in the activity being observed and may deliberately try to be mistaken by the participants as being part of the group or situation being observed. Therefore, a distinction is made between the participant and non-participant observation methods.

In **participant observation**, a trained investigator studies a pre-existing group by joining it as a member, while avoiding a conspicuous role that would change what occurs in the group and bias the data. The researcher's role may be known or unknown to the other members of the group (APA, 2022).

For example, in one well-known study that used participant observation, the researchers had themselves admitted to several different psychiatric hospitals by imitating the symptoms of schizophrenia. After they had been admitted, the fake patients took part in ward activities and spent time observing and writing notes about ward staff and how patients were treated. Their record-keeping behaviour was regarded by the hospital staff as being a symptom of their mental disorder. In all, they remained in hospital for 7 to 52 days (average 19 days) and were eventually discharged with a diagnosis of 'schizophrenia in remission' (Rosenhan, 1973).

When the researcher tries to conceal their presence so that their observations are made in entirely inconspicuous manner, it is commonly called **non-participant observation**. When observations of behaviour are made in the natural setting in which the target behaviour ordinarily occurs, psychologists will often conceal their presence by watching from the 'sidelines'.

For example, a researcher might sit on a park bench pretending to read a newspaper in order to observe the reactions of passers-by to a person who appears to be in need of help. On alternating occasions, the person is a male or female research assistant dressed in either a business suit or as a homeless person. Sex differences in helping responses are then recorded.

Similarly, a researcher interested in the use of specific 'body language' when reunited following a long-term separation may observe the non-verbal interactions of people being met by at the arrivals gate of the international terminal at an airport. They may attend the airport and position themselves where they can blend in with the crowd, concealing as best as possible what they are doing so as not to influence the target behaviour in any way. In other situations, psychologists might use a hidden video camera to record events.

Figure 1.42 The person on the right is a researcher engaging in non-participant observation for a study on conformity to norms. She is seated outside a mosque recording behavioural responses to a sign describing dress standards for tourists who wish to enter the mosque.

1.7.3 Advantages and limitations of observational studies

Each type of observational study is useful under different circumstances and has advantages and limitations depending on the specific procedures used, particularly the degree of structure in the data collection technique and the observational setting.

The main advantage of observational studies, especially naturalistic observation, is that researchers can watch and record spontaneous, everyday behaviour without the need for any manipulation or intervention.

When people are observed in this way, they are not influenced by perceptions that can form in artificial, contrived environments and lead them to behave differently from how they normally do. Sometimes, merely being present in an artificial or unfamiliar environment can cause an unnatural change in behaviour. This is more likely when the participant knows they are being observed.

Thus, naturalistic observation often enables researchers to gain more accurate information about the typical behaviours of people (and animals), both immediately and over a longer period, than do other research methods. When compared to research methods that involve asking people about their behaviour, the researcher can observe what people actually do (or say), rather than what they say they do.

In addition, structured observations through use of checklists and specific criteria enhance the accuracy of data collection and therefore the results obtained. This is a more likely outcome when the observational setting is strictly controlled, as in a contrived laboratory-type situation. Controlled observations in laboratory settings can also be more easily replicated by other researchers using the same procedures. This means that the reliability of results can be tested.

Another advantage of naturalistic observational studies is that some types of human behaviour can only be studied as they naturally occur because it would be unethical or impractical to study them in a laboratory setting. For example, it would be unethical to severely deprive children in their early life in order to observe the effect of deprivation on behaviour in the future.

Similarly, some behaviours cannot be realistically reproduced in a laboratory. A researcher cannot, for example, study most aspects of true crowd behaviour in a laboratory. Nor could a researcher expect to obtain valid information about how people usually behave when they are in love by bringing a pair of participants into a laboratory situation and asking them to 'be in love' so that observations can be made. However, since the observer does not directly influence the behaviour of interest in an unobtrusive observational study, it sometimes requires a lot of time and patience to wait for the target behaviour to occur. Consequently, some observational studies can be very time-consuming.

A practical advantage of naturalistic observation is that it does not require the co-operation of participants being observed. However, this raises the ethical issue of not obtaining informed consent, particularly if participant observation is required.

When participant observation is used without informed consent, a person's expectation of privacy can be violated. This issue has to be weighed up against the fact that the participants are not informed that they will be observed in some special way so that their observed behaviour is more likely to be true to life.

A limitation of any observational study, particularly when unstructured, is that it cannot be used to determine the *cause* of the behaviour of interest that is observed, because many factors may influence that behaviour and there is a lack of control of such variables. This is especially the case in a natural environment. For example, a researcher could not determine through observation alone *why* some children become aggressive towards others in the school yard.

The true factors that influence a particular behaviour could be ones of which the researcher is not immediately aware. Consequently, an observational study may reveal a relationship between variables, but not a cause–effect relationship as does an experiment.

In addition, naturalistic observation studies often lack a representative sample. For instance, they may be biased in relation to participant variables such as age, sex, cultural and socioeconomic background. This means that the results may not readily be generalised to a wider population. The lack of control over a wide range of potentially influential variables, including the field setting itself, makes it difficult for researchers to replicate the study to test the results.

A potential limitation of any observational study or technique is *observer bias*. It is possible, for example, that researchers sometimes unconsciously distort what they see so that it resembles what they hope to see, even when they are using structured formats. This is why researchers who collect the data are trained to observe and record accurately in order to minimise the influence of their personal biases. Furthermore, when recording participant responses or making detailed notes as part of the observation process, the researcher may neglect to record certain behaviours that they either judge to be irrelevant or do not actually see.

To overcome these limitations, researchers often use two or more observers for data collection and check for inter-rater ('inter-observer') consistency. This procedure usually results in a more complete and accurate set of data than one observer could obtain alone.

Figure 1.43 A limitation of observational studies is that participants may not behave as they typically do when they know they are being observed.

1.7 LEARNING ACTIVITY 1

Review

1. Define the meaning of observational study.
2. Distinguish between each of the following:
   a. a naturalistic and a controlled observational study
   b. structured and unstructured observations
   c. event sampling and time sampling
   d. participant and non-participant observations.
3. a. Give an example of a possible naturalistic observational study with a between subjects design, other than one used in the text.
   b. Explain why this study would not be considered to be a true experiment.
4. a. Suggest an example of an observational study with a non-experimental between subjects design, but not an example used in the text.
   b. Explain why this study would be considered a quasi-experiment.
5. Explain the meaning of observer bias and how it could be controlled.
6. Are naturalistic observations of people without obtaining their informed consent ethically acceptable? Explain your answer.

7. Give two advantages and two limitations of observational studies.
8. To what extent do reality TV programs such as *Married at First Sight, Real Housewives* and *Survivor* produce authentic human behaviour? Explain with reference to an example of a program and design features of observational studies that could help ensure 'normal' behaviour is more likely to be recorded.
9. Complete the following table to analyse different observational studies.

Observational study	Structured vs Unstructured	Naturalistic vs Contrived setting	Participant vs Non-participant
(a) A teacher concerned about the unsafe behaviour of students at the school's bus stop at the end of the school day organises an observational study. Observations will be made from a nearby classroom with reference to a checklist.			
(b) Trainee counsellors will be assessed while they conduct consultations with each other, taking turns to be the counsellor then the client. All assessments will be conducted in a room at the university set up for that purpose. The course leader will video record each session and a criteria sheet will be used to guide feedback to trainees.			
(c) The captain of the school's senior hockey team will analyse the players' communication styles during an upcoming match.			
(d) A researcher will record the number of drivers who obey a give way sign at a roundabout.			
(e) Researchers will compare the behaviour of AFL football spectators who sit behind the goals with those who sit in a grandstand. Observations will target the number of comments directed at umpires and players (but not the content).			
(f) A VCE student is planning to conduct an observational study in a shopping mall to find out whether people look at their own reflections or avoid doing so when walking past a large department store. Sex differences will be recorded using a 3-point rating scale based on 'Yes', 'No' and 'Not sure'.			
(g) A VCE student is planning to conduct an observational study at school to find out whether junior school students are more disruptive with a replacement teacher. There will be two observation sessions conducted in the same period, in the same classroom, on the same day across two weeks. In week 1, the student will observe a Year 7 Maths class from a storeroom when taught by their usual teacher. Only six of the students will be observed — two seated mid-front row, two mid-middle row and two mid-back row. In week 2, the student will observe students in the same class, seated in the same positions, but when taught by a replacement teacher who has never previously been at the school. Disruptive behaviour has been operationalised to enable development of observation criteria.			

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

1.7 LEARNING ACTIVITY 2

Multiple-choice questions

1. A researcher observes and records unsafe behaviours by students at the school's bus stop with reference to a checklist whilst seated in a car parked nearby.
   This investigation may be described as a _____ observational study in a _____ setting.
   A. participant; contrived
   B. participant; naturalistic
   C. non-participant; contrived
   D. non-participant; naturalistic
2. A researcher acting as a passenger observes and records how many school students on a crowded train stand and offer their seat to an elderly passenger.
   This investigation may be described as a _____ observational study in a _____ setting.
   A. participant; contrived
   B. participant; naturalistic
   C. non-participant; contrived
   D. non-participant; naturalistic
3. A researcher acting as a passenger observes and records the behaviour of other passengers on a train when an adult female appears to have a panic attack compared to an adult male.
   This investigation may be described as a/an
   A. experiment using an observation technique in a contrived setting.
   B. experiment using an observation technique in a naturalistic setting.
   C. participant observational study in a naturalistic setting.
   D. non-participant observational study in a contrived setting.
4. A researcher observes and records the behaviour of participants when alone, while smoke gradually fills the room, compared with when other people are present in the room. Observations are made from an adjacent room with a two-way mirror.
   This investigation may be described as a/an
   A. experiment using an observation technique in a contrived setting.
   B. experiment using an observation technique in a naturalistic setting.
   C. participant observational study in a naturalistic setting.
   D. non-participant observational study in a contrived setting.
5. *Source: VCAA 2003 Psychology 2, Section A, Q.31; © VCAA*

   In which of the following types of research study does the experimenter have the most control over the participants?
   A. in-depth interview
   B. correlational study
   C. non-experimental study
   D. naturalistic observation

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

1.7 LEARNING ACTIVITY 3

Analysis and evaluation of research

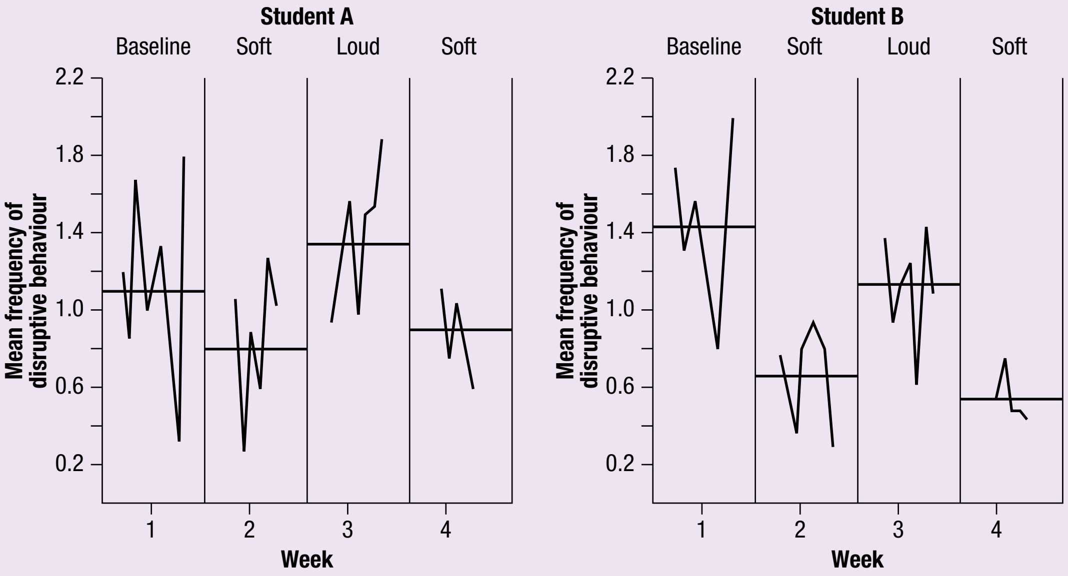
A researcher conducted an observational study to test the effectiveness of different types of reprimands when dealing with disruptive students. On the basis of observations from an earlier study, it was expected that giving soft reprimands to disruptive students would have a greater effect than loud reprimands.

Two disruptive students in a year 3 class at a local primary school were observed for a 20-minute period during an arithmetic lesson each day for 4 weeks by two trained observers who sat at the back of the classroom and were as unobtrusive as possible. The observers followed a schedule of observing for 20 seconds then recording for 10 seconds using a checklist with eight types of disruptive behaviour, including whether the student was out of their chair, noisy, communicating with another student, interfering with another student's property, or being aggressive.

There were four phases of the study:

1. Baseline: Measurements of disruptive behaviour before any treatment intervention is introduced. The teacher used their normal loud or soft reprimands; however, it was found that the teacher predominantly used loud reprimands throughout this period.
2. Soft: The teacher used soft, 'private' reprimands so that only the student being reprimanded could hear; soft reprimands were used with all students, not just the target students being observed.
3. Loud: The teacher used loud, 'public' reprimands that could be heard by all students; loud reprimands were used with all students, not just the target students.
4. Soft: The teacher used once again used soft, 'private' reprimands.

   The results are shown below.



a. Formulate a research hypothesis that would be supported by the results obtained for the study.
b. Give an advantage and a limitation of the sampling technique used for this particular study.
c. Explain whether the event sampling or time sampling procedure was used for this particular study.
d. What was the purpose of the baseline measurements?
e. Is the study best described as structured, unstructured or semi-structured?
f. Does the study use participant observation, non-participant observation, or both?
g. Explain whether the study can be described as a naturalistic observation study.
h. Identify the independent and dependent variables in the study.
i. Suggest a single, relevant title for the series of graphs showing the results.
j. What do the results show?
k. What conclusion can be drawn from the results?
l. To what extent can the results be generalised?

To answer questions online and receive immediate feedback, access learnON at www.jacplus.com.au.

1.8 Case studies

Sometimes a researcher will collect detailed information on only a small number of people, perhaps an individual or a small group of two or three. A researcher may also choose to focus on a particular activity or event, possibly involving an organisation or some other setting. When any of these are done, the researcher is likely to be conducting a case study.

A **case study** is an intensive, in-depth investigation of some behaviour, activity, event or problem of interest in a single individual, group, organisation or situation. In psychology, the 'case' that is the subject of 'study' is usually a person. It may involve any type of behaviour and/or mental process, over a short period of time or even many years.

Case studies for scientific research purposes are often used when large numbers of participants are not available for an investigation; for example, to study a single individual with a rare or unusual disorder or ability. Such a case study may involve a combination of different data collection methods.

For example, an individual may be interviewed at length. Information may also be collected through interviews of family members, friends and teachers or coworkers. The individual's medical records and school reports may also be considered. Other sources of information can include extensive psychological testing and observations of the person's behaviour. The research may also continue for an extended period of time so that processes and developments can be studied as they take place.

Case studies have played an important role in psychology. For example, many of the early language researchers started out by keeping detailed diaries on the language development of only a few individual children. Some gained valuable insights by recording the vocalisations and speech of their own children over time. Psychologists have learnt about memory from studying rare individuals who can retain enormous amounts of information and some who can remember little. Child prodigies, chess masters and other gifted or extremely talented individuals have been studied to gain insights into mental capabilities. Ideas about effective leadership have been picked up by analysing biographies of great leaders.

Psychologists have also learnt about behaviour in small friendship groups by conducting case studies in which they observe and record social interactions within the same group of people in different situations over a period of time. An assumption is that patterns of behaviour observed within the group may apply to other friendship groups made up of people of similar ages and backgrounds. Such case studies can also suggest hypotheses that could be tested using other research methods.

Theories in psychology have also evolved from case studies. For example, Sigmund Freud (1856–1939) used case studies of his patients who sought his help with mental health problems to clarify his understanding of the origins of certain mental disorders. He also based his theories of personality development on these case studies. As new evidence came to him from his patients, he expanded and revised his theories.

Much of what is known about the role of the brain in behaviour and mental processes has also come from case studies. Intensive study of individuals with different types of brain injuries has made it

Table 1.5 Examples of case studies

Person	The study of a single individual, compiling information from a variety of sources
Group	The study of a single distinctive set of people, such as a family or small group of friends or decision-making group
Organisation	The study of a single organisation or company and the way that people act within it
Activity	The study of the creative thinking process in a group
Problem	The study of why a particular individual 'trolls' others on social media or why a specific group choose to not get vaccinated.
Event	The study of a particular social or cultural event and the interpretations of that event by those participating in it
Location	The study of a particular place and the way that it is used or regarded by people

possible for researchers to gain detailed, valuable information about the role of the brain in all sorts of behaviour and mental processes – speech production and comprehension, states of consciousness, learning, memory, and so on.

One of the most influential case studies of an individual with a brain injury is that of Henry Molaison, whose brain injury was intentionally caused through surgery. In 1953, when Molaison was 27 years old, he agreed to brain surgery to treat the debilitating epilepsy from which he had been suffering since the age of 10. As Molaison's seizures were so severe, and because their precise origin could not be determined, his neurosurgeon decided to remove over 5 centimetres of tissue from each temporal lobe, including about two-thirds of each hippocampus, most of each amygdala, and adjacent cerebral cortex from around the hippocampus and amygdala.

Medically, the surgery was successful in terms of its goals. However, he was left with permanent memory impairments. For example, Molaison could no longer remember what he had eaten for breakfast when asked shortly afterward, and he had to be reintroduced to his doctors every time he visited them, including his neuropsychologist who tested him regularly for some 50 years. Importantly, Molaison's case study provided important, long-standing evidence for the crucial roles of various brain structures and areas in memory processes, particularly the role of the hippocampus in long-term memory formation.

Clinical psychologists who treat people with mental health problems and disorders routinely conduct case studies involving their clients. However, this research is usually for diagnostic and treatment goals (rather than for scientific research purposes). Therefore, when used in a clinical setting for therapeutic reasons, a case study is often referred to as a *case history* or a *clinical observation*.

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learnMORE | A case study of an individual diagnosed with Anton's syndrome

Access learnON to read a description of case study research in the late nineteenth century that led to the identification of a rare disorder involving blindness without any awareness of being blind.

Figure 1.44 Henry Molaison (1926–2008), whose case study of memory impairments associated with brain injury provided important evidence for the crucial roles of various brain structures and areas in memory processes.

1.8.1 Advantages and limitations of case studies

Case studies provide a useful way of obtaining detailed information on behaviour and mental processes. In particular, they often permit investigation of otherwise impractical (or unethical) situations such as when a large number of people with an unusual condition cannot be accessed. Their depth of analysis and the richness of the data are commonly described as their main advantage (or 'strength').

With case studies, there is usually no manipulation or control of variables, as with research conducted under strictly controlled experimental conditions (unless an experiment is used to collect some of the case study data). Consequently, case studies can avoid artificiality and provide a 'snapshot' of the actual or real-life experience of one or more individuals at a particular time in a particular situation.

Case studies are, however, not only useful for a 'snapshot'. They can be conducted over a prolonged period, even many years where relevant and practical to do so, and may therefore also be useful for tracking and describing experiences and change over time.

Case studies can also provide insights into how others may think, feel or behave under similar circumstances, especially when information from different case studies on the same topic or research question is compiled and knit together to help identify a general pattern or trend in the results.

Another advantage of case studies is that they can be a valuable source of hypotheses for further research or for data to support theory building or challenge a theory's assumptions.

A major limitation of case studies is that they cannot test or establish a cause–effect relationship as does a controlled experiment. Some experiments involve a person as the sole participant. However, a case study cannot be considered to be a single participant experiment because the method does not actually involve manipulation of any independent variable.

Their small sample size is another limitation. By their very nature, case studies usually focus on rare or unusual individuals, groups, events, problems or situations. This means that the sample is often a 'convenience sample' (rather than a random sample) and limited to a size of one. The results for such a sample can usually provide only very tentative and limited support for drawing conclusions.

Nor can generalisation of the results to others in a relevant population be done with any certainty. Generalising is a bigger problem when the case study involves a rare or unusual disorder or ability. Because the mental experiences, processes or behaviours of such individuals (or groups) are 'extraordinary', they may not reflect typical ways of thinking, feeling or behaving. Similarly an activity, problem or event that is the focus of the case study may be a 'one-off' involving one or more people who happen to assemble at that time and place Therefore, the researcher can never be fully confident that the conclusions drawn from their study are representative of similar instances within the wider population or apply elsewhere over time. In addition, if a case study uses a rare or unusual sample this means that it often cannot be replicated to test the reliability of the results in the way that an experiment can.

Case studies also have other limitations. Because of the very detailed and comprehensive data usually obtained, the process of analysing, summarising and reporting these data can be painstaking and time-consuming.

In addition, case studies are often susceptible to biased information from the participants or the researcher. This can influence the accuracy of the information that is obtained and conclusions that may be drawn.

For example, case studies usually rely on the individuals under investigation to provide a great deal of the required information. Some participants may not remember clearly what they actually experienced, or they may intentionally change or omit information that they do not wish to reveal for personal reasons.

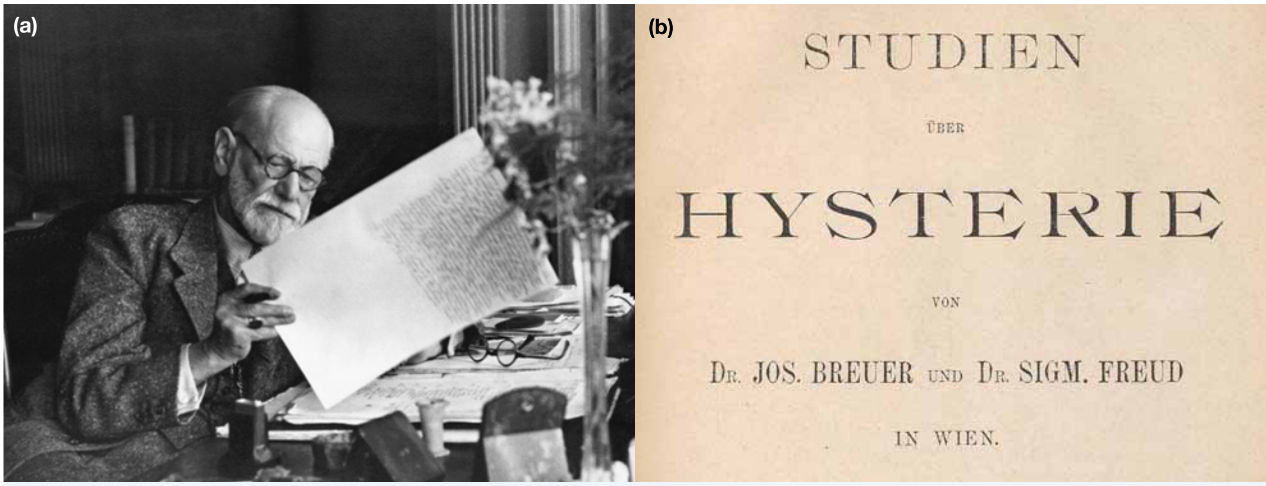

Figure 1.45 (a) Sigmund Freud (1856–1939) developed his psychoanalytic theories mainly from case studies of patients who sought his help with mental health problems they were experiencing. (b) The title page of Freud's case studies publication (1895) in which he and a colleague documented five cases of females with 'hysteria' — a condition in which memories of unresolved psychologically traumatic experiences are converted into diagnosable physical symptoms.

Similarly, case studies are usually conducted by one researcher and are vulnerable to their bias. For example, it is possible that the researcher may see or hear what they expect or hope to see or hear. Furthermore, the researcher is also responsible for deciding what to include in their descriptions and what to leave out. In writing a report on the case, the researcher may select information that supports key points or conclusions they wish to make and omit other points that may be just as relevant and could have been included by another researcher interpreting the same information.

A case study may be an option when a large number of participants is not available. For example, eccentric behaviour has been investigated using the case study method. Eccentric behaviour refers to a pattern of human behaviour that is viewed as very odd or unusual without appearing to be maladaptive in the particular society or culture where it occurs. Researchers have found that despite their typically non-conforming behaviour, most eccentrics tend to be happy, well-adjusted people who are 'strange but sane' (Weeks & James, 1995).

1.8 LEARNING ACTIVITY 1

Review

1. List three key features that distinguish a case study from other research methods.
2. Suggest an example of an experiment that could be conducted as part of a case study.
3. There is an issue of productivity on a factory assembly line and the case study method will be used to collect and analyse detailed information to help understand the issue.
   List five items of information that could be collected for the case study.
4. a. Describe two advantages and two limitations of case studies when used for research purposes.
   b. What is a potential limitation of a case study conducted over a prolonged period of time, but other than a limitation referred to in part a?

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1.8 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2014 Psychology, Section A, Q.29 (adapted); © VCAA

Fraser hit his head playing hockey and found he was unable to remember the events leading up to the hockey game. Fraser was asked by the hospital to take part in a case study to examine the effects of his injury on the functioning of his brain.

In this situation, a case study would be useful because

A. a case study uses only non-harmful techniques to study the brain.
B. case studies could provide ideas for further research into brain injuries.
C. a case study is a useful experimental method that collects rich, detailed data.
D. results from Fraser's case study could be generalised to other patients with different brain injuries.

Question 2 (1 mark)

Source: VCAA 2012 Psychology 1, Section A, Q.32 (adapted); © VCAA

A patient was about to have brain surgery. The patient gave informed consent to participate in a study using direct brain stimulation.

The study involving direct brain stimulation is an example of

A. a case study.
B. an observational study
C. a self-report study.
D. an experiment using the observational technique.

Question 3 (1 mark)

Source: VCAA 2010 Psychology 1, Section A, Q.7 (adapted); © VCAA

A researcher was interested in the possible link between brain tumours and depression in elderly patients. She conducted an intensive study of six individual patients in a hospital using diagnostic tests, patients' interviews, and examination of the patients' medical records.

One limitation of this method for her research is that

A. the research does not enable strict control of all variables.
B. the reliance on patients' reports will not produce very detailed information.
C. the patients cannot be randomly allocated to the control and experimental groups.
D. it is too easy to generalise the results of this type of research.

Question 4 (1 mark)

Source: VCAA 2009 Psychology 1, Section A, Q.16 (adapted); © VCAA

Which of the following statements about case studies is the most correct?

A. Case studies can provide ideas for further research.
B. A case study is a useful experimental method.
C. A case study can only use one human participant.
D. Results from a case study are able to be generalised in most situations.

Question 5 (2 marks)

Source: VCAA 2008 Psychology 1, Section B, Q.3; © VCAA

Case studies are an important research tool used to study the brain. However, case studies lack control over variables.

In terms of research,

a. why can the lack of control over variables be considered a limitation? 1 mark
b. how can the findings from a case study be useful? 1 mark

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1.9 Simulation studies

Sometimes a researcher cannot gain access to a particular setting or environment to conduct their investigation. For example, a researcher may be interested in decision-making processes used by jurors as they serve in actual cases. Undoubtedly, the researcher would not be legally permitted to enter the court room in which a jury is deliberating to observe how they decide whether the person standing trial is guilty, let alone to conduct a controlled experiment.

At other times, it may be too risky or dangerous to conduct an experiment with participants in certain settings and would therefore not be ethically permissible. For example, an experimenter interested in studying the effect of inattention among interstate truck drivers travelling long distances or by pilots during take off and landing would not be able to conduct such experiments in the real world.

In these cases, the researcher may conduct a simulation study. **Simulation studies** involve reproducing situations of research interest in a realistic way to investigate the behaviour and/or mental processes of individuals in that environment.

Generally, the situation is set up in way that is as similar as possible to that in the real world in terms of all the important features. Participants are then asked to behave 'as if' they were in the setting of interest. They usually pretend that they actually are in that situation and role play how they would behave so that the researcher can observe their behaviour and/or have them describe how they would behave. Because the situation is not real, physical or psychological harm is unlikely, which helps overcome ethical issues as well as the access problem.

A simulation is often an imitation of a real event in a real environment. With psychological investigations, it often takes the form of a controlled presentation in a setting that can't reasonably be experienced by a participant in a real-world environment.

One of the best-known simulation studies is the 'Stanford Prison Experiment' conducted in the 1970s. In this investigation, participants were randomly assigned to play the role of either a prisoner or prison guard in a mock prison. Those assigned as prisoners were arrested at their homes by, taken to the prison, issued prisoner clothing and put in cells. The participants who became guards were given uniforms and clubs. Many 'guards' took their roles so seriously that the experiment was cancelled after a few days because of the psychological trauma experienced by 'prisoners'.

Many simulation studies take advantage of existing technology to recreate the required environment. For example, simulators may be used to conduct the potentially dangerous research with truck drivers and pilots referred to previously. These devices resemble the environment of the actual operating situation and replicate the actual equipment used, such as steering wheels, brakes and flight controls.

Experiments in simulators are also suited to data collection using physiological measures such as heart and breathing rates, reaction times via button presses, brain wave activity via sensors and even eye movements to track what participants are actually looking at.

Importantly, the participant experience is safe within the simulated environment. Furthermore, such simulations allow researchers to not only test responses in settings that are dangerous, it also allows researchers to precisely replicate them. For example, they can assess how different drivers or pilots react to the same dangerous setting time and time again.

Through the development of virtual reality technology, it's now also possible to create almost any type of experience within any type of environment. And many simulation studies using simulators are not merely confined to dangerous events and settings.

For example, to assess risk factors for problem gambling, the researcher may simulate money-free gambling in a pokie venue or casino. Or, to study helping behaviour, participants placed in virtual reality environments may actually see and engage in all kinds of scenarios in which they may decide to help or not help someone. They may, for example, be placed among a group of bystanders so a researcher may investigate whether the size of a crowd that is watching street violence impacts on the likelihood of intervening to stop it. This is not a situation that would be set up in the real world for research purposes.

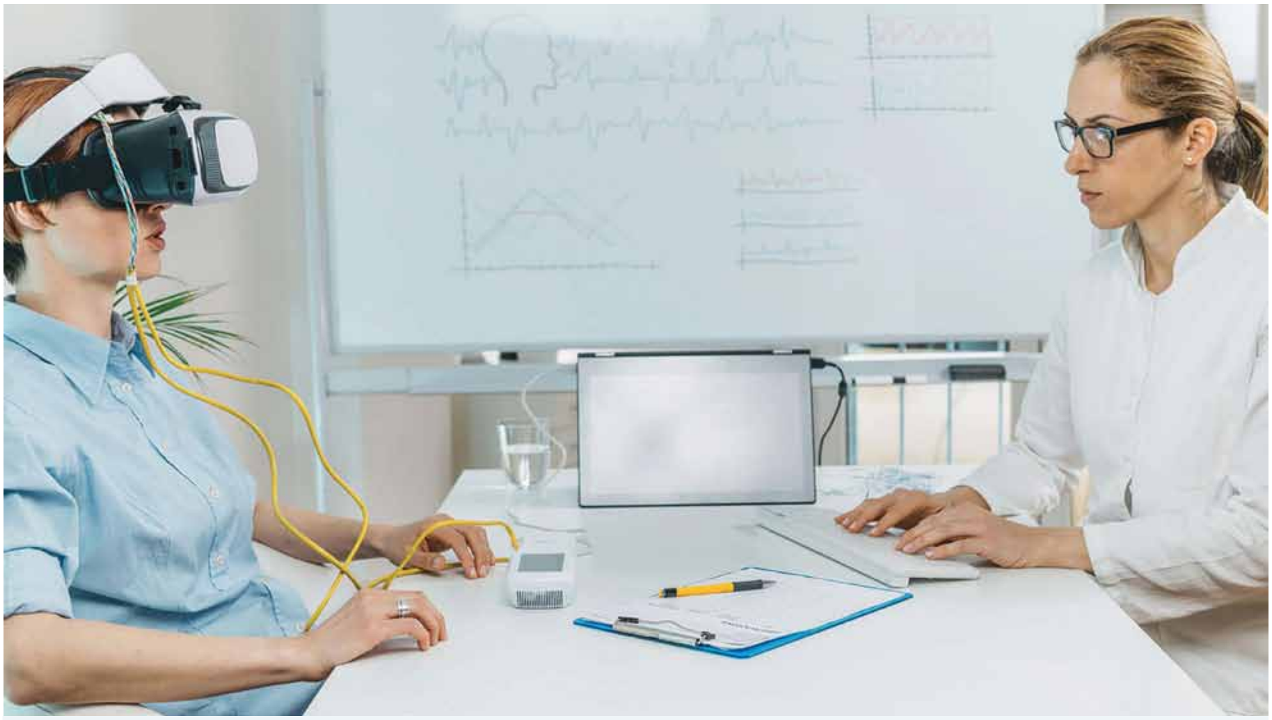

Figure 1.46 Virtual reality is increasingly used for simulation studies in psychology. It's now possible to create almost any type of experience within any type of environment. This researcher is studying voluntary control of physiological responses to anxiety when exposed to a virtual stressor presented in a simulated environment where the stressor may be encountered.

Similarly, psychologists have studied mental processing and behaviour of burglars during robberies in homes that have been created using digital technologies. The controversial experiment on obedience to authority conducted in the 1960s by Stanley Milgram has also been recreated in an immersive, computer-generated virtual environment (Slater et al., 2006). In Milgram's experiment (1963), participants recruited through a newspaper ad obeyed the orders of an authority figure to cause pain to a stranger, sometimes to even administer what they believed was a lethal electric shock.

1.9.1 Advantages and limitations of simulation studies

An advantage of simulation studies is that they can be used to conduct experiments in social and other environments which investigators cannot easily access. This is achieved by reproducing those environments in a realistic way.

Simulation can also be used when an investigation is not ethically permissible; for example, when the environment or conditions of research interest are unsafe and therefore potentially harmful to participants.

Basically, a simulation study can be a suitable alternative when the real environment is not available or possible. This enables psychological investigations of many important research questions that would not be ordinarily possible.

Simulation studies using simulators or other technologies are not only confined to dangerous events and settings. The diversity of research questions that can be investigated means that they can be a valuable source of hypotheses for further research or for data to support or challenge a theory or model.

When a simulator and/or computer assisted technology is used, this may also be a time- and cost-effective alternative for researchers. Greater experimental control can also be used in these situations and a wider range of data may be collected relatively easily. The capability of reproducing an identical environment whenever needed also supports replication of experiments to test the results.

A significant limitation of simulation studies is that simulation environments are artificial and therefore the studies may lack realism. In particular, participants know that the environment they are in is fake. Therefore, they may behave differently than they would in that situation in reality. Even asking participants in a simulated environment what they think they would do often does not reflect what they actually do.

In turn, despite their strict control of situational variables, artificiality makes it difficult to generalise the results of many simulated studies to the population or other situations of research interest.

Although the development of virtual reality technology has broadened the scope of what can be studied through simulation, it's artificiality can be difficult to avoid. For example, it is unlikely that conditions such as those in the Milgram experiment can actually be exactly replicated in virtual reality since the participants will always know that the situation is unreal.

And, if eventually the experience of virtual reality became so indistinguishable from reality that the participants are unable to tell the difference between the two, then the ethics issue that led to the use of virtual reality would arise again (Slater et al., 2006).

Despite their limitations, simulation studies have provided valuable insights into a wide range of behaviour and mental processes within environments that otherwise would have been inaccessible.

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1.9 LEARNING ACTIVITY 1

Review

1. Define the meaning of simulation study.
2. Give an example of a simulation study in psychology of interest to you that is not described in the text.
3. Describe two advantages and two limitations of simulation studies when used for research purposes.

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1.9 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.46 (adapted); © VCAA

Ekon wants to join his local emergency volunteer group. The volunteer group has identified five risk factors that could potentially impair a volunteer's social and emotional wellbeing while they are in the role. Using an online questionnaire, Ekon rates himself against each of the factors on a rating of 1–10, with 1 indicating low risk and 10 indicating high risk.

The type of research method used in this scenario was a/an

A. interview.
B. self-report.
C. focus group.
D. online experiment.

Question 2 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.61 (adapted); © VCAA

When investigating naturally occurring behaviour, an advantage of using observational studies as a data collection technique is that

A. compared with experiments, observational studies do not require controlled variables.
B. unlike self-report methods, standardised procedures are not required in observational studies.
C. similarly to experiments, it is possible to control all variables in observational studies.
D. compared with case studies, experimental and control groups are not needed in observational studies.

Question 3 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.39 (adapted); © VCAA

Dr Rajesh is researching localisation of function in the brain. She asks Peter, one of her stroke patients, to undertake a series of tasks so she can observe the possible changes in localisation of function as a result of his stroke.

An advantage of this particular type of study is that

A. the results are easily generalised.
B. it produces highly detailed results.
C. all unwanted variables are easily controlled.
D. conclusions can be drawn about the effect of the independent variable on the dependent variable.

Question 4 (1 mark)

Source: VCAA 2004 Psychology, Section A, Q.38 (adapted) © VCAA

A study looking at sex differences in attitudes towards gun control

A. could use a within subjects design.
B. could not use an independent samples design.
C. could use a self-report design.
D. could not use a stratified sampling design.

Question 5 (1 mark)

Source: VCAA 2004 Psychology 2, Section A, Q.44 (adapted); © VCAA

Professor Von Trapp is studying how the length of time that a stimulus is exposed to a participant affects the participant's ability to recall the shape of the stimulus. She recruits 30 first-year university students, 15 male and 15 female. Each participant is presented with three sets of 10 shapes, which are exposed for: four seconds for the first set of 10 shapes, two seconds for the second set of 10 shapes and one second for the third set of 10 shapes. She then asks each participant to perform a memory recognition task for 50 different shapes, the 30 shapes previously seen and 20 distracters.

What research design was used in the professor's study?

A. within subjects
B. mixed design
C. between subjects
D. correlational

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1.9 LEARNING ACTIVITY 3

Review

For each aim, decide which research method(s) — controlled experiment, correlational study, observational study, interview/questionnaire, case study or simulation study — would be the most appropriate for the investigation that would be conducted and briefly explain why.

a. To determine whether people learn better in noisy conditions or quiet conditions by testing the effect of noise on memory.
b. To find out if healthcare workers were left feeling isolated and under-appreciated during the covid pandemic.
c. To find out whether adolescent males and females have different preferences for social media apps.
d. To describe how young adolescents behave with their partner at the school formal.
e. To determine why a father gave up his successful career and role swapped with his wife so he could spend time at home with his first newborn.
f. To compare the behaviour patterns of anaesthetists during a routine and critical incident in the operating theatre.
g. To investigate whether VCE practice exam results and actual exam results are associated.
h. To compare sleep quality of adolescents who jog regularly and those who do not jog at all.
i. To compare how males and females react in an emergency when their safety and wellbeing are threatened.
j. To find out how students react when someone invades their personal space in a public setting.
k. To measure the relationship between scores on a job interview and level of performance in that job.
l. To find out if melatonin pills improve sleep quantity and quality.

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1.10 Sources of error and their control or minimisation

Scientific research helps ensure that the data collected are accurate and reliable and that the conclusions drawn from the data are justifiable and can be trusted. Scientific research, however, is not completely free from error. Errors can creep in at any stage of an investigation. For instance, the researcher may not properly control or minimise the influence of all things that can impact on the results. It is therefore important to take into account potential errors when planning and conducting an investigation and when evaluating the data that are collected.

1.10.1 Random and systematic errors

Generally, there are two types of errors of particular concern to researchers when conducting an experiment and measuring participant responses on the dependent variable. These are called random and systematic errors.

Random errors are errors due to some chance factor or chance variation in a measurement (so they are also called *chance errors*). Random errors occur arbitrarily or indiscriminately when unknown or uncontrolled factors affect the measurement process or variable being measured.

They affect the *precision* of a measurement and are present in all measurements, except for measurements involving counting.

For example, consider all the things that might affect each individual participant's performance on a memory task in an experiment — their upbringing, how they go about learning and committing new information to memory, their personality type, health, motivation, mood, alertness, and so on. Perhaps one participant presents feeling ill, another arrives after an argument with their partner, another skipped breakfast and is hungry and another has to leave early for an appointment.

The list is almost endless when human participation is involved. Any one of these can affect performance on the dependent variable and produce a random error. Similarly, there may be an unexpected disturbance in the experimental setting that impacts on measurement of the DV for some of the participants.

Although specific random errors may be unknown and therefore unpredictable, the researcher needs to be aware of their potential occurrence and influence. Random errors may change the measurements and therefore results obtained in either of two directions — positively or negatively.

Many random errors cannot be eliminated but their influence can be controlled or minimised. For example, participant differences in an experiment may be cancelled out through random allocation to different conditions.

Random errors affect the precision of a measurement, whereas systematic errors affect the *accuracy* of a measurement.

Systematic errors are produced by some factor that consistently favours one condition rather than another (so they are also called *constant errors*). They are typically associated with a flaw in some aspect of the research design, its procedures or implementation, like an inbuilt fault.

For example, it could be a sampling error that has introduced sample bias favouring specially motivated participants, a faulty measuring instrument that repeatedly gives out the same false reading each time, or an uncontrolled order effect that has occurred because the order in which all testing is carried out consistently favours one group of participants rather than the other.

Unlike random errors, systematic errors affect all measurements in the same way so that the errors are always in the one direction — either positive or negative — and do not cancel out. Furthermore, unlike random errors that may remain unknown, most systematic errors are foreseeable and therefore a preventable source of bias. However, they can often be detected and corrected for during statistical analysis of the results.

In relation to measurement results, random errors are evident when the degree of error *varies* each time and systematic errors are evident when the measurement has the *same* degree of error each time.

For example, suppose you are conducting an investigation requiring measurements of participant reaction times. You use a stopwatch to time the same participant 5 times but overestimate or underestimate the reaction time on each trial because of the variation in the speed with which you press the start and stop button. That would be considered a random error because the value of the measurement error differs each time. But if your stopwatch had a bug so that it always overstated the reaction time by say 1 second, that would be considered a systematic error because the amount of error introduced into each measurement is constant. Similarly, a scale that repeatedly provides readings 0.5 g lower than the true weight would be demonstrating systematic error.

Of course, measurement tools or instruments (i.e. ‘measures’) that may be used in psychology, and therefore a potential source of measurement error, are not confined to stop watches and weight scales. They include questionnaires, interviews, aptitude tests, ability tests, intelligence tests, personality tests and measures or data collection tools for a virtually endless list of human behaviours and mental processes.

Since random and systematic errors occur with variables that are being measured, they need to be considered when evaluating the data that are collected. For example, random errors reduce both the consistency (reliability) and the accuracy (validity) of measurements or results; whereas systematic errors reduce accuracy (validity) but not consistency (reliability) as the error is always in the same direction (i.e. consistently too high or too low).

The effect of random errors can be reduced by making more or repeated measurements and calculating a new mean and/or by refining the measurement method or technique. However, the accuracy of measurements due to systematic errors cannot be improved by repeating those measurements (because they are due to some kind of flaw in the research design or measurement technique that was used).

Random and systematic errors are different from personal errors. **Personal errors** are faults entirely

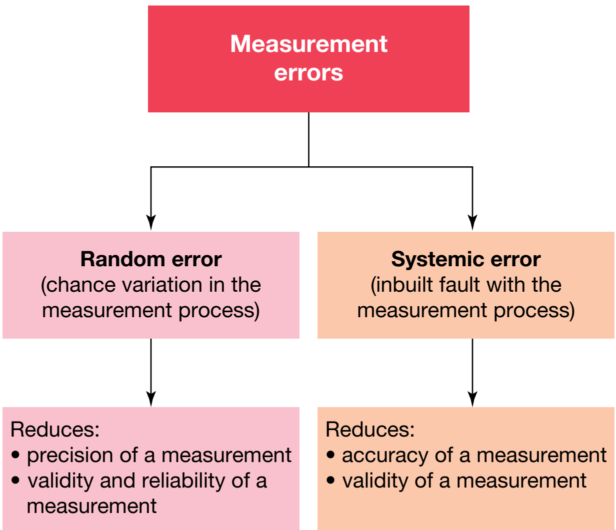

Figure 1.47 The two types of measurement errors when making observations to measure responses for the DV

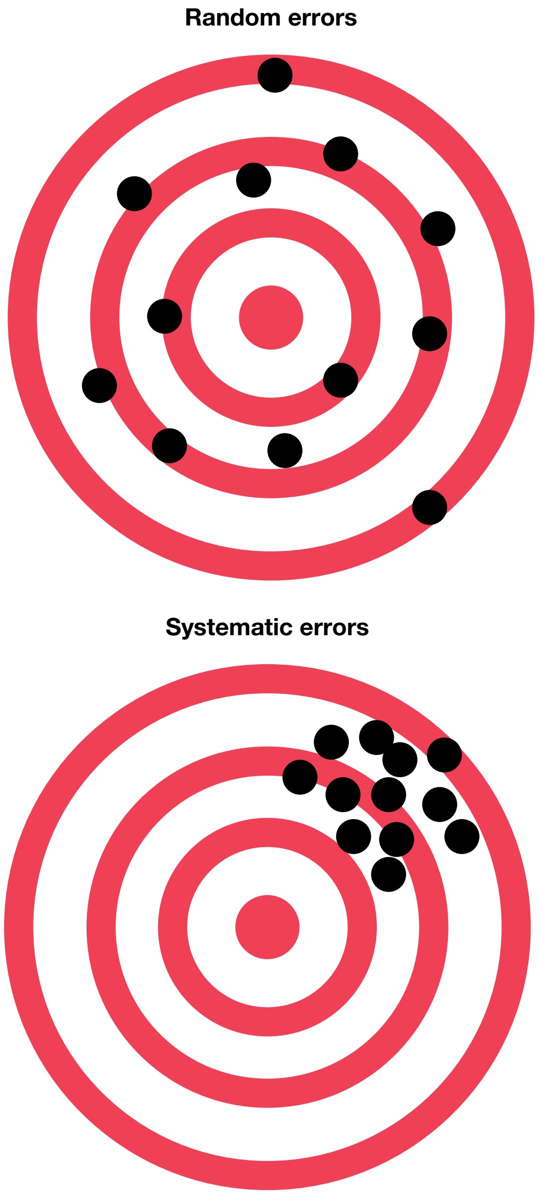

Figure 1.48 A comparison of the effects of random and systematic errors when target shooting. With random errors, the shots are both inaccurate and inconsistent because they all miss the centre of the target in various directions away from the centre. With systematic errors, the shots are inaccurate but consistent because they repeatedly miss the centre and do so in the same direction.

sourced with the researcher, which is why they are also called *human errors*.

Personal errors include mistakes, miscalculations, slip-ups and observer errors; for example, overlooking a participant's response, losing a questionnaire, using an early draft of a questionnaire instead of the final version, calculating incorrectly, misreading a score, using the wrong formula to calculate a score, running late or out of time, not taking enough care when making or recording observations, and so on.

Random and systematic errors are discussed in the report on the research, whereas personal errors are not.

Data and measurement — uncertainty, accuracy and precision

It is important not to confuse the terms 'error' and 'uncertainty', which are not synonyms.

The **uncertainty** of the result of a measurement reflects the lack of exact knowledge of the value of the quantity being measured. VCE Psychology requires only a qualitative treatment of uncertainty (no calculations). When evaluating personally sourced or provided data, students should be able to identify contradictory (incorrect data) and incomplete data (missing data-questions without answers or variables without observations), including possible sources of bias.

When analysing and discussing investigations, accuracy and precision also need to be considered. Accuracy and precision are closely related, but not the same. Accuracy describes how close measurements are to a specific value, while precision describes how close the measurements are to each other.

- **Accuracy**: The accuracy of a measurement relates to how close it is to the true value of the quantity being measured. Accuracy is not quantifiable; measurement values may be described as being more accurate or less accurate.
- **Precision**: Refers to how closely a set of measurement values agree with each other. Precision gives no indication of how close the measurements are to the true value and is therefore a separate consideration to accuracy.

Source: *VCE Psychology Study Design (2023–2027)*, pp.19, 21.

1.10 LEARNING ACTIVITY 1

Review

1. Complete the following table to compare the two types of measurement error according to the criteria in the first column.

Criteria	Random error	Systematic error
a. Source of error		
b. Example of error type		
c. Direction of error		
d. Variability in degree or value of the error		
e. Preventability of error		
f. Predictability of error		
g. Effect of error on DV		
h. Effect of error on accuracy (validity) of results		
i. Effect of error on consistency (reliability) of results		
j. Improvement of accuracy by repeating measurements		
k. How to eliminate, control or minimise occurrence or effect of error		

2. Consider each error listed in the left-hand column in the table. Assume the error impacts on the results. For each error, tick (✓) the appropriate column(s) to indicate whether you think it is a random, systematic or personal error.

Error	Random	Systematic	Personal
a. A participant in a visual perception experiment forgot their spectacles but responded as best as possible to each stimulus			
b. The experimenter forgot their spectacles and was unable to read some of the details in the participant instructions			
c. The experimenter's spectacles were cracked so they were unable to read some measurements			
d. Too many participants in the sample are very old			
e. Not enough choice in the rating scale so many participants are forced to agree much more than they would like to			
f. A participant keeps checking their phone screen throughout the experiment despite experimenter instructions that phones should be switched off			
g. Some participants deliberately give rude answers so the experimenter treats them harshly.			
h. The test used to measure the DV is too hard			
i. The experimenter ticks the wrong column in the observer checklist when distracted			
j. The fire alarm sounds before all participants have completed all tasks and all are forced to evacuate			
k. The fire alarm sounds before all participants have completed all tasks but the experimenter instructs participants to ignore it			
l. The experimenter makes a mistake when transferring data from one record to another			

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1.10.2 Extraneous and confounding variables

Random and systematic errors can have unwanted effects on the dependent variable and therefore the results of an experiment. Variables that may cause these errors are referred to as extraneous and confounding variables.

Extraneous variables

An **extraneous variable** is a variable other than the IV that may cause a change in the DV and therefore may affect the results. An extraneous variable is not intentionally studied (as are the IV and DV), nor does the experimenter wish to study this type of variable.

However, when one or more extraneous variables are present in an experiment, they can make it difficult to conclude with confidence that any change in the DV was caused solely by the presence of the IV. The experimenter will therefore try to identify all relevant extraneous variables when designing their experiment, then try to monitor and control (or keep constant) their influence when conducting the experiment by using procedures that will minimise such influence to an acceptable level. A 'relevant' extraneous variable is one that is believed to have the potential to cause a change in the DV.

For example, suppose a researcher will conduct an experiment to investigate age differences in navigating between different spatial locations. Participants in different age groups ranging from very young to very old will be required to find their way through a series of increasingly complex mazes. The maze navigation tasks will be presented online using a computer so that the time taken to successfully complete each maze can be electronically measured and recorded. The IV is age and the DV is navigational ability. In this study, extraneous variables that could impact on the DV and would therefore need to be controlled or eliminated include:

- biological sex of participants, e.g. one sex may have inherently better ability for this kind of spatial task
- prior experience with computers and online task completion, e.g. a large number of very young or very old participants may lack computer and online experience which may interfere with maze navigation
- prior experience with maze navigation, e.g. to ensure no age group is advantaged
- motivation, e.g. to ensure one age group is no more or less motivated to complete the maze tasks than the others
- instructions, e.g. to ensure all clearly understand what needs to be done and that no age group is unduly advantaged or disadvantaged by the administration or comprehension of instructions
- test conditions, e.g. to ensure they are the same for all participants.

Sometimes the experimenter does not become aware of relevant extraneous variables until after the experiment has commenced; for example, during the experiment or when evaluating the experiment after it has been conducted. In some cases, the experimenter remains unaware of relevant extraneous variables until another researcher points them out after reading the report on the experiment.

There are potentially many extraneous variables that may affect the DV of an experiment and it can be difficult for the researcher to predict and control all of them. Consequently, experimenters tend to focus on controlling those variables that are likely to have a significant effect on the DV. For example, in an experiment to determine the softest noise a person can hear, it would be very important to control background noise. However, in an experiment to test the effect of caffeine on performance of some physical task, background noise may not be so critical.

Confounding variables

Every experiment used in psychological research is designed to answer the same basic question: *Does the IV cause the predicted change in the DV?* The researcher recognises that there are other variables that may affect participants' responses (i.e. the DV), such as all those variables collectively referred to as extraneous variables.

Extraneous variables are inevitable and do not pose a problem if controlled in an appropriate way. By strictly controlling unwanted effects of relevant extraneous variables on the DV, the effects of the IV on the DV can be isolated. If there is a measurable change in the DV, then the researcher can more confidently conclude that the IV caused the predicted change in the DV.

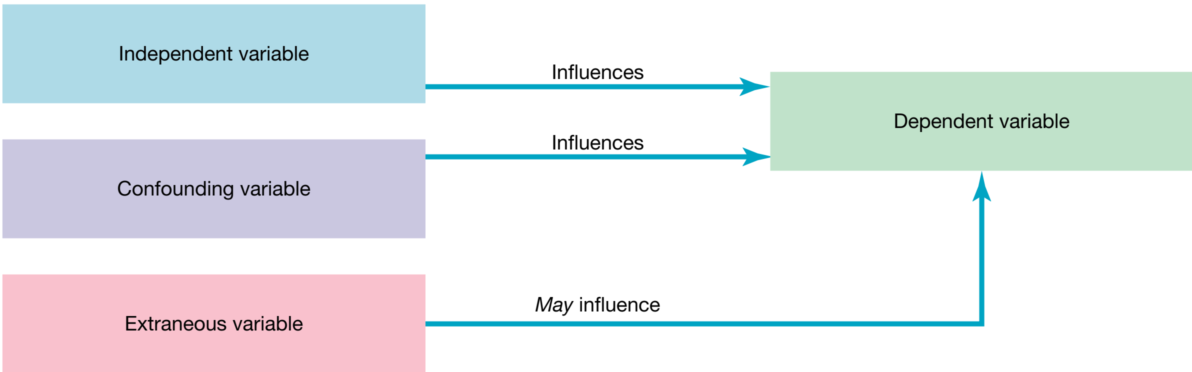

Figure 1.49 An extraneous variable is any variable that is not the IV that *may* affect the DV; whereas a confounding variable is any variable that is not the IV that *has* affected the DV, and therefore provides an alternative explanation for the results.

If a variable that can affect the DV is not controlled, then its effect on the DV may not be able to be clearly distinguished from that of the IV. When this happens, the uncontrolled extraneous variable has become a confounding variable.

A **confounding variable** is a variable other than the IV that has had an effect on the DV which cannot be separated from that of the IV. A confounding variable is not manipulated or controlled by the researcher (and therefore not intentionally studied). It has an effect (systematically changes) at the same time or together with the IV so the experimenter cannot tell which of the variables produced the predicted change in the DV.

This means that a confounding variable is like a second unwanted IV that has influenced the DV, and therefore the results. It is called a confounding variable because its effects are entangled and therefore confounded (meaning 'confused') with those of the IV, thereby preventing the experimenter from concluding with any confidence that the IV alone caused the predicted change in the DV.

A well-known example of the importance of controlling all variables in an experiment involves a taste test conducted by the Pepsi-Cola Company. Coca-Cola® drinkers were asked to taste two unidentified cola drinks and indicate which of the two they preferred. The drinks were Coca-Cola and Pepsi. The brand of cola was the IV, and the participants' taste preference was the DV. To prevent the participants from knowing which cola they were tasting, they were given Pepsi in a cup labelled 'M' and Coca-Cola in a cup labelled 'Q'. The results showed that most of the participants preferred Pepsi.

The Pepsi-Cola Company proudly advertised this as evidence that even Coca-Cola drinkers preferred Pepsi. But, to test the findings, the Coca-Cola Company replicated the experiment, this time filling both cups with Coca-Cola. The results showed that most of the participants still preferred the cola in the cup labelled 'M'.

It seems that the Pepsi taste test had not demonstrated that Coca-Cola drinkers preferred Pepsi. It had demonstrated that Coca-Cola drinkers preferred the letter M to Q. The letters were an uncontrolled variable that had an unwanted effect on the DV (taste preference). Consequently, it remained unclear as to whether the IV (the kind of cola) or the unwanted variable (in this case the confounding variable of the letters) had affected the DV (taste preference).

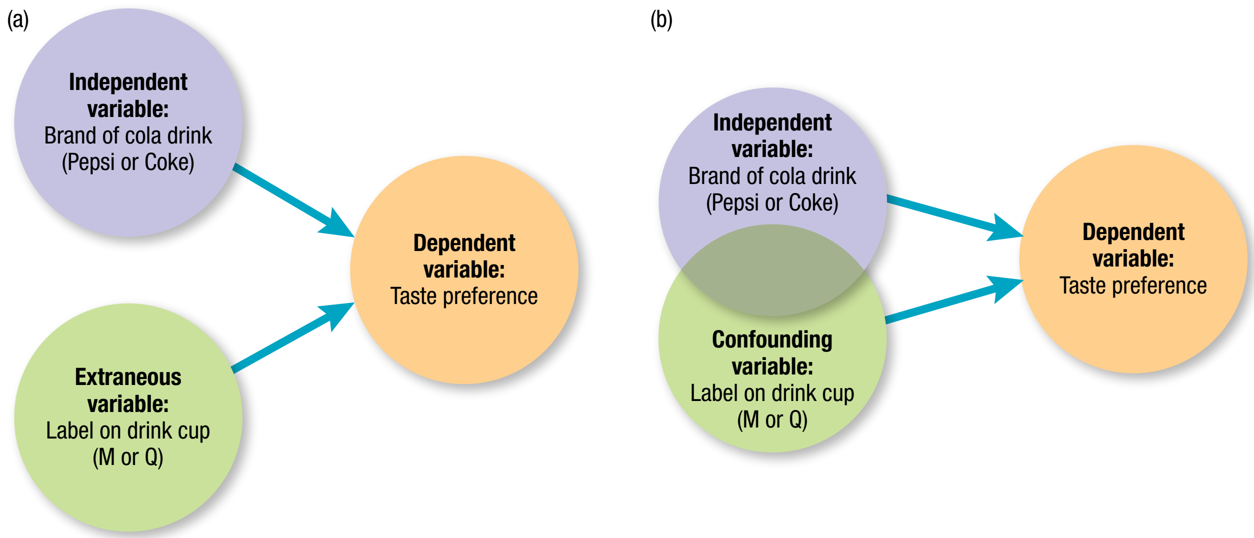

Figure 1.50 (a) In the taste test experiment, the label on the drink cup was an uncontrolled extraneous variable. (b) The effect of the label on the DV (taste preference) could not be isolated from that of the IV (brand of cola drink). The label on the drink cup had therefore become a confounding variable that provided an alternative explanation for the experimental results, making it impossible to be certain that the IV (rather than the confounding variable) caused the DV result.

The presence of one or more confounding variables does not necessarily mean that the IV did *not* cause the changes in the DV. However, the presence of a confounding variable suggests that there may be one or more alternative explanations for the results.

For example, if there is a difference in the results for the experimental and control groups, it could be caused by the IV, the unwanted confounding variable or the combined effects of both. The more alternative explanations there are for the results, the less confident the experimenter will be that the IV alone was responsible for the results.

A confounding variable is sometimes described as a type of extraneous variable. A confounding variable may have its origin as an extraneous variable but there is an important distinction. A confounding variable produces a measurable change in the DV. This change is consistent with what was predicted in the hypothesis, whereas an extraneous variable may or may not affect the DV. What both variables have in common is that they create problems for the researcher in isolating the real effect of the IV, moreso a confounding variable.

Not all extraneous variables become confounding variables. Nor are all confounding variables initially extraneous variables. Confounding variables are typically built into the experiment itself, but unintentionally.

An experiment with one or more confounding variables compromises interpretation of the results and the validity (accuracy) of the experiment, specifically *internal validity* (which is described in section 1.15.5).

The more alternative explanations there might be for an observed result, the less confidence an experimenter will have in their research hypothesis, which states or implies that the IV *will* be the cause of a particular result.

Because humans are complex and there are often multiple causes of how they may think, feel or behave in any given situation, good experimental design involves anticipating potential extraneous and confounding variables and developing strategies to minimise their influence and ensure that extraneous variables do not become confounding variables.

Figure 1.51 (a) This participant has a high error rate in a driving simulator. (b) Is his poor performance due to his driving ability or because he went out with his friends and stayed up late the night before, slept poorly and felt excessively tired on awakening? Confounding occurs when the effects of the IV on the DV cannot be separated from those of another variable — a confounding variable. The presence of a confounding variable provides an alternative explanation of the results.

1.10 LEARNING ACTIVITY 2

Review

1. Distinguish between:
   a. extraneous and confounding variables
   b. controlled and uncontrolled variables.
2. In what two ways are extraneous and confounding variables alike yet different?
3. a. Explain why the presence of extraneous and/or confounding variables is problematic for the researcher.
   b. Sometimes researchers refer to the 'presence of a confound' in an experiment. What do you think this means?
   c. Similarly, a researcher may refer to a variable having 'confounded' the results or their interpretation. What do you think this means?
4. For each of the following experiments, identify the IV, the DV and three potential extraneous or confounding variables.
   a. The reaction time of 20 people who have just awoken from sleep is compared with that of a group who have just run a kilometre.
   b. The goal shooting accuracy of one group during a 10-minute period is measured when alone and compared with that of another group who goal shoot in the presence of others.
   c. Participants read a description of a person. All read the same description but half are told the person is of the same cultural background as themselves, whereas the other half are told the person has a different cultural background. All participants are then required to select characteristics they believe best describes the person; for example, 'good vs bad', 'warm vs cold' and 'friendly vs unfriendly'.
5. A researcher is planning an experiment to investigate the rate of forgetting (how much time it takes) and amount of forgetting (how much information) that occurs when new information (a list of nonsense 'words' such as qab and jir) is learned.
   a. Identify the IV(s) and DV(s).
   b. Suggest two extraneous or potential confounding variables that could affect the DV (in addition to the IV) and therefore need to be controlled.
   c. Suggest a way that each variable referred to in part (b) could be controlled.
6. An experiment was conducted to test whether people make fewer errors in detecting spelling errors in an interesting text than in a boring one. Two groups of randomly selected and allocated participants were used. Group 1 looked for errors in a physics text on string theory (a boring task) and Group 2 looked for errors in the script of a recently released blockbuster movie (an interesting task). The results showed that Group 1 detected significantly fewer spelling errors than did Group 2.
   a. Identify the IV(s) and DV(s).
   b. Suggest a potential confounding variable in the experiment. Explain your choice.

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1.10 LEARNING ACTIVITY 3

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.23; © VCAA

In an experiment, it is essential to control for extraneous variables so that

A. there is a probability that the results will be obtained by chance.
B. a valid conclusion can be made about the effect of the independent variable on the dependent variable.
C. a valid conclusion can be made about the effect of the dependent variable on the independent variable.
D. the hypothesis is supported and the results of the experiment can be generalised to the broader population.

Question 2 (1 mark)

Source: VCAA 2010 Psychology 1, Section A, Q.7; © VCAA.

A researcher was interested in the possible link between brain tumours and depression in elderly patients. She conducted an intensive study of six individual patients in a hospital using diagnostic tests, patients' interviews, and examination of the patients' medical records.

One limitation of this method for her research is that

A. the research is not controlled for potential confounding variables.
B. the reliance on patients' reports will not produce very detailed information.
C. the patients cannot be randomly allocated to the control and experimental groups.
D. it is too easy to generalise the results of this type of research.

Question 3 (1 mark)

Source: VCAA 2004 Psychology 2, Section A, Q.45; © VCAA

Professor Von Trapp is studying how the length of time that a stimulus is exposed to a participant affects the participant's ability to recall the shape of the stimulus. She recruits 30 first-year university students, 15 male and 15 female. Each participant is presented with three sets of 10 shapes, which are exposed for: four seconds for the first set of 10 shapes, two seconds for the second set of 10 shapes and one second for the third set of 10 shapes. She then asks each participant to perform a memory recognition task for 50 different shapes, the 30 shapes previously seen and 20 distracters.

A confounding variable that was not controlled for in the study was

A. the order of time of exposure of the stimuli.
B. the memory skill of the participants.
C. the length of exposure of the stimuli.
D. the level of education of the participants.

Question 4 (1 mark)

Source: VCAA 2003 Psychology 2, Section A, Q.37; © VCAA.

Dr Vogel is studying the effects of caffeine on behaviour. She deprives 30 first-year university students of sleep for 24 hours before the experiment begins. She divides her participants into two groups of 15 by picking their names out of a hat.

Experimental Group

The 15 students in the experimental group are given a capsule containing a dose of caffeine equivalent to five cups of strong coffee.

Control Group

The other group is given an apparently identical capsule containing powdered sugar only.

The students are then tested on their ability to perform a number of complex arithmetic problems.

A confounding variable that was not controlled in the study may have been the

A. gender of the participants.
B. education of the participants.
C. level of fatigue of the participants.
D. amount of caffeine consumed by the participants.

Question 5 (1 mark)

Source: VCAA 2009 Psychology 1, Section B, Q.14b (adapted); © VCAA

Professor Latina, a sleep researcher, is interested in finding out if meditating for 15 minutes before bedtime will help reduce insomnia compared to no meditation. She recruits 50 people who suffer from insomnia. Professor Latina employs a within subjects design.

A within subjects design will minimise extraneous variables that a between subjects design will not. Name and explain one such extraneous variable.

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1.11 Types of extraneous variables and their control

Researchers have described different types of extraneous variables (that may also be confounding variables). These include participant variables, situational variables, demand characteristics, experimenter effects and the placebo effect.

In this section we describe these types of variables and procedures commonly used for their control and to keep their effects at an acceptable level in experiments. Extraneous variables, however are not limited to experiments. They may also be present and therefore require control in non-experimental investigations.

Although the different types of extraneous variables are described separately, they do not necessarily influence participant responses in isolation of each other. Any one or more of these variables can interact in affecting participant responses to produce further bias and stronger unwanted effects.

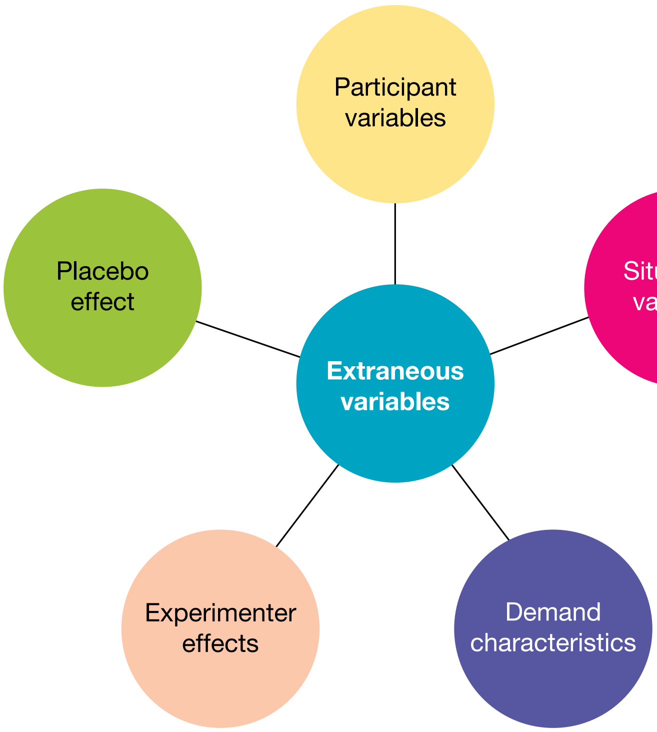

Figure 1.52 Types of extraneous variables

1.11.1 Participant variables

The personal characteristics that individual participants bring to an experiment and which could influence their responses are called **participant variables**. These may be biological, psychological and/or social in nature.

Some participants will be more or less easy going, anxious or motivated than others. Some will be curious about the experiment and have expectations about how they should behave. They will also differ in a wide range of mental abilities such as intelligence, learning, memory, reading comprehension and problem-solving skills, as well as physical abilities such as strength, athleticism, hearing, vision, eye-hand coordination and finger dexterity. Furthermore, they will differ in such variables as sex, age, diet, sleep patterns, responsiveness to medication, self-esteem, educational background, social relationships, ethnicity, cultural experiences and religious beliefs.

Any one or more of these variables in a virtually endless list can affect how participants behave in an experiment and therefore the results, including generalisations that may be made. For example, mood may affect participants' responses and make them more or less reactive to the experimental procedures. Some participants may be more or less competitive than others, and some may pay more or less attention to instructions or tasks required of them.

Thus, the researcher tries to take into account those participant-related variables that have the potential to impact on the DV (in addition to the IV), and therefore possibly distort the results. For example, a researcher conducting an experiment on sex differences in aggressive behaviour after playing a violent video game will recognise that participant characteristics such as age, personality, mood, prior experience with violent video games, cultural background, and so on, can also influence aggressive behaviour.

Consequently, the researcher will try to ensure that the influence of these other participant variables is controlled or minimised and will do so before the experiment is conducted.

Figure 1.53 Even if they share a common interest or have the same cultural background, participants will differ in all kinds of personal characteristics and abilities. Variables arising from such differences can become confounding variables if uncontrolled. Participant variables arising from such differences (that are not an IV) are potential extraneous or confounding variables that need to be identified and controlled, or at least monitored.

Control

The experimenter can control participant variables by ensuring, as far as possible, that participants in different experimental conditions (or groups) are as similar as possible in personal characteristics that may have an unwanted influence on the results.

An appropriate starting point is to obtain a sufficiently large number of participants and use a *random sampling* technique to help ensure the sample is representative of the population being studied. Random sampling is considered the ideal because it increases generalisability, however, it is not always possible. Therefore, it is vital that a random allocation technique is used once the sample has been selected, regardless of how biased or representative the sample may be.

Random allocation is a crucial feature of any controlled experiment so that any differences found between the groups or conditions can be confidently attributed to the effects of the IV. With a sufficiently large number of participants, it is reasonable to assume that each group (or condition) will end up with the same kind of spread of participant characteristics that may affect the DV and therefore the results.

Use of an *appropriate experimental design* will also help control participant variables. The choice will be dependent on such factors as the hypothesis to be tested, the number of participants available, how the DV will be measured and various practical constraints. Either the within subjects, between subjects or mixed designs could be used. All controlled within-and between subjects experiments use random allocation. These designs (or a combination) are considered to control participant variables to an acceptable level.

Generally, the *within subjects* design tends to be the most effective for controlling participant variables because each participant performs under all conditions of the experiment so the effects of participant variables will balance out exactly.

Nonetheless, the *between subjects* design would also control individual participant differences. Random allocation to the different conditions will help ensure groups are well matched on participant variables and therefore much the same. Although random allocation does not guarantee that different groups are entirely equivalent in the spread of participant variables, it does greatly reduce the likelihood of differences. The bigger the groups, the more likely it is that a uniform spread of characteristics will be achieved.

1.11.2 Situational variables

In contrast to participant variables which occur within the individual, situational variables occur outside the individual. **Situational variables** are external factors (other than the IV) associated with the experimental setting that may influence participant responses and therefore the results.

Situational variables include the physical features of the immediate environment such as its size and lighting conditions, background noise, time of the day, air temperature, presence or absence of other participants, and so on, depending on the hypothesis being tested. Any of these can affect the quantity and quality of participant responses.

Naturally, the experimenter and any research assistants are part of the experimental setting as well, and the manner in which they conduct the experiment and interact with participants are also associated with the setting.

For example, personal versus impersonal contact with the experimenter may affect performance and participants may respond differently in a group situation to the way that they would on an individual basis. If a test is used to measure the DV, participants may react differently to a digital presentation rather than a personal one. Likewise to test items requiring a written response as opposed to an oral response.

The instructions and procedures used by the researcher can therefore also impact on how participants respond. This can be a particular concern when research is carried out by multiple research assistants or when large sample sizes require many researchers to complete the project. For example, suppose that the researcher is interested in studying factors influencing the reaction time of helicopter pilots when flying over a hostile war zone at night. The researcher sets up an experiment in which participants perform a task in which they have to detect the blink of a faint red light in a dark room as quickly as possible.

Imagine how the results could be affected if 20 participants received different *instructions* on what the experiment is about, what they are supposed to do, whether they can sit or stand, how much time they have to respond, and so on. What if some participants complete the task early in the morning and others late at night (and may therefore be more or less alert)? Or what if some participants complete the task in a room with 'darker' conditions?

Figure 1.54 A situational variable is any external, 'non-participant' factor (other than the IV) that is associated with the experimental setting and may influence participant responses and therefore the results.

Procedures not only involve what the experimenter does but also how the relevant research activities are conducted, including their sequence. When the research instructions and procedures are nonstandardised, this means that they are not the same for all participants (except for exposure to the IV by participants in the experimental group).

Even small variations in instructions and procedures may affect participants' responses in unforeseen ways. An experiment that uses *non-standardised* instructions and procedures is not strictly controlling all of the possible extraneous and confounding variables that can influence the DV and therefore the results.

Order effects arising from the experimental design are also situational variables. In some experiments, participants may be required to perform the same type of task twice or even many times under the same conditions. In a within subjects experiment, they are required to perform a task first in one condition and then again in another condition.

An **order effect** occurs when performance on the DV is influenced by the specific order in which the experimental tasks are presented rather than the IV. Performing one task affects the performance of the next task, and so on if there are multiple tasks (or trials).

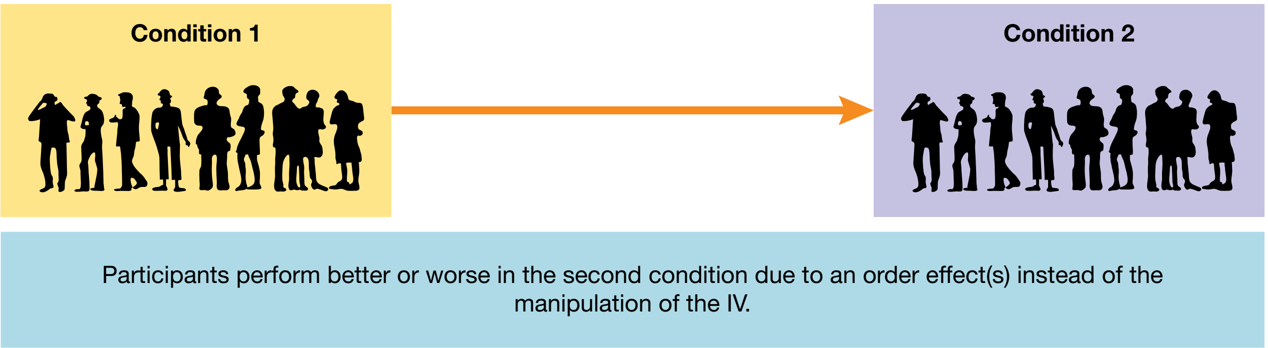

Figure 1.55 Order effect

Order effects may change the results so that the impact of the IV may appear to be greater or less than it really is. This means that an order effect may cause a positive or negative performance change.

Two types of order effects that explain how this can occur are called practice effects and carryover effects.

- *Practice effects* are the influence on performance (the DV) that arises from repeating and/or prior experience with a task, including the test materials, procedures and settings.

Practice effects can improve or impair performance. For example, in an experiment measuring speed and accuracy, participants may become quicker or more accurate as they become familiar with the task and the response requirements. With even more trials, however, performance may worsen due to fatigue or tiredness (sometimes called a *fatigue effect*).

Similarly, their performance may be influenced by boredom due to repeating the same task, especially if the task takes a long time and does not change. Boredom is quite common in experiments in which participants are required to complete many trials or tests, especially when task requirements are not particularly interesting

- *Carryover effects* are the influences that a particular task has on performance in a task that follows it. They arise simply from experiencing a task. The effect of experiencing a task has the potential to 'carry over' to the next task, regardless of whether the task is the same or different.

As with practice effects, a carryover effect can help or hinder performance. For example, if a task happens to be very easy, difficult, frustrating or even anxiety-provoking, the feeling may 'carry over', improving or lowering performance in later trials. Whatever the carryover, this is an unwanted effect.

A carryover effect is more likely when an experiment involves a drug or other substance that may linger in the body. In such cases, sufficient time is required between conditions for the active substance to 'wash out' from the body and become ineffective.

Order effects are of particular concern in experiments with a within subjects design because of their use of the same participants in all the experimental conditions. This means that the order in which participants are exposed to each condition can influence their responses in the next condition. There are, however, procedures that may be used to control order effects and other situational variables.

Control

The most effective way of controlling most situational variables is to hold them constant throughout the experiment. All participants in different groups or conditions must be tested in the same way *and* in the same situation (except for exposure to the IV where appropriate) in order for the experimenter to more confidently conclude that any change in the DV is the result of the IV.

An appropriate starting point is to consider situational variables when planning the experiment and ensure they are eliminated, minimised or occur in all experimental conditions if they can't be adequately controlled.

For example, if background noise is likely to affect the results of an experiment in an unwanted way, then its effects could be removed by conducting the experiment in a soundproof room. This would remove any unwanted influence it may have on the results.

If background noise cannot be entirely eliminated because of the setting in which the experiment must be conducted, then the experimenter would attempt to ensure that background noise occurred at about the same level in the different experimental conditions.

There are potentially many extraneous situational variables that can affect experiments and it is difficult for an experimenter to predict and control *all* of them. Therefore, experimenters tend to focus on controlling those situational variables that are likely to have an influential effect on the DV. For example, in an experiment to determine the softest noise a person can hear, it would be very important to control background noise. However, in an experiment to test the effect of caffeine on performance of some physical task, background noise may not be so critical.

An experimenter may also minimise the effects of situational variables by balancing or equalising their effects for all groups of participants involved in the research. For example, if experimenters testing the effectiveness of a particular reading program on children's reading skills used two different rooms to test the children, a way of controlling the possible effects of being in the different rooms could be to test half the participants in each group (that is, some using the reading program and some not using the reading program) in each room.

Another procedure for controlling situational variables is called *randomisation*. This would involve testing participants in random order, rather than testing all participants in one condition first, then all participants in the other condition. In this way, any variable which may change over time such as the temperature, time of day, or the functioning of the apparatus will affect the conditions approximately equally. Randomisation can be achieved simply by coin tossing for each participant to decide which of the two conditions they do first.

It is also essential that all participants experience the same environment and procedures, with the only exception being exposure to the independent variable. Variations in instructions and procedures that may be a source of extraneous or confounding variables can be controlled by standardisation ('consistency') across the different conditions. Using standardised instructions and procedures means that instructions and procedures are the same for all participants (except for variations required for participants exposed to the IV).

There are also specific procedures that can be used to control order effects. The choice depends on the type of effect(s) that is expected and how significant it will be. One way of dealing with practice, fatigue and boredom is to increase the time between measuring the DV in each condition. For example, participants might be in the one condition one day, then return a week later for the other condition.

If this procedure is inappropriate, inconvenient or impractical, the experimenter can use a counterbalancing procedure. **Counterbalancing** involves systematically changing the order of treatments or tasks for participants in a 'balanced' way to reduce or avoid ('counter') the unwanted effects on performance of any one order.

By counterbalancing, the researcher recognises that an order effect is a potential confounding variable and cannot be controlled or eliminated through other means. Experiments with a within subjects (repeated measures) design are most vulnerable to order effects.

There are different ways of counterbalancing that vary in complexity. A simple procedure involves alternating the order in which participants are exposed to the IV (or different levels of the IV). Each group of participants is exposed to each condition of the experiment in a different order.

For example, suppose a researcher will conduct an experiment in which all participants first learn a list of words when rap music is playing and then learn a list of similar words when there is no music. It is possible that the participants may demonstrate better learning in the no music condition because of a practice effect.

To address this order effect, the researcher could split the sample into two groups — A and B. Group A could learn words in the rap music condition first, then learn words in the no music condition. Group B would learn words in the no music condition, followed by the rap music condition. Participants would also be randomly allocated to each group to experience either condition first or second. The procedure is shown in Figure 1.56 on the next page.

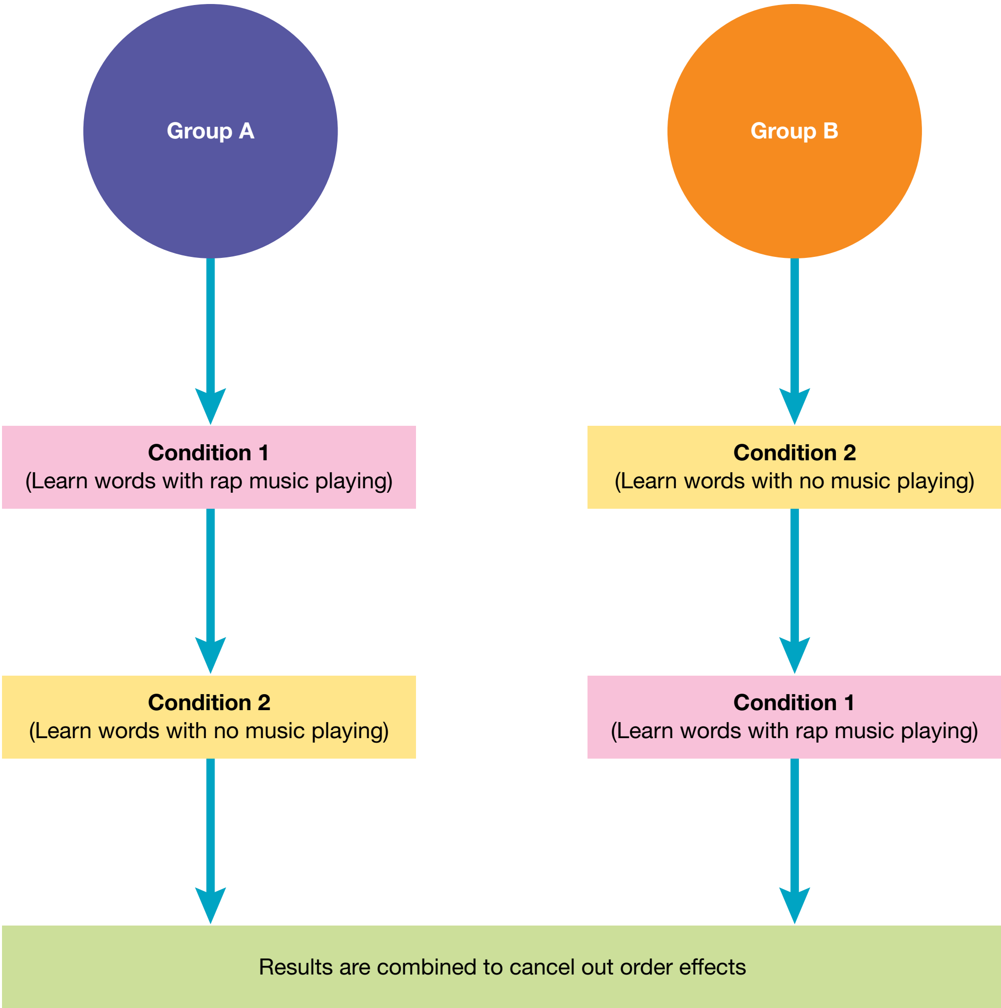

Figure 1.56 A counterbalancing procedure for the learning and rap music experiment. The two groups are exposed to the experimental conditions in a different order.

The results for all participants are then combined across the entire experiment to achieve counterbalancing. In this way, whatever order effects impact on learning the words are controlled. Although an order effect may have occurred for each participant, because they occurred equally in both groups, they have balanced each other out in the results.

If this procedure is inconvenient or impractical for a particular experiment, then the counterbalancing procedure shown in Table 1.6 could be used. Half the participants would follow one order (learn words in the rap music condition first, then in the no music condition). The other half would follow the reverse order (learn words in the no music condition, then in the rap music condition).

An alternative counterbalancing procedure for the learning and rap music experiment. Half the participants follow one order (experimental condition first) and the other follow the reverse order (control condition first).

Table 1.6 An alternative counterbalancing procedure for the learning and rap music experiment.

Participant	Experimental group (Learn words with rap music playing)	Control group (Learn words with no music playing)
1	First	Second
2	Second	First
3	First	Second
4	Second	First
5	Second	First
6	First	Second

1.11 LEARNING ACTIVITY 1

Review

1. Define the meaning of participant variable as an extraneous variable.
2. Why is random allocation considered an effective control for participant variables?
3. In what way can sample size influence the presence of unwanted participant variables?
4. Define the meaning of situational variable as an extraneous variable.
5. Give three examples of factors within an experimental setting that may be situational variables.
6. Suggest two potential situational variables in experiments that will be designed to test a research hypothesis for each of the following aims.
   a. To find out whether a particular study technique improves performance on an exam
   b. To determine whether the level of anxiety experienced affects the ability to perform a complex motor task
7. *Source: VCAA 2003 Psychology 2, Section B, Q.14; © VCAA*
   a. What is counterbalancing?
   b. Explain why it is used.
8. Suggest a simple randomisation or random allocation technique that could be used to counterbalance order effects in an experiment.
9. a. A researcher will test whether playing violent video games increases aggressive behaviour among children. All participants will play a violent game for 15 minutes then be taken to a play area immediately after where they will be observed for 30 minutes. Aggressive behaviour will be defined as the number of times a child makes actual physical contact with another child. The participants will then play a non-violent video game for 15 minutes and again be observed in the play area for 30 minutes. Differences in aggressive behaviour in each condition will then be compared.

      Identify a possible order effect and explain a counterbalancing procedure that could be used to minimise its influence.

   b. i. A researcher believes that the biological sex of participants is a potential confounding variable. Explain how counterbalancing could be used to control this variable.

      ii. The researcher will use a number of research assistants to conduct the study and also believes that their sex is a potential confounding variable. Explain how counterbalancing could be used to control this variable.

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1.11 LEARNING ACTIVITY 2

Multiple-choice questions

1. Which experimental design is considered the most effective for controlling extraneous variables arising from individual differences among participants.
   A. between subjects
   B. within subjects
   C. mixed subjects
   D. counterbalancing
2. When using a between subjects experimental design, control of participant variables is achieved through
   A. random selection to different conditions.
   B. manipulation of the independent variable.
   C. random allocation to different conditions.
   D. use of a single, independent variable.

3. When the gender of a participant is expected to affect the results of an experiment in an unwanted way, this variable would be best controlled by
   - **A.** using random selection and allocation procedures.
   - **B.** using standardised instructions and procedures.
   - **C.** using both males and females as participants.
   - **D.** repeating the experiment at least two times, once with females and once with males.
4. Which of the following may be classified as a situational variable?
   - **A.** attention
   - **B.** memory
   - **C.** motivation
   - **D.** noise
5. A researcher conducted an experiment to find out if females are better able to recognise emotions from photos of facial expressions than males. A group of randomly selected male and female participants were randomly assigned to different groups and tested individually.

   Each participant in group 1 was shown photos of different female facial expressions, one at a time for 5 seconds each. Group 2 participants observed the photos under the same conditioning, but for 10 seconds each.

   The results showed that female participants were significantly better than males at identifying facial expressions of emotions in photos.

   A potential confounding variable in this experiment involves
   - **A.** the participant sampling procedure.
   - **B.** the participant allocation procedure.
   - **C.** time allowed to observe each photo.
   - **D.** gender of the person in each photo.

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1.11 LEARNING ACTIVITY 3

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.9; © VCAA

To use counterbalancing in an experiment, a researcher must

A. alternate the order of exposure to the independent variable.
B. change the order of each group experiencing the dependent variable.
C. randomly allocate participants to either the experimental or control group.
D. balance experimental and control groups based on participant characteristics.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.25 (adapted); © VCAA

Dimitri conducted a within subjects experiment. He used lists of 15 four-letter words as the stimuli.

In the first condition, after a list of 15 words was presented, a beep signalled the end of the list and the time for participants to start writing the words down using free recall.

In the second condition later that day, using a different list of words, Dimitri added a distractor task for 30 seconds before the beep signalled that participants were to start writing down the words they remembered.

Would Dimitri need to counterbalance the experiment?

A. No, because he controls the order of the conditions.
B. No, because he used a different list of words in the second condition.
C. Yes, because the order of the condition might affect the number of words recalled.
D. Yes, because the number of words recalled might be affected by the order of the words.

Question 3 (1 mark)

Source: VCAA 2010 Psychology 1, Section A, Q.40 (adapted); © VCAA

A researcher who is interested in studying the effect of soft music on the sleep patterns of infants would find it an advantage to use a within subjects experimental design because

A. she can avoid the use of random allocation.
B. it would eliminate participant differences.
C. it would increase the number of participants she could use.
D. it would eliminate all uncontrolled variables.

Question 4 (1 mark)

Source: VCAA 2004 Psychology 2, Section A, Q.40 (adapted); © VCAA

A researcher wants to see if his students have improved throughout the year. He records the marks that his students received for their first lab reports at the beginning of the year, and he compares these results with the marks that his students receive for their lab reports at the end of the year. So, from each student, he has two results: one for the first lab report and one for the second lab report.

Which one of the following statements is true of this research?

A. The researcher is using a between subjects design.
B. The researcher is using a within subjects design.
C. The researcher could avoid practice effects by counterbalancing the testing order.
D. The dependent variables are the two times (beginning of the year and end of year).

Question 5 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.19; © VCAA

Mr Wallace is a Geography teacher at a high school. He is interested in finding out whether Year 9 students or Year 10 students are faster at learning the names of capital cities. One class at each year level is shown a presentation with each of the selected 20 countries and their capital cities on separate slides. Students are instructed to silently memorise the name of each country's capital city. At the end of the presentation, each student is then provided with a list of countries only, in the same order as presented. Students are asked to write the name of the correct capital city beside the name of as many countries as possible. Mr Wallace then records how many correct pairs of capital cities and countries each student gets, and calculates the mean for each class.

Which of the following procedures were used in Mr Wallace's research?

A. convenience sampling and random allocation
B. random allocation and standardised procedures
C. convenience sampling and standardised procedures
D. random sampling and non-standardised procedures

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1.11.3 Demand characteristics

When people know they are in an experiment, they may behave in the way they think the experimenter wants them to. **Demand characteristics** are cues in an experiment that may influence or bias a participant's response, thereby distorting the results. These cues suggest the kind of response that the experimenter is wanting or expecting and leads them to believe that they should respond in that way. Consequently, participant responses influenced by demand characteristics are not their true responses.

A *cue* is some kind of stimulus, event, or object that serves to guide behaviour. A participant may use cues such as random noises, changes in lighting or even a broken pencil point to work out what is being investigated and how they should respond. Sometimes participants can work out whether they are in an experimental or control group and behave differently. If a participant detects that they are in the 'special' experimental group, their interest and performance may increase. Furthermore, some may try to guess the hypothesis and attempt to act in ways that they think will support the hypothesis. It is also possible that some will respond in the opposite way. However, most tend to be cooperative.

Participants don't necessarily respond to demand characteristics intentionally or even consciously. However, demand characteristics typically result in reactions that are not natural responses to the variables under investigation, thereby influencing or even changing the results. In such cases, the experiment may be confounded because the experimenter can't be confident whether the results are due to the IV or to the effects of demand characteristics.

Each experiment is likely to have demand characteristics that are perceived by the participant. These may be produced by the experimenter or the setting. Consequently, demand characteristics are sometimes classified as a situational variable or an experimenter effect.

Figure 1.57 Under 'stage hypnosis', these audience members perform various silly behaviours that they would not ordinarily do in public. Can their behaviour be explained by demand characteristics?

Control

There are several ways of controlling demand characteristics to help ensure participants respond more naturally. The most commonly used procedures involve withholding information that may reduce the likelihood of participants working out the purpose of the experiment or how the experimenter may be expecting them to perform.

One way is through the use of *deception*. This means that the experimenter deliberately conceals the purpose of the experiment from participants by misleading or misinforming them. For example, the experimenter may provide a 'cover story' about what is being investigated. This may be partly or completely false.

The use of deception has ethical issues associated with the requirement for all participants to give their informed consent. However, deception is considered acceptable if the potential benefits of an experiment justify its use and there is no feasible alternative to its use.

Another way of controlling demand characteristics is to use a blind procedure. The **single blind procedure** would keep participants unaware of ('blind' to) the experimental condition they are in. For example, they may know what the experiment is about, but they don't know whether they are in an experimental or control group.

In some experiments, a *placebo* may be used to achieve a single blind outcome. For example, consider an experiment with an experimental group and a control group to test the effectiveness of a new drug for use by people with a specific mental health disorder. All participants would be given details of the research for ethical and practical reasons. However, participants in the experimental group would be given the drug and those in the control group would be given a placebo substitute that would be identical in appearance and taste.

In this way, control group participants will not know which condition they are in so expectations have been controlled because all participants believe they are actually using the drug. This means that the placebo has provided the demand characteristics of the drug used in the experimental group so the control group has experienced the same demand characteristics as the experimental group. Use of placebos and the placebo effect are described in more detail later in this topic.

Note, however, that single blind is not always possible. For example, in an experiment assessing which type of psychotherapy is most effective, it would be impossible to keep participants unaware of whether or not they received some kind of psychotherapy.

In addition, in some experiments the participants may know which condition they are in and one or more researchers do not. For example, a researcher conducting a vital data collection, recording or assessment procedure may intentionally be kept unaware of the condition to which participants are allocated in order to avoid bias or some other 'experimenter effect' on participant performance or results. In such cases, the researcher is said to have been 'blinded' or 'blinded to' the condition, so it is considered that single blind has been used.

If there is concern that the experimenter could give cues about the purpose of the experiment or some other signal that could influence participant expectations then double blind is another option.

The **double blind procedure** is when both the participants and the experimenter(s) interacting with them are unaware of the conditions to which the participants have been allocated. Only a researcher who is removed from the actual research situation knows which participants are in which condition (or groups). Consequently, double blind would control possible experimenter cues while also controlling participant expectations.

Given that different extraneous variables may be intertwined, use of an *appropriate experimental design* may also help control demand characteristics. For example, in a within subjects experiment the same participants experience all conditions and therefore have more information about the experiment, especially information about the likely IV treatment. Depending on the hypothesis and other considerations when planning an experiment, an alternative experimental design may be more appropriate. Similarly, moving the experiment outside of the laboratory and conducting it unobtrusively in a real-world setting would control demand characteristics.

Careful attention to the preparation and implementation of *standardised instructions and procedures* may also help control demand characteristics. For example, the experimenter would ensure features of the experimental setting that can provide cues for demand characteristics are minimised, whilst also ensuring all participants in each condition have the same experience.

Instructions and procedures would also take account of the possibility that participants often discuss the experiment when they have the opportunity to do so. For example, a participant may discuss the experiment with future participants after they leave the experimental setting. In this case, new participants may arrive at the experiment knowing more about the experiment or research hypothesis than is desirable.

In some cases, the experimenter may choose to use a *self-report* measure such as a questionnaire or interview to ask participants what they thought the true purpose of the experiment was or to indicate the extent to which they were aware of the research hypothesis. This would be administered after the experiment and statistical techniques could be used to help measure the extent to which demand characteristics may have been influential.

Figure 1.58 These children are participating in research testing an Omega-3 dietary supplement that may alleviate symptoms of their attention disorder. Half are given a placebo and the double blind procedure ensures neither the researcher nor the participants know who received the placebo or the dietary supplement. The researcher is also referring to a document containing standardised instructions and procedures.

1.11.4 Experimenter effects

Another extraneous variable that may affect the results of an experiment relates to the experimenter themself. Personal characteristics of the experimenter and their behaviour during the experiment may affect how participants respond. In addition, an experimenter may make a mistake when observing and recording responses or when interpreting the results. Each of these are examples of the experimenter effect.

The **experimenter effect**, sometimes called *experimenter bias* or *research bias*, refers to any influence the experimenter (or any other researcher) may have on the results of their investigation. An experimenter effect may be derived from or occur through:

- interaction with participants, or
- unintentional errors when making observations, measuring responses, when analysing or interpreting the results.

Although unintentional errors may have no direct effect on participant responses, they may indirectly distort the results, including conclusions that are drawn.

Personal characteristics of the experimenter that may contribute to the experimenter effect include their age, sex, ethnic appearance, cultural background, accent, attitudes, biases and expectations. In an experiment, the effect of such characteristics occurs when there is a change in a participant's response because of one or more of those characteristics, rather than the effect of the IV.

For example, an experimenter may treat participants differently depending on whether they are in a control or experimental group, which in turn influences the behaviour of the participants and how they respond to the DV. Similarly, if the experimenter is tired, in a bad mood or unwell it may affect the way the experimenter relates to the participants which, in turn, may lead the participants to behaving in a manner different from how they would otherwise behave, thereby influencing the results.

A commonly described experimenter effect is called experimenter expectancy. *Experimenter expectancy* involves cues the experimenter provides about the responses participants should make in the experiment. In particular, the experimenter's non-verbal communication ('body language') can produce a *self-fulfilling prophecy* — the experimenter obtains results that they expect to obtain, not simply because they correctly anticipated a response, but rather because they helped to shape the response through their expectations (Rosenthal & Rubin, 1978). The results may therefore be attributable to behaviour associated with the experimenter's expectations rather than the IV. Actions that can promote a self-fulfilling prophecy include:

- facial expressions, such as smiling at participants in one group but not at those in another
- mannerisms, such as shaking hands with participants in one group but not with those in another
- tone of voice, such as speaking in a monotone voice to participants in one group and in a more lively way to those in another.

An experimenter effect may involve not only the personal characteristics and actions of the researchers during the experiment, but also unintentional errors or biases in the treatment of data or when analysing or interpreting the results. For example, an experimenter may unknowingly make an error in reading or summarising the data in favour of what they want to show or to draw a conclusion that supports their hypothesis. These examples are not deliberate dishonesty. Instead, they are likely to be unconscious mistakes that can be made because of the experimenter's close involvement with their research.

Experimenter effects have been studied extensively by German-born American psychologist Robert Rosenthal. He has found some kind of experimenter effect to be present in many experiments. For example, the experimenter's sex, physical attractiveness and whether they are well-dressed or casually dressed can affect the behaviour of research participants and therefore the results of the experiment (Barnes & Rosenthal, 1985).

In one of Rosenthal's best-known experiments, conducted with his colleague Lenore Jacobson (1966, 1968), experimenter expectancy was shown to promote what they described as a *self-fulfilling prophecy* or *Pygmalian effect*. They found that primary school teachers' expectations of the performance of their students affected how well the children actually performed.

Students whose teachers were led to believe that they were 'bloomers' who were showing 'unusual potential for intellectual growth' and were therefore expected to develop rapidly performed better than students whose teachers were led to believe that they were not 'bloomers'. Yet the students hardly differed in their initial intellectual abilities, assessed at the outset of the study using an intelligence ('IQ') test. Teachers were found to have unintentionally influenced the performance of their students, depending on what they had been told by a researcher.

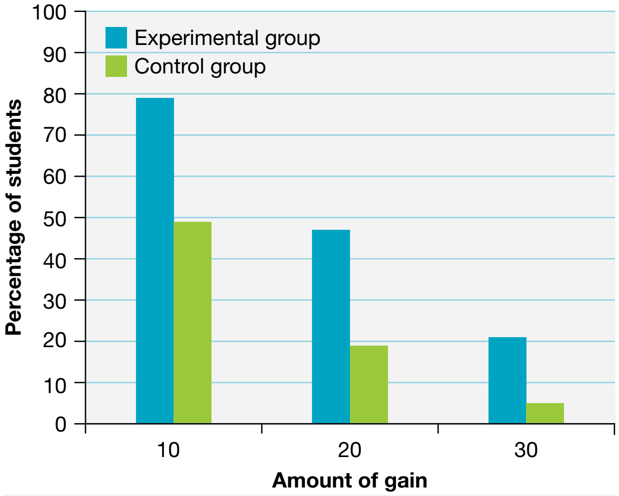

Figure 1.59 IQ score gains by Grades 1 and 2 students in the Rosenthal and Jacobson (1966) experiment.

Figure 1.60 Self-fulfilling prophecy

Control

The use of a blind procedure is the standard means of controlling experimenter effects. Double blind would help ensure both the participants and the experimenters interacting with them are unaware of the particular experimental conditions to which participants have been allocated. Only a researcher or research assistant who has no personal contact with the research participants, is aware of this information.

In some cases, the experimenter may also be kept unaware of the results that are expected from the different experimental conditions or of the results themselves. Again, only a person not directly involved with the experimental situation would be aware of this information.

The double blind procedure has obvious value in experiments in which knowledge of the conditions might affect the behaviour of the experimenter as well as the participants; for example, when testing the effects of a drug. In drug testing studies, called 'clinical trials', use of double blind is a standard procedure. However, as with single blind, double blind is not always possible.

In some cases, triple blind may be used to enhance control of experimenter effects. **Triple blind** is a procedure in which the participants, experimenters, and research assistants only doing data analysis are all unaware of the particular experimental conditions. For example, a researcher conducting a vital data collection, recording or assessment procedure may intentionally be kept unaware of the condition to which participants are allocated in order to avoid bias or some other 'experimenter effect' on participant performance or results.

The use of digital and automation technologies can help keep experimenters and their assistants blind as to who is in which condition and the data associated with each condition during data collection and analysis. Automating data collection can also help ensure that the scoring system is consistently and accurately applied.

Figure 1.61 A research assistant is conducting a study on food preferences during pregnancy. The assistant is referring to standardised instructions and procedures prepared by the lead researcher. This helps ensure all participants are treated in the same way, as appropriate to the experimental condition to which they have been assigned, thereby minimising the influence of unwanted participant variables, demand characteristics and experimenter effects.

1.11 LEARNING ACTIVITY 4

Review

1. Define the meaning of demand characteristic as an extraneous variable.
2. Give two examples of possible sources of demand characteristics in an experiment.
3. Explain whether demand characteristics could be classified as a participant variable.
4. When would deception be considered ethically permissible to control demand characteristics?
5. a. In what way are the single and double blind procedures similar and different?
   b. Which of the two procedures gives more control and why
   c. In an experiment testing different levels of an IV (without a control group), participants are told which condition they are in but the experimenter remains unaware. Which blind procedure, if any, is the experimenter using?
6. a. What are standardised instructions and procedures?
   b. Explain how the use of standardised instructions and procedures could help avoid demand characteristics.
7. Define the meaning of experimenter effect as an extraneous variable.
8. Give two sources of experimenter effects.
9. What is the most commonly used procedure for controlling experimenter effects?

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1.11 LEARNING ACTIVITY 5

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.35 (adapted); © VCAA

Which of the following would most assist researchers with minimising extraneous variables in an experiment?

A. single blind procedures and use of a placebo
B. standardised instructions and procedures
C. standardised instructions and double blind procedures
D. counterbalancing to control order effects and experimenter bias

Question 2 (1 mark)

Source: VCAA 2009 Psychology 1, Section A, Q.44 (adapted); © VCAA

Harvey, a university researcher, designs a between groups experiment. The experiment is testing the effect of a new drug on relieving symptoms of sleep apnea. He obtains informed consent from the participants. He uses a single blind experiment.

This means that

A. only one group of participants know whether they are receiving the placebo or the real drug.
B. the participants do not know about the nature of the experiment, unlike Harvey who does know.
C. Harvey does not know about the nature of the experiment, unlike the participants who do know.
D. the participants do not know whether they are taking the placebo or the real drug, unlike Harvey who does know.

Question 3 (1 mark)

Source: VCAA 2006 Psychology 1, Section A, Q.43; © VCAA

While carrying out an experiment, the psychologist unintentionally encouraged the experimental group to perform well.

The psychologist's influence on the participants confounded the results and is known as the

A. participant effect.
B. experimenter effect.
C. bias effect.
D. random allocation effect.

Question 4 (1 mark)

Source: VCAA 2006 Psychology 1, Section A, Q.44 (adapted); © VCAA

While carrying out an experiment, the psychologist unintentionally encouraged the experimental group to perform well.

To overcome this problem, the psychologist could

A. employ a research assistant, who is unaware which group the participants are in, to collect the results.
B. make sure the participants do not know which group they are allocated to.
C. include a placebo group.
D. use a stratified sampling technique.

Question 5 (1 mark)

Source: VCAA 2005 Psychology 1, Section A, Q.44; © VCAA

Krystal plans to incorporate a placebo group in her research design.

Using a placebo group means that Krystal will be able to reliably evaluate whether

A. the difference in the results between the placebo group and experimental group is due to the independent variable, and not the participants' expectations.
B. the difference between the placebo group and experimental group is due to the dependent variable, and not the participants' expectations.
C. the results of the experimental group give a true indication of the effectiveness of the drug because participant expectations will only influence the results for the placebo group, not the experimental group.
D. the results of the experimental group give a true indication of the effectiveness of the drug because experimenter expectations will only influence the results within the placebo group, not the experimental group.

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1.11.5 Placebo effect

In medicine, the placebo effect refers to an improvement in health or wellbeing due to an individual's belief that the treatment given to them will be effective. The placebo effect is evident when a patient recovers from an illness or pain after they have been given a substance or a treatment that has no actual medicinal or therapeutic value, such as a 'sugar pill' or fake injection.

This inactive substance or fake treatment, which substitutes for the real substance or treatment, is called a placebo. The mere suggestion to the patient that they have received, or will receive, some kind of treatment is often sufficient to minimise or eliminate the symptoms. For example, some people begin to feel better if they are put on a waiting list for treatment compared with how they might feel if they were not on a waiting list.

In an experiment, the **placebo effect** occurs when there is a change in a participant's behaviour due to their belief that they are receiving some kind of experimental treatment and they respond in accordance with that belief, rather than to the effect of the IV. Essentially, the participants' behaviour is influenced by their expectations of how they should behave.

For example, suppose an experimental group is given an alcoholic drink so that its effects on performance of a task can be observed, whereas the control group receives nothing. Impaired performance observed in the experimental group may be due to the alcohol, or it may have arisen because the act of giving the participants alcohol suggested that they were expected to act drunkenly, so they did.

Furthermore, because the experimental group received the alcohol and the control group did not, only the experimental group experienced the placebo effect. This means that a confounding variable is present, so the researcher cannot be certain whether it was the effects of alcohol or the placebo effect that caused the performance difference.

Figure 1.62 The placebo effect involves a change in behaviour in the absence of any experimental manipulation. It can be triggered by the belief that a treatment is real, even though it isn't. These two glasses contain a drink that looks identical but one is alcoholic (the experimental treatment) and the other tastes alcoholic but is inactive (the placebo)

Control

In order to control and minimise the impact of the placebo effect on the DV, the control group can be given a **placebo**—a fake treatment that is like the IV treatment used in the experimental group but which is actually neutral or has no known effect. In this way, control group participants should form the same expectations as the experimental group, thereby controlling the effects of this unwanted variable.

For example, in the alcohol experiment, the control group would be given a drink that smells and tastes like alcohol but is not alcohol. The control group would not be informed that their drink is not alcoholic and they would have no way of distinguishing it from a real alcoholic drink.

Using this procedure, both groups will form the same expectations for acting drunkenly, so any differences in performance can be assumed to be due to the real alcohol given to the experimental group.

Similarly, when testing drugs (or new medical therapies), researchers give placebo pills or injections to the control group so that all participants experience the same procedure and form the same expectations. And in studies that require the experimental group to perform, for example, a physically or mentally demanding task prior to making a response, the researcher could have the control group perform a similar placebo task to eliminate differences between the groups in terms of motivation or fatigue (Heiman, 2002).

A placebo can be any type of inert or fake treatment. It may be a drug or any other type of substance, an edible product such as a food, a special diet, a psychological therapy, a physical therapy, exercise or even surgery (such as incision and a procedure that is faked so that the participant doesn't know they actually had nothing done).

When a placebo is given to a control group, the group is often referred to as the *placebo control group* or the *placebo condition*.

Another way of controlling a placebo effect is to use a blind procedure. The single blind procedure would keep participants unaware of the experimental condition they are in. They may know what the experiment is about, but they don't know whether they are in an experimental or control group and therefore whether they have been given the active treatment or the inert placebo.

Figure 1.63 A placebo may be used to control the placebo effect. This was evident in research with astronauts. The inability of many astronauts to sleep well when on space missions led to an experiment designed to test whether they could be helped by taking melatonin, a hormone known to have a role in sleep onset. Half the astronauts aboard a space shuttle took a pill containing melatonin, and the other half took a placebo pill that looked the same but did not contain any active ingredient. All astronauts were blind as to which experimental condition they were in — they did not know whether they had taken the melatonin or placebo. The research found that melatonin could assist sleep onset, moreso in conditions of minimal light. This photo shows space shuttle astronauts in their sleeping bags. Their arms are floating free but their bodies are restrained and kept in place.

on Resources

Weblinks TED-Ed Lesson: The power of the placebo effect 4 m 38 s
Theories on how placebos work

1.11 LEARNING ACTIVITY 6

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.41; © VCAA

Participants involved in research into mental health are informed that a placebo will be used. Which additional piece of information is most likely to be provided to these participants?

A. which condition they are in
B. that they could be in either the control group or the experimental group
C. that they should continue taking any other medications they have been prescribed
D. misleading information about the research in order to prevent the participants' expectations from affecting the results

Question 2 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.46; © VCAA

Dr Smith is one of 10 doctors who work at the Bayview Lodge Medical Clinic. He wanted to investigate the effect of a new brand of benzodiazepine on the progression of a specific phobia in patients at the clinic. Fifty of Dr Smith's patients volunteered to take part in the study.

Dr Smith randomly divided the participants into two groups and gave Group A the treatment and Group B the placebo. The participants did not know if they were receiving the treatment or the placebo. The participants completed a self-report phobic anxiety scale both before and after the treatment.

Group B was given the placebo to control for

A. participant error.
B. experimenter bias.
C. participant expectations.
D. experimenter expectations.

Question 3 (1 mark)

Source: VCAA 2003 Psychology 2, Section A, Q.38; © VCAA

Dr Vogel is studying the effects of caffeine on behaviour. She deprives 30 first-year university students of sleep for 24 hours before the experiment begins. She divides her participants into two groups of 15 by picking their names out of a hat.

Experimental Group

The 15 students in the experimental group are given a capsule containing a dose of caffeine equivalent to five cups of strong coffee.

Control Group

The other group is given an apparently identical capsule containing powdered sugar only.

The students are then tested on their ability to perform a number of complex arithmetic problems.

The control participants received _____ while the experimental participants received _____.

A. caffeine; powdered sugar
B. powdered sugar; caffeine
C. complex problems; simple problems
D. simple problems; complex problems

Question 4 (1 mark)

Source: VCAA 2008 Psychology 1, Section B, Q.17b; © VCAA

Doctor Finlay is carrying out research into the causes of insomnia. She selects a sample of participants and randomly divides them into two experimental groups.

Doctor Finlay uses a single blind procedure.

b. Explain the benefit of using a single blind procedure.

Question 5 (2 marks)

Source: VCAA 2007 Psychology 1, Section B, Q.16a; © VCAA

Tegan is planning to carry out a study that considers the effects of caffeine on sleep. She plans to have two independent groups of participants. One group will take a low dose of caffeine while the other will drink a high dose of caffeine.

Tegan does not want the participants to know to which group they have been allocated.

a. Name and define the effect that could occur if participants knew to which group they had been allocated.

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1.12 Ethical considerations in psychological research and reporting

Is it appropriate to expose human participants to stressful conditions in order to study bodily changes when stressed? Is it appropriate to deprive participants of sleep for a prolonged period in order to study the effects? Is it appropriate to deceive participants and misinform them of what an experiment is about in order to control responses that may not ordinarily occur? Is it appropriate to test a new medication by giving a placebo treatment that is known to not work to participants in a placebo group who are unwell and genuinely need the new medication, and are therefore intentionally allowed to remain unwell? Should all participants be fully informed of the purpose of the research before they agree to participate? Should participants have the right to withdraw from an experiment at any time without giving a reason for wanting to do so? Such questions raise important ethical issues that need to be considered by researchers.

1.12.1 Defining ethics and ethical standards

The term **ethics** refers to standards that guide individuals to identify good, desirable or acceptable conduct. Essentially, ethical standards help us to make moral judgments about what is right (or acceptable) and what is wrong (or unacceptable).

All societies and cultural groups have ethical standards that guide the behaviour of their members. In addition to these standards, most professions have their own standards of ethical conduct that must be followed. For example, just as it would be considered unethical for a medical doctor to discuss a patient's condition with anyone apart from the patient or people legally responsible for the patient, so too would it be unethical for a psychologist to reveal information discussed in a counselling session or the results of a psychological test to anyone apart from the client (or the guardians of the client if the client is a child under a guardian's care).

Ethical standards and relevant considerations also apply to any type of research or data collection method involving people (or animals). These help ensure that the wellbeing and rights of research participants are respected and protected before, during and following their involvement in the research. In addition, ethical standards and guidelines help prevent unnecessary research and promote research that is or will be of benefit to the wider community or humankind in general.

The Australian Psychological Society (APS) has a *Code Of Ethics* (2007) which provides standards and guidelines for all psychological research (and other areas of professional practice). The Code has been devised with reference to a national set of standards and guidelines for research in a document called the *National Statement on Ethical Conduct in Human Research 2007 (Updated 2018)*. This is simply referred to as the National Statement. Psychological researchers strictly follow these standards and guidelines.

Figure 1.64 Ethical standards for human research ensure all participants are given the respect and protection due to them, irrespective of who they are. The researcher is responsible for the proper ethical conduct of their investigation.

1.12.2 Ethical concepts and guidelines

Ethical standards for psychological research described in the Australian codes of conduct (and international codes), are based on a common set of ethical concepts and principles. These are reflected in the ethical concepts and guidelines specified in the VCE Psychology Study Design (pp.20–21) and therefore apply to any research undertaken as part of the course.

Ethical concepts

The five ethical concepts described in the study design are:

- **Beneficence**: The commitment to maximising benefits and minimising the risks and harms involved in taking a particular position or course of action.

For example, the researcher must consider and maximise all possible good outcomes while minimising the risks of harm to participants and to the community in general. The potential benefits must justify any risk or harm or discomfort to participants.

- **Integrity**: The commitment to searching for knowledge and understanding, the honest reporting of all sources of information and results, whether favourable or unfavourable, in ways that permit scrutiny and contribute to public knowledge and understanding.

For example, research that is conducted with integrity is carried out with a commitment to following recognised ethical principles and guidelines for conducting research, including accurate and responsible reporting of findings, whether the results are favourable or unfavourable.

- **Justice**: The moral obligation to ensure that there is fair consideration of competing claims; that there is no unfair burden on a particular group from an action; and that there is fair distribution and access to the benefits of an action.

For example, the researcher must use fair procedures and ensure fair distribution of costs and benefits. In particular, the process of recruiting and selecting participants should be fair so the researcher must avoid imposing on particular groups an unfair burden of participation in their research. Similarly, the benefits of the research should be distributed fairly between the participants and the wider community.

- **Non-maleficence**: Involves avoiding the causations of harm. However, as positions or courses of actions in scientific research may involve some degree of harm, the concept of non-maleficence implies that the harm resulting from any position or course of action should not be disproportionate to the benefits from any position or course of action.

For example, the researcher must strive to ensure that there are benefits from their research and take care to not only avoid harm to all participants but to protect them from harm. If there is any potential for harm, then it must be justifiable and outweighed by the benefits.

- **Respect**: Involves consideration of the extent to which living things have an intrinsic value and/or instrumental value; giving due regard to the welfare, liberty and autonomy, beliefs, perceptions, customs and cultural heritage of both the individual and the collective; consideration of the capacity of living things to make their own decisions; and when living things have diminished capacity to make their own decisions ensuring that they are empowered where possible and protected as necessary.

For example, the researcher must recognise that all individuals, both human and non-human, have value and importance. In relation to people, the researcher must take account of the rights, beliefs, perceptions and cultural backgrounds of all participants and the groups to which they belong. In particular, all participants have the rights to privacy, confidentiality and to make informed decisions about matters that affect them. People must be protected and empowered if they are vulnerable or their capacity to make informed decisions is impaired; for example, children and intellectually disabled people who depend on others.

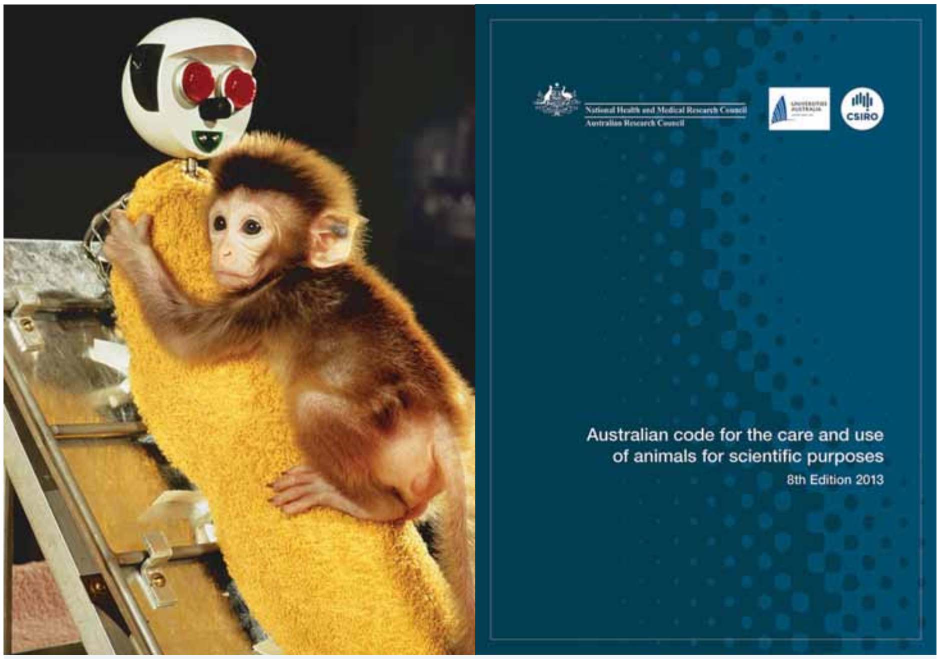

Figure 1.65 Animals are used in a wide variety of psychological research studies. This type of research is also governed by ethical standards and guidelines 'to promote the ethical, humane and responsible care and use of animals for scientific purposes'.

Ethical guidelines

The following guidelines should therefore be considered when conducting and evaluating psychological investigations:

- **Confidentiality**: The privacy, protection and security of a participant's personal information in terms of personal details and the anonymity in individual results, including the removal of identifying elements.

Confidentiality also includes the obligation of the researcher not to use or disclose private information for any purpose other than that for which it was given to them. Participants have a right to privacy, so the researcher must avoid undue invasion of privacy by collecting only information that is needed. Therefore, any information that may identify an individual or their involvement in research, such as personal data or test results, cannot be revealed unless consent has been obtained.

The right to privacy and procedures for establishing and maintaining confidentiality must be explained to participants before the study commences. Confidentiality also applies to the collection, recording, accessing, storage, dissemination and disposal of personal information. If personal information about an individual is no longer needed, then the information should be destroyed or de-identified.

- **Debriefing**: Ensures that at the end of the experiment, the participant leaves understanding the experimental aim, results and conclusions. Any questions participants have are addressed, and support is also provided to ensure there is no lasting harm from their involvement in the study. Debriefing is essential for all studies that involve deception.

Checking the wellbeing of the participant and addressing any harm that may have resulted from their participation in the study is another important requirement of debriefing; for example, providing information about counselling services and how to access them to help treat any distress resulting from the study. In extreme cases, participant wellbeing may be monitored after the research; for example, participants may receive questionnaires, be asked to complete diaries and/or have follow-up meetings with the research team.

- **Informed consent procedures**: Ensure that participants understand the nature and purpose of the experiment, including potential risks (both physical and psychological), before agreeing to participate in the study. Voluntary written consent should be obtained by the experimenter and if participants are unable to give this consent, then a parent or legal guardian should provide this.

Consent is a voluntary choice for participants and must be based on sufficient information and adequate understanding of both the proposed research and the consequences of participation in it. In order for this to be achieved, information should be given about the purpose, methods, demands, risks and potential benefits of the research.

This information must be presented in ways suitable for each participant; for example, it should be in plain language (with the least possible technical jargon) and the researcher should take account of personal characteristics such as age, educational background, cultural background and any other possible barriers to understanding the information. There should be an opportunity for prospective participants to ask questions about the research.

It is essential that participants have the competence to give informed consent. A wide variety of symptoms, diseases, injuries and other conditions can affect a person's ability to understand information and the researcher must take this into account when seeking informed consent. For participants who are legally unable to give informed consent (e.g. children and individuals with an intellectual disability), the researcher must obtain appropriate consent from the persons who are legally responsible for participants' wellbeing (i.e. parent or guardian).

Often, researchers obtain informed consent using a document like the sample consent form in the Ethical conduct and safety learnMORE section in learnON. Two copies are made so that one can be kept by the researcher and one by the participant.

- **Use of deception in research**: Is only permissible when participants knowing the true purpose of the experiment may affect their behaviour whilst participating in the study, and the subsequent validity of the experiment.

The use of deception is discouraged in psychological research and used only when necessary.

By its nature, deception violates the ethical requirement of informed consent. Its use also means that the relationship between researcher and participant is not open and honest. However, deception is considered acceptable if the potential benefits of the research justify its use and there is no feasible alternative to its use.

- **Voluntary participation**: Ensures that no coercion or pressure is put on the participant to partake in an experiment, and they freely choose to be involved. Therefore, the researcher must ensure all participants voluntarily consent to be involved in an investigation. The researcher must also ensure that prospective participants do not experience negative consequences if they choose not to be involved in a study.
- **Withdrawal rights**: Involves a participant being able to discontinue their involvement in an experiment at any time during or after the conclusion of an experiment, without penalty. This may include the removal of the participant's results from the study after the study is completed. Participants also have the right to withdraw without giving a reason for doing so.

Withdrawal rights must be explained to participants before the study commences and the researcher must ensure that participants suffer no negative consequences as a result of withdrawing from the study.

learnon

learnMORE | Ethical conduct and safety

- Human Research Ethics Committees
- Sample consent form to participate in research
- Australian Privacy Principles
- Safety and wellbeing in VCE Psychology
- Use of animals in psychological research

Access learnON for additional information.

Figure 1.66 The National Statement requires that all research that carries more than a low level of risk to human participants must first be reviewed and approved by a Human Research Ethics Committee. Organisations such as universities and hospitals which conduct a considerable amount of research involving people usually set up their own ethics committees to meet National Statement guidelines.

1.12 LEARNING ACTIVITY 1

Review

1. Define the meaning of ethics in relation to research.
2. What is the primary purpose of ethical standards, concepts and guidelines for psychological research with human participants?
3. Name and briefly describe the five concepts underlying ethical standards and guidelines for all research with human participants.
4. List four essential informed consent procedures.
5. What is the ethical responsibility of a researcher who conducts research with human participants, but does not fully inform them of the true purpose of the research before the study begins because it may influence the participants' behaviour?
6. A research participant became distressed during an important investigation with some very significant potential benefits for the individual involved and all others. Based on your understanding of the ethics concepts and principles, what should the researcher do?
7. Explain the ethical relevance of the Australian Privacy Principles.

8. Which ethical research concept — *beneficence, integrity, justice, non-maleficence* or *respect* — is relevant to each of the following statements?

Statement	Ethical concept
a. The process of recruiting participants is fair.	
b. The researcher does not 'make fun' of a participant's unexpected responses.	
c. The researcher sees it as their duty to do no harm or allow any harm to all participants	
d. The researcher has a commitment to following all relevant ethical standards.	
e. The researcher does not put pressure on a participant to consent to study participation.	
f. The researcher is certain that what is likely to be learnt from their study justifies the risks of harm or discomfort to participants.	
g. The researcher ensures easy access to the results of the research when available.	
h. Every single human being has value in himself or herself.	
i. The researcher ensures all members of the research team are properly qualified to undertake their respective responsibilities.	
j. The researcher is willing and able to answers even the most trivial questions about the research.	

9. Consider the following fictitious examples of research studies that may breach one or more ethical concepts or guidelines and identify the ethical issue(s) raised, if any, in each example.

   a. **Study 1:** A psychology lecturer at a university was studying techniques for reducing fear of spiders. He asked a research assistant to telephone students in the first-year psychology course he was teaching to determine their willingness to participate. The researcher was unaware that the assistant told participants that they had to participate.
   b. **Study 2:** A researcher was interested in factors influencing cheating. She gave participants an exam, then collected and photocopied their answers. The participants were not informed about the photocopying. The answers were returned unmarked and the participants were given the opportunity to cheat while marking their own papers. The answers were collected again and compared with the photocopies.
   c. **Study 3:** Another researcher investigated cheating by concealing themself and three colleagues in a projection booth in an auditorium during an exam. From this vantage point high above all students, the researchers used binoculars to observe cheating behaviours of students in different quadrants of the room. Each observer used a checklist to record inappropriate head movements, exam paper switching, note checking, note passing and other suspicious exam behaviours within the quadrants.
   d. **Study 4:** An experiment was conducted to assess driver reaction to a stressful situation. Each participant was asked to drive a car past a construction site. The researcher rigged a human-looking dummy in such a way that it would be propelled in front of the car, making it impossible for the participant to avoid hitting it. The participants reacted as expected. When they learned that the situation was faked, they informed the researcher of their displeasure. Despite their complaints, the researcher continued testing further participants (adapted from Wood, 1981).
   e. **Study 5:** A VCE Psychology student was required to undertake a research investigation to satisfy the course requirements. The student researcher replicated an experiment on learning that involved classical conditioning of an eye-blink response using two preschool children and two adults as participants. The student researcher thought that the adult participants' knowledge of the conditioning procedure would affect the results in an unwanted way and decided not to seek their informed consent. The student researcher also based their decision on the belief that the conditioning procedure was physically and psychologically harmless. The student researcher did, however, obtain informed written consent from both parents of each child.

f. **Study 6:** A researcher conducted an observational study to investigate behaviour in public rest rooms. This research method was expected to obtained more valid and reliable data than could be accessed through a self-report measure. A team of male and female researchers concealed themselves in vacant toilet stalls of the respective rest rooms and observed behaviours of men and women (adults only), such as flushing vs non-flushing, hand washing vs hand drying, mirror checking, clothing adjustments, littering and graffiti writing.

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1.12 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.42; © VCAA.

Which of the following outlines the informed consent considerations when researching children and adults with a mental disorder?

	Children	Adults with a mental disorder
A.	are not likely to understand complex research and are unable to give their own informed consent	are incapable of giving informed consent
B.	deception can be used in research with children if their parent/guardian has consented	a placebo treatment may be used with informed consent despite intentionally denying access to treatment
C.	children can be studied at school without informed consent	informed consent can be obtained from a legal guardian when an individual is incapable of giving it
D.	no informed consent is needed when studying children through observation	no informed consent is needed when adults with a mental disorder are admitted to the public health system

Question 2 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.39; © VCAA

Professor Dominique wants to test an intervention for stress management. She plans to recruit participants from the university community and randomly allocate them to groups of four. Participants will be told that they will be locked in an escape room until they either solve the puzzles in there or an hour passes. After reading the participant information sheet about the specific purposes of the study and signing a consent form, the groups will be further randomised to either the experimental condition or the control condition.

The groups in the experimental condition will be given a 30-minute presentation by one of her research assistants on effective coping strategies to help alleviate stress, then put into the escape room. The groups in the control condition will immediately go into the escape room after providing consent.

Immediately after leaving the escape room, the participants will rate their feelings of stress across the study period, then Professor Dominique plans to discuss the findings with the participants and any uncomfortable experiences they had. The groups will be assessed on how long it took them to escape and their self-reported stress. The key outcome will be the difference between the two conditions.

The ethics review panel requested modifications when it first received Professor Dominique's study proposal. Based on the information provided above, what did Professor Dominique fail to consider?

A. deception
B. debriefing
C. informed consent
D. withdrawal rights

Question 3 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.37 (adapted); © VCAA

Cora, a university student, conducts an experiment in a classroom to test the effectiveness of bright light therapy on adolescent boys with a circadian phase disorder. She recruits nine 16-year-old boys from a suburban boys' school to participate in her experiment.

Before commencing this experiment, Cora is ethically required to collect informed consent from

A. the adolescents.
B. a parent/guardian.
C. the adolescents and their teachers.
D. the adolescents and their parent/guardian.

Question 4 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.7; © VCAA

A psychologist wanted to investigate people's responses to being pricked by a needle. Details of the investigation were provided to a group of 10 participants prior to the investigation. The investigation involved blindfolding participants and pricking each participant's finger over several trials.

When the psychologist first pricked her with the needle, Nerissa started crying and ran outside. She did not return and the psychologist was unable to contact her afterwards. Which ethical principle was potentially compromised as a result of Nerissa leaving the investigation before it had finished?

A. debriefing
B. confidentiality
C. informed consent
D. withdrawal rights

Question 5 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.49 (adapted); © VCAA

Dr Smith is one of 10 doctors who work at the Bayview Lodge Medical Clinic. He wanted to investigate the effect of a new brand of benzodiazepine on the progression of a specific phobia in patients at the clinic. Fifty of Dr Smith's patients volunteered to take part in the study.

Some of the patients had a legal guardian. In order to obtain informed consent from these patients, Dr Smith needed to ensure that

A. only the patient was informed about the nature, purpose and risks of the study.
B. only the guardian was informed about the nature, purpose and risks of the study.
C. the guardian provided consent and the patient understood to the best of their ability the nature, purpose and risks of the study.
D. the patient provided consent and their guardian understood to the best of their ability the nature, purpose and risks of the study.

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1.13 Types of data

All psychological research involves collection of information. In research, the information which is collected is called **data**. The data is evidence that will form the results of the investigation and be the basis of the conclusions that will be made.

Data can take different forms. The type of data collected is determined by the specific kind of research method used. For example, questionnaires and interviews often provide data in the form of words, whereas data collected in correlational studies is usually in the form of numbers.

There are many ways of classifying data. We consider the distinctions between primary and secondary data and quantitative and qualitative data in relation to psychological research.

1.13.1 Primary and secondary data

Primary data is information collected directly from the source by the researcher (or through others) for their own specific purpose. It is collected from the original source for the first time by the researcher, which is why it is sometimes described as 'first hand' data. For example, you will collect primary data when you conduct your own scientific investigations.

If you use an experiment to collect data then the primary data will be the participants' responses for your measure of the dependent variable. Their original responses may also be called *raw data* because they have not been processed from their original state. Raw data is a type of primary data.

When you summarise your data as a table or convert it to percentages, it will still be primary data because you are the researcher who originally collected and processed it. You have also retained control over it.

When someone else accesses your primary data, you lose control over it because they can manipulate or use it in whatever way they want for their own purpose. It will be secondary data for the other person.

Secondary data is information that was not collected directly by the current researcher but was collected at an earlier time by someone else. It has already been collected by some other individual, group or organisation and will not be used for the first time, which is why it is referred to as 'secondary' (like second-hand).

The Australian Bureau of Statistics is a widely used source of secondary data, as are the results reported by researchers in journal articles. Of course, the same lot of secondary data can be collected multiple times by multiple researchers.

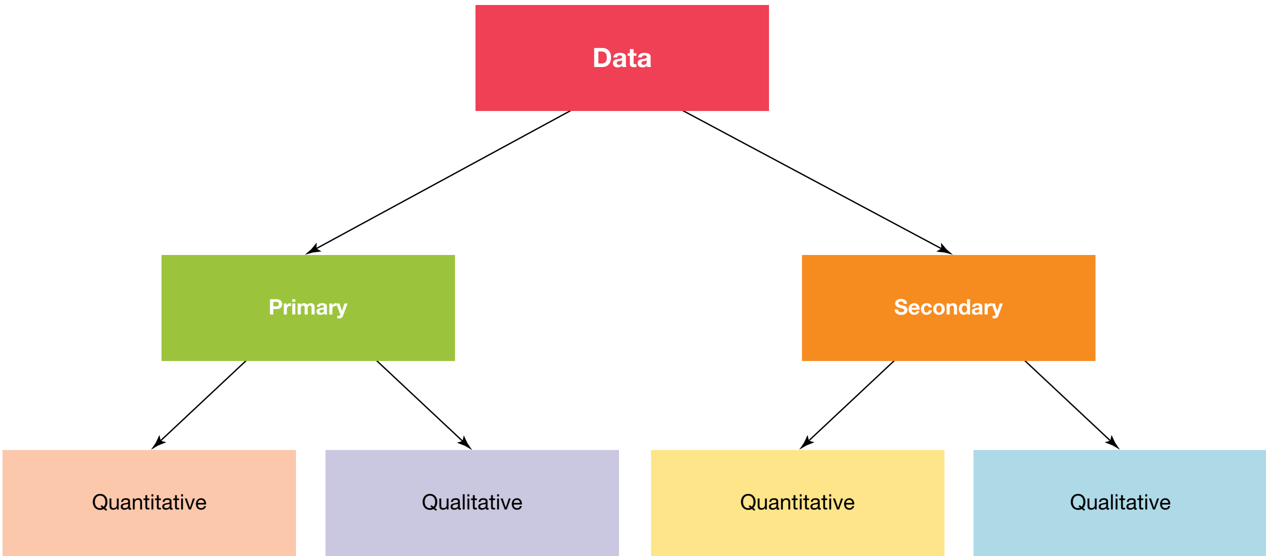

Figure 1.67 A classification system for different types of data

The main difference between primary and secondary data is in who collects the original data, whether it originates with the researcher specifically to address a research question or whether it has already been collected by someone else. Both types of data have their advantages and limitations.

Primary data offers tailored information sought by the researcher to test a hypothesis for a research question of their choosing. To the researcher, there is little doubt about the quality of the data collected. They are also responsible for the quality of their data, but it can be time-consuming to collect and process.

Secondary data tends to be readily available and can usually be accessed in less time, especially if you know where and how to look. There can be uncertainty about its quality because it is usually collected for another purpose and there is often a need to comb through it to find what you're looking for.

1.13.2 Quantitative and qualitative data

Primary and secondary data may be quantitative or qualitative. The majority of investigations referred to in this text use quantitative data. This reflects the preference for quantitative data in most psychological research.

Quantitative data

Quantitative data is information that is expressed numerically. As suggested by the term, it is information about the 'quantity' or amount of what is being studied; that is, how much or how many of something there is.

This type of data is usually expressed in the form of units of measurement or numbers, such as raw scores, percentages, means, standard deviations and so on. For example, the height or age of a participant is considered quantitative data as both of these characteristics can be expressed in units of measurement (centimetres or years). Similarly, the percentages of participants who respond with 'Agree' or 'Disagree' to interview questions, or the mean time taken to solve a problem in an experiment, are quantitative data.

All types of mental experiences and behaviours can be described in quantitative terms as amounts or numbers. For example, a questionnaire might ask participants to use a 5 point scale to rate the level of stress caused by different events or the effectiveness of different strategies for coping with stress.

Psychologists use many different tests to measure various mental processes and behaviours and most of these also provide quantitative data. There are tests to measure intelligence, personality traits and all kinds of aptitudes, interests and abilities. Answers are often totaled to yield a score that can be interpreted and applied to the person or group who did the test.

Similarly, data collected by devices used to record the electrical activity of the brain when awake or asleep are measurements and numerical values that are best described as quantitative data.

The use of numerical data makes it easier to summarise and interpret information collected through research. This is why quantitative data is often preferred to qualitative data, although this does not mean that qualitative data is less important or less useful than quantitative data.

Qualitative data

Qualitative data is information that is not expressed numerically. As suggested by the term, it is information about the 'qualities' or characteristics of what is being studied.

It may be in the form of descriptions, words, meanings, photos, pictures, audio or video recordings, and so on. It can describe any aspect of a person's mental experience or behaviour; more specifically, what something is like, how something is experienced or whether it was an X or Y type of experience.

Qualitative data may be collected as written or verbal statements made by participants, or as descriptions of behaviour observed and recorded by the researcher. For example, a researcher may make a video recording of a sleeping person when investigating sleep-related behaviour, such as changes in body position, or, a researcher may collect and analyse drawings in order to study how a child is feeling following a recent family trauma.

Likewise, a researcher may conduct an investigation on the advantages and limitations of government-funded mental health services provided over the internet and telephone. The researcher may collect data by conducting interviews or focus groups with individuals who have recently used one or more of these services. Participants may be asked to give examples of when they have used a service and describe their experience without any constraint, other than occasional questions by the researcher to ensure their responses are relevant, have enough detail and have been clearly understood.

Experiments can produce qualitative data as well as numbers. For example, in his classic experiments on obedience to authority in the 1960s, Milgram described the behaviour of his participants in some detail (qualitative data), as well as measuring the extent to which they were prepared to obey the experimenter (quantitative data).

Although different, quantitative and qualitative data are not mutually exclusive and are not often used separately. Qualitative data are typically expressed in the form of words, but they can be converted into a quantitative form. For example, participants' responses to free-response interview questions about their thoughts and feelings when they are anxious could be summarised as numbers based on the frequency ('how often') or intensity ('how strong') with which certain feelings are reported.

As you would expect, a research investigation that collects quantitative data is referred to as *quantitative research* and as *qualitative research* if qualitative data is collected.

Generally, psychologists tend to prefer quantitative data because using numbers increases the precision of results and the ease with which the results can be communicated. Quantitative data also enables more precise and detailed analysis through the use of statistical procedures and tests. These are also the reasons why qualitative data are often converted into quantitative data.

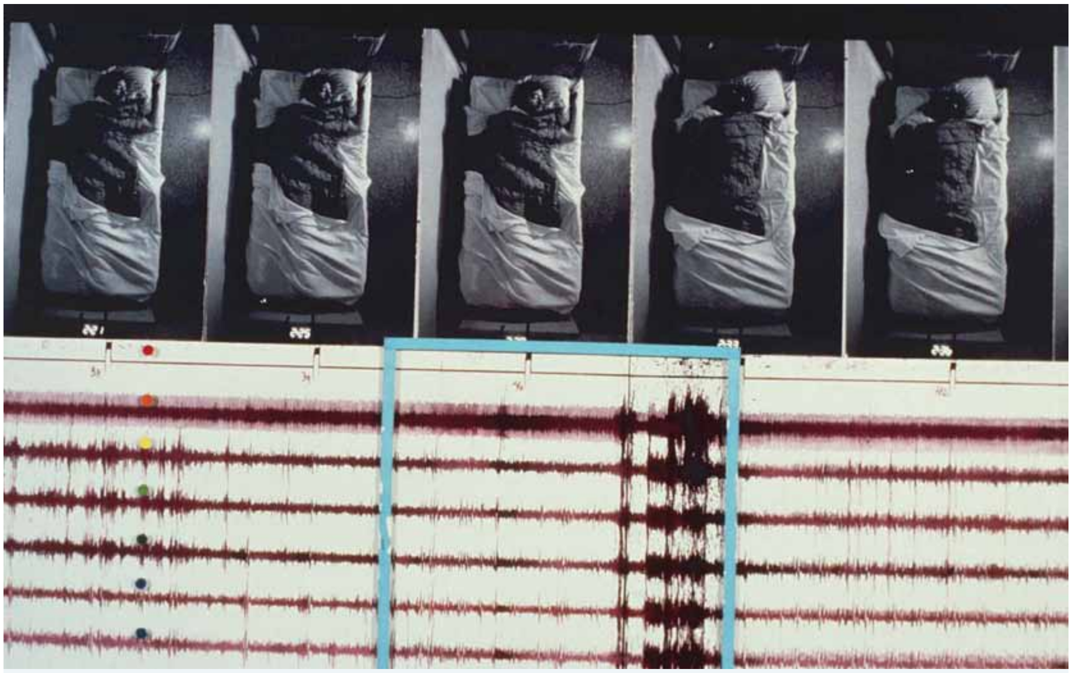

Figure 1.68 The recordings of electrical activity and various movements made by this person during sleep will be primary, quantitative data collected by the researcher.

on Resources

Teacher weblink Australian Bureau of Statistics — What are quantitative and qualitative data?

Figure 1.69 This participant is required to identify emotions from photos of facial expressions. Are the data collected by the researcher primary or secondary? Qualitative or quantitative?

1.13.3 Objective and subjective data

The terms ‘objective’ and ‘subjective’ are also used in relation to data – primarily, to refer to the way in which data are collected and the way they are described and explained.

Key science skills specified for VCE Psychology require you to evaluate data and to construct evidence-based arguments and conclusions. In doing so, you need to be able to make judgments about the quality of data and distinguish between opinion, anecdote and evidence, as well as scientific and non-scientific ideas. It is therefore useful to understand the distinction between data that are objective and subjective and that quantitative and qualitative data may also be objective or subjective.

Objective data is information that is observable, measurable, verifiable and free from the personal bias of the researcher. For example, the data can be seen, heard or touched (observable), counted or precisely described (measurable), can be confirmed by another researcher (verifiable) and is factual (free from personal bias). In science, there is a strong preference for objective data.

Data collected through a strictly controlled experiment in which observations and measurements are planned, precise and systematic is considered objective. So is data collected using an assessment device that yields a score, such as an intelligence or personality test.

Automated and mechanical devices can also be used to collect objective data. For example, an instrument that shows underlying physiological activity in measurable form, such as an EEG which records brain wave activity, provides objective data.

Sometimes researchers collect information about behaviour or mental processes that cannot be directly observed; for example, sexual behaviour or criminal acts. In these cases, researchers tend to rely on self-reports – participant responses to questions asked by the researcher. This information will be subjective.

Subjective data is information that is based on personal opinion, interpretation, point of view or judgment. Unlike objective data, this data is determined by the research participants and often cannot always be verified by the researcher. It is often biased, can vary from person to person, day to day from the same person, and is not always entirely accurate.

When using subjective data, researchers assume that participants are honest, can accurately recall what they are asked to describe and are able to give detailed accounts about their thoughts, feelings or behaviour.

Although subjective data may be more detailed than that available from more scientifically rigorous methods under controlled conditions, it tends to be difficult to interpret accurately when compared with objective data (which is usually quantitative).

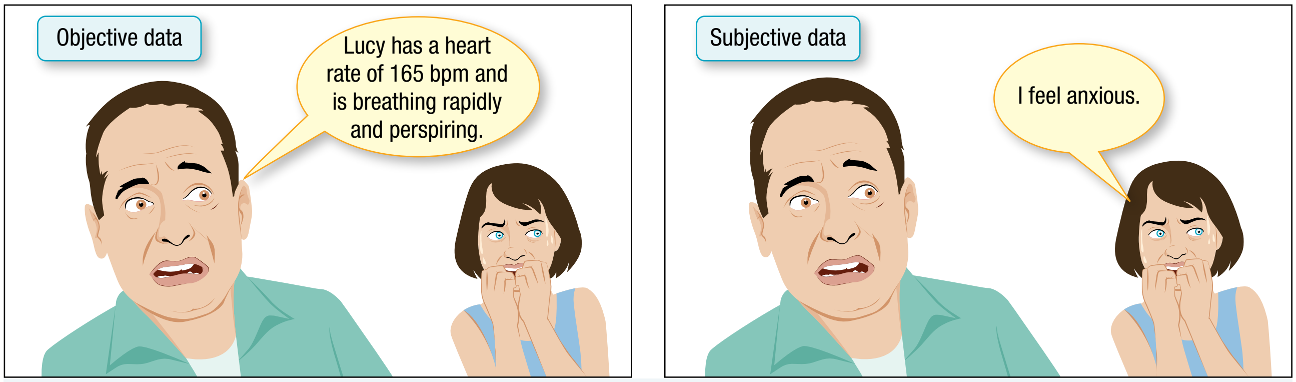

Figure 1.70 Objective and subjective data

1.13 LEARNING ACTIVITY 1

Review

1. Distinguish between primary and secondary data with reference to an example of each data type.
2. a. Distinguish between qualitative and quantitative data with reference to characteristics of your psychology class.
   b. Give examples of two strengths and two weaknesses of quantitative and qualitative data.
3. Consider each of the following investigations. For each one, enter the correct letters in the spaces provided to indicate which of the three types of data are used: Primary data: Pr | Secondary data: Sc | Qualitative data: Ql | Quantitative data: Qn | Objective data: Ob | Subjective data: Su
   a. ____ ____ ____ A researcher compares the detail in paintings by people with a phobia and people with schizophrenia
   b. ____ ____ ____ A researcher compares the differences in visual perceptual abilities of kittens with and without damage to the visual cortex in the brain
   c. ____ ____ ____ A researcher observes how much time male and female adolescents take to get ready for a deb ball
   d. ____ ____ ____ A researcher reviews a YouTube mini-documentary showing participant responses during an experiment on the effects of playing violent video games
   e. ____ ____ ____ A researcher uses diary records kept by people hospitalised with a mood disorder to study their mental experiences
   f. ____ ____ ____ A researcher analyses the content of media reports that attribute causation to the results of correlational studies
   g. ____ ____ ____ A researcher uses diary records kept by people hospitalised with a mood disorder to study their mental experiences
   h. ____ ____ ____ A researcher analyses the emotional content of a blog on the ethics of animal research
   i. ____ ____ ____ A researcher collects data to assess the relationship between scores on a standardised test for antisocial personality disorder and the length of sentences for prisoners convicted of a violent crime.
   j. ____ ____ ____ A researcher analyses participant scores on a test of recall in a study on long-term memory decline and ageing
   k. ____ ____ ____ A researcher uses free response questions to investigate how people feel when stressed

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1.13 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.46 (adapted); © VCAA

Ekon wants to join his local emergency volunteer group. The volunteer group has identified five risk factors that could potentially impair a volunteer's social and emotional wellbeing while they are in the role. Using an online questionnaire, Ekon rates himself against each of the factors on a rating of 1–10, with 1 indicating low risk and 10 indicating high risk.

The type of research method used in this scenario was

A. interview with objective data.
B. self-report with quantitative data.
C. questionnaire with qualitative data.
D. within subjects with experimental data.

Question 2 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.36 (adapted); © VCAA

Parminder compared the effects of consumption of alcohol on reaction times in people at various stages of life. His stratified sample included participants aged 18 to 70 years. In the within subjects experiment, participants consumed one standard drink of alcohol at half-hourly intervals until they reached 0.10% blood alcohol concentration (BAC). Participants completed a series of computer-based tests for reaction times at BACs of 0.00%, 0.05% and 0.10%.

Additionally, once participants reached 0.10% BAC, Parminder asked all participants to write down on a lined piece of paper their immediate feelings, thoughts and memories, and to provide an estimate of how long they thought the tests ran for.

Which of the following accurately describes the two types of data Parminder was gathering during the testing period and after the last test?

A. subjective and qualitative
B. self-report and qualitative
C. objective and quantitative
D. quantitative and qualitative

Question 3 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.50 (adapted)*; © VCAA*

One of the strengths of using secondary data from the internet for psychological research is that secondary sources will

A. have satisfied ethical guidelines.
B. have already been published and so the data is likely to be reliable and valid.
C. provide large reserves of data and be representative of the general population.
D. provide access to volumes of data that the researcher may not be able to gather.

Question 4 (1 mark)

Source: VCAA 2012 Psychology, Section A, Q.4; © VCAA

Maggie and Tom are two healthy 15-year-old high school students who participated in a sleep study. During the study, they had to record their respective number of hours of sleep. They submitted their sleep records to the researchers at the end of the study.

The type of data collected in Maggie's and Tom's sleep records was

A. qualitative only.
B. quantitative only.
C. counter balancing.
D. both qualitative and quantitative.

Question 5 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.50; © VCAA

Xuan is a researcher who wants to gather subjective and descriptive data from people who have been diagnosed with a mental illness in order to understand what living with a mental illness is like.

Which of the following identifies the type of data Xuan is collecting, the best method for collecting this data and the best sample size?

	Type of data	Data collection method	Sample size
A.	qualitative	interviews	small
B.	quantitative	interviews	large
C.	qualitative	questionnaire	large
D.	quantitative	online questionnaire with rating scales	small

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

1.14 Data organisation and presentation

When data have been collected to test a hypothesis, the researcher must decide whether the results support or do not support the hypothesis. The researcher must also draw a conclusion(s) relating to the hypothesis. This conclusion(s) must be based on the results obtained and limitations of the conclusion should be identified, described and explained. Reasons must be suggested about why the particular results were obtained and what they mean, including whether they can be applied to other similar situations. In addition, suggestions for further research and evidence are often made.

The first step is to organise and present the data in useful and meaningful ways. Tables, bar charts, line graphs and scatter plots may be constructed to assist this process, especially with quantitative data. Importantly, they may provide the basis of identifying trends and patterns in the data, including relationships between the variables that were investigated. They may also be used to help describe the data, which is why tables and graphs are called 'descriptive statistics'.

Suppose, for example, that a researcher is interested in whether memory declines with age. In order to investigate this, some previously unseen information may be given to ten 10-year-olds, ten 25-year-olds, ten 40-year-olds, ten 55-year-olds, ten 70-year-olds and ten 85-year-olds. The research participants would be required to learn the information and then complete a memory test so that their memory could be assessed. In all, there would be 60 bits of data (test scores) about the memory of participants in different age groups.

It is difficult to draw conclusions about whether (and if so, how) memory declines with age by looking at 60 individual scores. Thus, in order to compare the memory scores of the six different age groups to determine whether there has been a decline in memory with age, the data for each group could be summarised and presented in a table.

Tables are an effective means of recording data, but they may not be the best way to show trends, patterns or relationships. Often, a graphical representation of the data is best for this purpose.

1.14.1 Tables

A **table** is an orderly arrangement and display of data in columns and rows. The columns and rows are usually identified by names (or 'headers') that assist in making comparisons. Guidelines for constructing appropriate and useful tables include:

- All tables should be consecutively numbered, e.g. Table 1, Table 2.
- Each table should have an individual title
- The title should be a clear statement which explains what the table is about without being too long e.g. Mean scores on memory test of each age group.
- Each column should be identified using a descriptive header.
- The first letter of each header in the table should be capitalised.
- The reader should be able to quickly work out what the table is about and comparisons of data should be easy to make.
- In the research report, essay or other document, the word table is capitalised whenever referring to it, e.g. '. . . as shown in Table 1'.

Table 1.7 provides some order to the data by organising the individual scores into age groups. However, comparison of scores across the different ages is still difficult because the data have not been adequately summarised.

To better enable the scores for different ages to be compared, a single number that summarises the data for each age could be calculated. For example, the researcher could calculate the mean score on the memory test for each age. The mean scores could be used to describe the 'average' performance on the memory test for each age and would enable the researcher to compare the different ages, as shown in Table 1.8. The use of the mean for simplifying comparison between groups is discussed further in the next section.

Table 1.7 Individual participant scores on a memory test

Age (years)	Participant scores
10	14, 11, 9, 10, 15, 16, 14, 12, 13, 11
25	14, 16, 16, 18, 13, 17, 14, 15, 17, 8
40	17, 15, 12, 16, 19, 10, 18, 14, 13, 18
55	10, 18, 13, 14, 15, 14, 12, 19, 12, 10
70	13, 10, 12, 16, 7, 15, 9, 12, 11, 8
85	6, 14, 12, 10, 11, 9, 16, 10, 8, 13

Table 1.8 Mean scores on memory test of each age group

Age (years)	Mean scores
10	12.5
25	14.8
40	15.2
55	13.7
70	11.3
85	10.9

A commonly used table in psychology is called a frequency distribution. A frequency distribution is a way of organising data to show how often ('frequently') a value or measure (such as a score) occurs in a set of data. A frequency distribution can also be presented as a graph.

Table 1.9 is an example of a frequency distribution for scores obtained by males and females in an experiment. It shows all the possible values of what has been measured (organised into groups or categories called *class intervals*) and the number of times each value occurs in the set of data (the number of individuals in each class interval).

Table 1.9 Example of a frequency distribution of scores by males and females

Scores	Males	Females
20–24	0	0
15–19	1	2
10–14	3	5
5–9	4	2
0–4	2	1
Total	10	10

In a frequency distribution, the scores are often arranged either from the highest to the lowest score or from the lowest to the highest score, so that data are presented in an orderly, logical way.

When there is a large number of scores, it is often useful to organise the scores into class intervals, then total the number of scores for each class interval. The class interval can be any size within the range of scores, but the size of each class interval should be consistent across all scores. Intervals of five or ten units are typically used. If an interval of five is used (as in Table 1.9), then the difference between one interval and the next is five; that is, 0–4, 5–9, 10–14, and so on.

1.14.2 Graphs

A **graph** is a pictorial representation of data. Graphing or plotting data typically involves the use of two lines (axes) drawn at right angles to one another. The horizontal line is the *x axis* and the vertical line is the *y axis*. The point where the axes intersect is called the *origin* (0).

When constructing a graph for experimental research data, it is essential that the IV is represented on the horizontal (*x*) axis and the DV is represented on the vertical (*y*) axis.

Graphs are best used to determine and communicate trends, patterns or relationships in the data collected; for example, how often a response is made, how aspects of behaviour change over time or as a participant's experience changes, and how one variable may be related to or change in relation to another.

Among the more commonly used graphs in psychology are bar charts and line graphs. Scatter plots may be used to display correlational data.

In psychology, graphs are more formally referred to as 'figures' (along with drawings, photos and any type of illustration). Guidelines for constructing appropriate and useful graphs include:

- All graphs should be consecutively numbered, e.g. Figure 1, Figure 2.
- Each graph should have an individual title
- The title should be a clear statement which explains what the graph is about without being too long, e.g. Reaction time of each age group.
- The number and title are both on the same line and usually shown below the graph.
- Both the horizontal and vertical axes must be labelled clearly and indicate what is plotted (and, as stated above, the IV is represented on the *x* axis and the DV on the *y* axis).
- The reader should be able to quickly work out what the graph is about.

Bar charts

A **bar chart** is a graph which uses a series of separate bars or rectangles next to, but not touching one another, to enable comparisons of different categories of data. The bars can be positioned horizontally or vertically. One axis is used to show the types of categories (e.g. age, sex, type of response) and the other axis is used to show the frequency with which each category occurs (e.g. how often, how much).

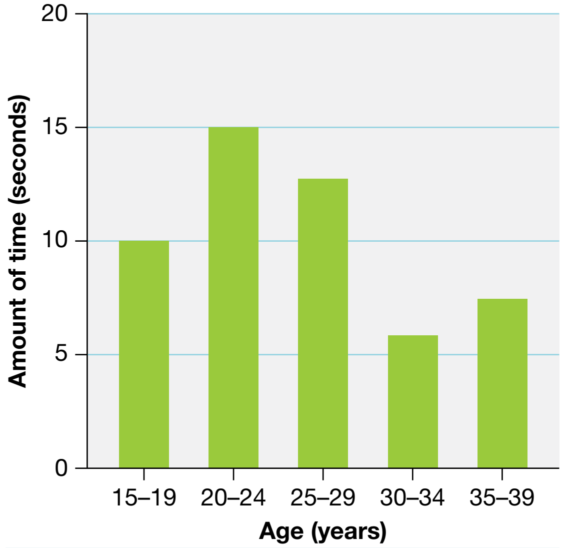

Figure 1.71 An example of a bar chart

One important feature of a bar chart is that each of the categories shown in the graph is separate and there is no continuation between one category and the next; for example, there would be separate bars for data about female participants' responses and male participants' responses. Each bar is the same width and has a small space between it and the next bar.

Sometimes a bar chart is used to represent values from two categories; for example, scores obtained by age group (e.g. amount of time to solve a problem) and by sex. This is shown in Figure 1.72a on the next page. The data for two categories can also be presented within a single bar. This is shown in Figure 1.72b which combines results for males and females within single bars.

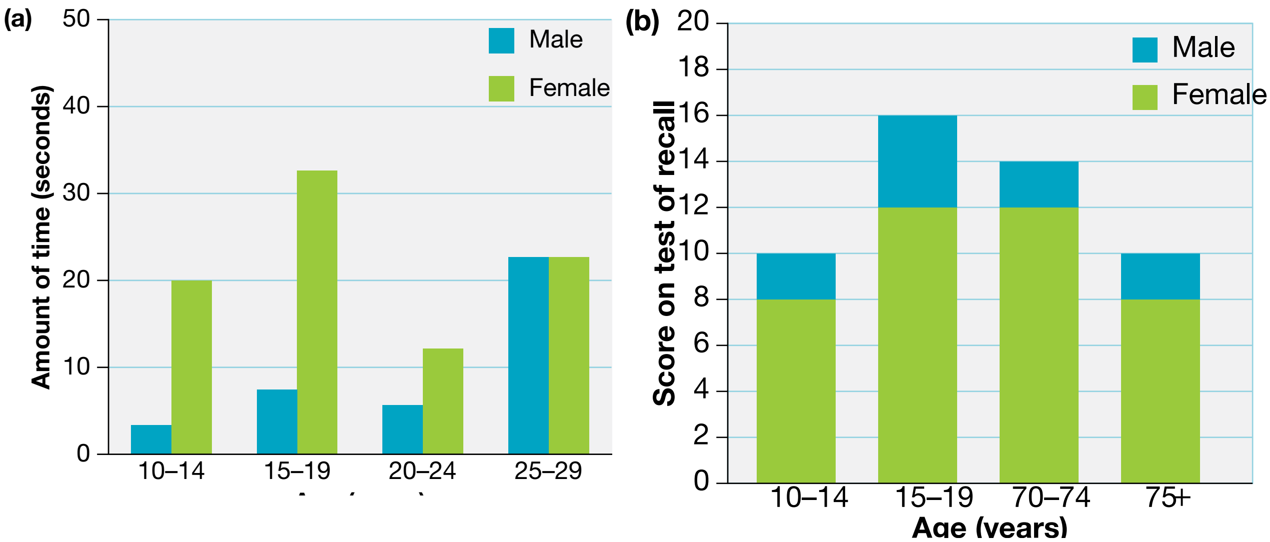

Figure 1.72 Two bar charts showing different ways of presenting data for males and females of different ages

Line graphs

A **line graph** uses points connected by lines to show how one variable changes as another variable changes. For example, Figure 1.73 shows how performance on a speed and accuracy test (e.g. matching symbols with numbers) changes in relation to the number of hours of sleep a person has had. You can see at a glance that the number of errors (the measure of performance) was the greatest when only one hour of sleep was obtained and that the number of errors tended to decrease as the amount of sleep obtained increased.

When used to show the results of an experiment, the IV is usually plotted on the horizontal (*x*) axis, with the numerical value of the data increasing as you go along this horizontal axis from left to right.

As shown in Figure 1.73, a line graph that describes the relationship between amount of sleep obtained and test performance would list the amount of sleep in hours on the *x* axis in intervals; for example, beginning at zero, then one, two, three, four hours and so on. One important feature of a line graph is that the variable plotted on the *x* axis is continuous; that is, a series of progressively increasing values can be listed.

The vertical (*y*) axis usually has the DV (ie. the measure of performance) plotted along it. A line graph that described the data from the experiment on the amount of sleep obtained and test performance would record the test scores (e.g. a total correct score or number of errors) along the *y* axis in intervals, beginning at zero. This is also shown in Figure 1.73.

Various points on a line graph represent the score on one axis that corresponds with a value on the other axis. The intersecting point can represent a corresponding IV/DV score on the two variables by one research participant, or the mean score of a group of participants.

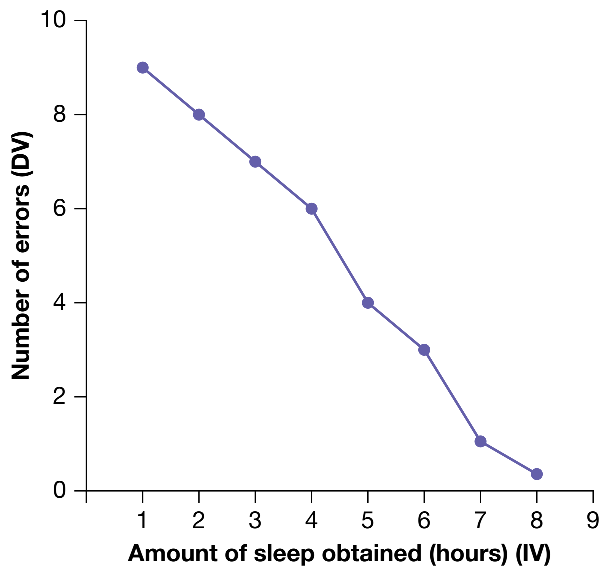

Figure 1.73 A line graph showing the results of an experiment investigating the effect of amount of sleep (IV) on performance on a speed and accuracy test (DV)

A number of different sets of data can also be plotted on the one graph. For example, in Figure 1.74 there are three sets of data showing age-related performance on a problem-solving task following different amounts of sleep deprivation. To identify the results of different age groups, a different coloured line has been used for each set of data. Note too the use of dots to identify the points of intersection between data for the *x* and *y* axes.

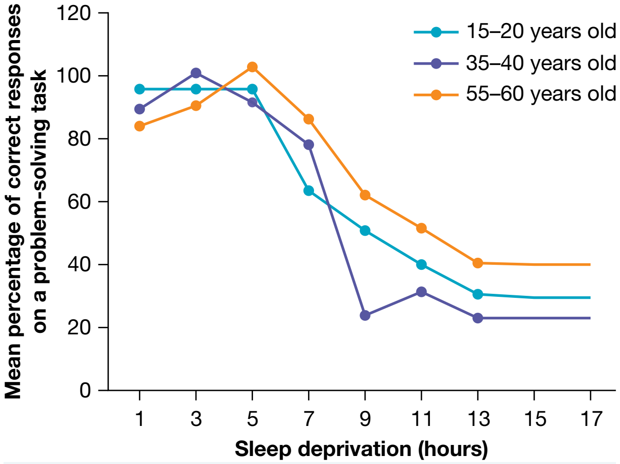

Figure 1.74 A line graph showing three sets of data so comparisons can be made

Scatter plots

Correlational data are often displayed in a scatter plot (also called a *scattergram* or *scatter diagram*). A **scatter plot** shows the scores (or other values) on two different variables measured in a correlational study. The values of one variable are shown on the vertical *y* axis and the values of the other variable on the horizontal *x* axis. Each pair of scores is plotted as a single point (or dot) in the scatter plot.

The spread of the dots on a scatter plot gives an idea of the *strength* of the correlation — the extent to which the two variables are related (or associated). Widely spread dots in the scatter plot in Figure 1.75 suggest that the two variables, facial attractiveness and intelligence, have little or no relationship. This would be represented by a correlation close to 0. In a zero correlation, individuals with high scores on one variable may have high, middle or low scores on the other variable. Figure 1.75 shows that participants with high scores on attractiveness have high, medium and low scores on an intelligence test (which have been converted to scores on a 10-point scale).

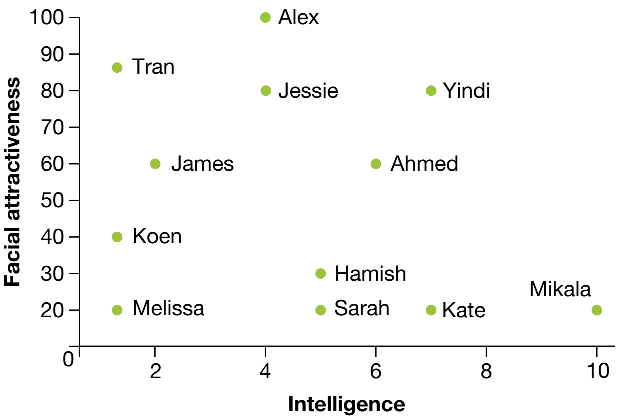

Figure 1.75 Scatter plot showing data for 12 participants obtained from a correlational study that investigated the relationship between facial attractiveness and intelligence

Figures 1.76 and 1.77 below both show a moderate correlation as the dots cluster together in a cigar-shaped pattern. Figure 1.76 shows a positive correlation and Figure 1.77 shows a negative correlation.

The *direction* of the correlation — whether the correlation is positive or negative — is indicated by the slope or 'lean' of the dots, that is, whether they slope upwards or downwards (or neither).

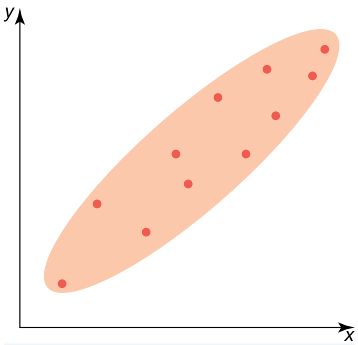

Figure 1.76 Moderate positive correlation

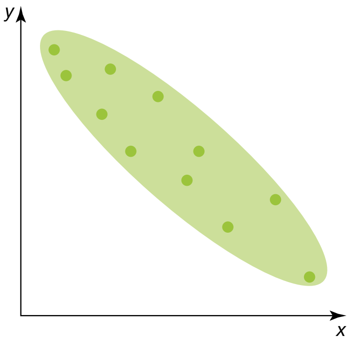

Figure 1.77 Moderate negative correlation

As shown in Figures 1.78 and 1.79 on the next page, a line can be been drawn through the middle of the dots to help identify the slope.

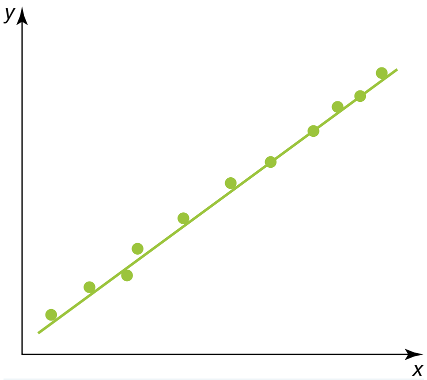

Figure 1.78 Strong positive correlation

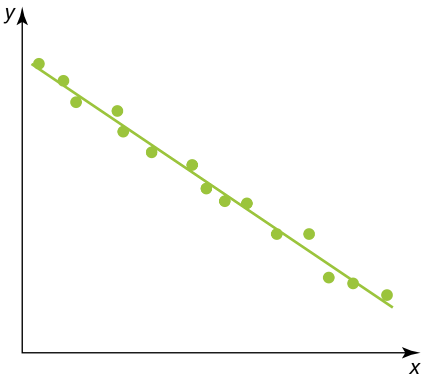

Figure 1.79 Strong negative correlation

In Figure 1.78 the upward sloping line indicates a positive correlation, whereas the downward sloping line in Figure 1.79 indicates a negative correlation. Note that in both Figures 1.78 and 1.79, the dots are closely clustered around each line, indicating a strong positive correlation in Figure 1.78 and a strong negative correlation in 1.79.

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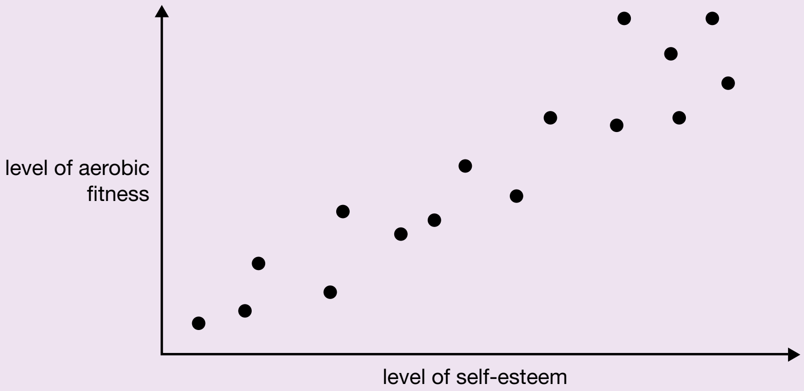
1.14 LEARNING ACTIVITY

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2003 Psychology 2, Section A, Q.43; © VCAA

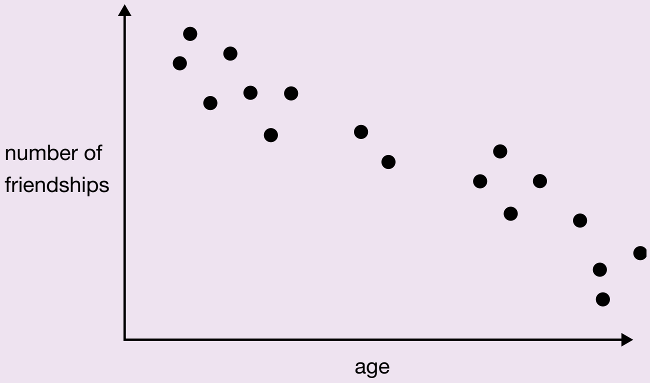


Which of the following statements best describes the results in the graph above?

A. There is a strong positive correlation between the two variables.
B. There is a weak positive correlation between the two variables.
C. There is a strong negative correlation between the two variables.
D. There is a weak negative correlation between the two variables.

Question 2 (1 mark)

Source: VCAA 2002 Psychology 2, Section A, Q.31; © VCAA

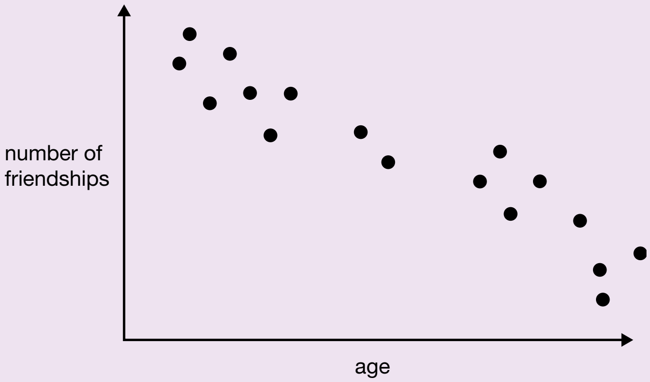


The scattergram shows that

A. there is a weak negative relationship between a person's age and the number of friendships they have.
B. there is a strong positive relationship between a person's age and the number of friendships they have.
C. there is a strong negative relationship between a person's age and the number of friendships they have.
D. there is a weak positive relationship between a person's age and the number of friendships they have.

Question 3 (1 mark)

Source: VCAA 2002 Psychology 2, Section A, Q.32; © VCAA Adapted



Which one of the following correlation coefficients most likely corresponds to the data in the graph?

A. .8
B. –.8
C. –.3
D. .3

Question 4 (1 mark)

Source: VCAA 2002 Psychology 2, Section A, Q.45; © VCAA

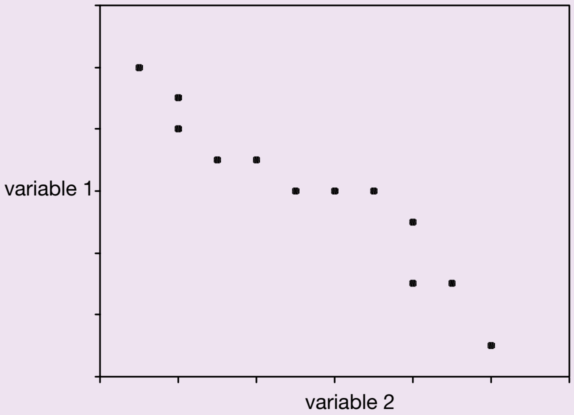
A correlation of .2 indicates

A. a strong relationship between two variables; one of which increases while the other decreases.
B. a weak relationship between two variables; one of which increases while the other also increases.
C. a weak relationship between two variables; one of which increases while the other decreases.
D. a strong relationship between two variables; one of which decreases while the other also decreases

Question 5 (1 mark)

Source: VCAA 2004 Psychology 2, Section B, Q.19a; © VCAA

Look at the following scatterplot.



How would you describe the relationship between the two variables?

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

1.15 Evaluation of data and research

Organising and presenting data in meaningful ways assists interpretation and evaluation. Some additional processing of the data is also useful, both for your own investigations and for interpreting data presented elsewhere.

In VCE Psychology, you need to be able to process quantitative data through calculations of percentages and measures of central tendencies. You also need to demonstrate an understanding of standard deviation.

As with tables and graphs, calculations such as percentages and mean scores will help you describe the data as these are descriptive statistics. Standard deviations are also descriptive statistics but you do not need to calculate this measure of variability.

1.15.1 Percentages

Suppose you conduct an observational study to find out whether more year 7 boys engage in disruptive behaviour in the classroom than do year 7 girls. You want to obtain quantitative data, so you work out a list of observable behaviours that you consider to be disruptive in the classroom. Your list includes behaviours such as distracting other students, calling out in class and being out of the seat without permission.

You observe two different classes from a store room at the back where you have concealed your presence. Whenever you see a boy or girl demonstrating one of the disruptive behaviours on your list, you record your observation with a tick and shift your attention to another child. Of the 25 boys you observe, 6 engage in a disruptive behaviour and 4 of 16 girls observed are disruptive on at least one occasion.

The data clearly shows that more boys than girls were disruptive at least once. However, more boys than girls were also observed. In order to reach a valid conclusion, you need to work out whether is more than or less than . This can be achieved by calculating the percentages of boys and girls who engaged in disruptive behaviour, then making a comparison.

A **percentage** is a statistic that expresses a number as a proportion (or fraction) of 100. The term *per cent* means 'per hundred', or 'for every hundred'. It is shown using the percentage sign (%). For example, 65% is equal to $\frac{65}{100}$ and means 65 parts out of 100; 100% of something means *all* of it.

A percentage is calculated using the formula

$$\% = \frac{\text{subtotal}}{\text{total}} \times \frac{100}{1}$$

It is easy to calculate a percentage when the original amount is 100. For example, if you complete a 100 item speed and accuracy test and correctly answer 90 items within the time limit, then your percentage score is:

$$\frac{90\text{ (subtotal)}}{100\text{ (total)}} \times \frac{100}{1} = \frac{90 \times 100}{100} = \frac{9000}{100} = 90\%$$

For the data obtained in the observational study of disruptive behaviour:

$$\text{boys: } \frac{6\text{ (subtotal)}}{25\text{ (total)}} \times \frac{100}{1} = \frac{6 \times 100}{25} = \frac{600}{25} = 24\%$$

$$\text{girls: } \frac{4\text{ (subtotal)}}{16\text{ (total)}} \times \frac{100}{1} = \frac{4 \times 100}{16} = \frac{400}{16} = 25\%$$

This means that the proportion of boys (calculated 'out of 100') who were disruptive in the classroom is slightly less than the proportion of girls. The main problem in making a comparison of the boys and girls based on the raw data is that the two groups were of unequal size. Calculating a percentage for each group overcame this problem and enabled a more precise comparison of the scores for boys and girls.

Percentages are commonly used in psychology to describe data; for example, scores on a test, categories of scores, changes or trends in scores, the percentage of people who respond in a particular way (such as correct or incorrect, agree or disagree, do something or do not do something) and the percentage of people in a socio-cultural group (such as gender, age, income level, educational qualifications and ethnicity).

Common percentages and short cuts

There are many percentages that are commonly used in everyday life. These include 10%, 20%, 25%, 50% and 75%. Similarly, there are various fractions that often need to be converted to percentages. These include ½, ⅓, ¼ and ¾.

It is useful to remember the fraction equivalents of commonly used percentages to make calculations involving them quicker and easier.

The table on the right shows the fractional equivalents of some commonly used percentages and how to use these to speed up calculations.

Percentage	Fraction	How to calculate this percentage
1%	$\frac{1}{100}$	Divide by 100
5%	$\frac{1}{20}$	Divide by 20
10%	$\frac{1}{10}$	Divide by 10
$12\frac{1}{2}\%$	$\frac{1}{8}$	Divide by 8
20%	$\frac{1}{5}$	Divide by 5
25%	$\frac{1}{4}$	Divide by 4
$33\frac{1}{3}\%$	$\frac{1}{3}$	Divide by 3
50%	$\frac{1}{2}$	Divide by 2
$66\frac{2}{3}\%$	$\frac{2}{3}$	Divide by 3, then multiply by 2
75%	$\frac{3}{4}$	Divide by 4, then multiply by 3

Calculating percentage change

Percentage change occurs when quantities increase or decrease.

There are many times in psychological research reporting when a calculation of percentage change is required. For example, the percentage change in mean scores, reaction times, or some other variable.

To calculate percentage change, first calculate the net increase or decrease and then express it as a percentage of the original quantity.

$$\text{Percentage change} = \frac{\text{increase or decrease in quantity}}{\text{original quantity}} \times \frac{100}{1}$$

For example, when 50 increases (by 20) to 70, the

$$\begin{aligned}\text{percentage change} &= \frac{20\text{ (increase amount)}}{50\text{ (original quantity)}} \times \frac{100}{1} \\ &= 40\%\text{ increase}\end{aligned}$$

Note that percentage increases of more than 100% are possible; for example, the increase from 30 to 45 is an increase of 150%.

1.15.2 Measures of central tendency

Data are often summarised by calculating a single numerical score that can be used to describe the data for the whole group(s). This score, called a **measure of central tendency**, describes the 'central' or 'average' value of a set of scores. When a measure of central tendency is calculated, it often provides a 'typical' score for a set of scores.

To help determine which group performed best, a measure of central tendency could be calculated. This would provide a single score for girls and a single score for boys. Scores could then be compared to estimate which group of participants, boys or girls, performed best on the visual perception test. The most commonly used measures of central tendency are the mean, median and mode.

Mean

The **mean** is the arithmetical average of all the individual scores (or values) in a set of scores. It is calculated by adding all the scores together and dividing the total by the number of scores.

For example, if 10 rats were put into a previously unseen maze for a learning experiment, the length of time (in seconds) it might take each rat to reach the end of the maze could be:

26, 17, 21, 18, 12, 17, 18, 24, 25, 17

The mean for the group is calculated by adding the scores together (195), then dividing the total by the number of scores (10). The mean is 19.5 seconds. The formula for calculating the mean is shown as:

$$\overline{X}\text{(mean)} = \frac{\sum\text{(sum or total of all scores)}}{\text{N(numbers of scores)}}$$

In this example, the mean provides the most exact measure of central tendency. However, in other sets of data, the mean may not always provide the most accurate measure, especially if the scores cluster at the extreme ends of the set of possible scores. For example, if a set of scores consisted of 140, 140, 140, 140, 180, 180, 180, 180, the mean would be 160.

When scores in a set of data cluster closely around a central score, the mean is a fairly accurate indicator of the 'typical' score as it would be representative of the scores. If, however, the scores are very widely spread, unevenly distributed or cluster around extreme values, then the mean can be misleading. For example, a few high or low values ('outliers') within a relatively small set of data may inflate (increase) or deflate (decrease) the mean. For example, in the set of scores 52, 58, 63, 17, 54, 61 and 92, both 17 and 92 lie a long way from the other results and are therefore outliers.

In such cases, assuming the outliers are true scores that cannot be dismissed, another measure of central tendency will be a more accurate measure of the 'typical' score and would therefore be used.

Two other measures of central tendency which can be considered are the median and the mode.

Median

Another way of obtaining a score that may represent the central point in a set of scores is to arrange the scores in order of size and select the score that falls in the middle as being typical of the whole set of scores. This score is called the median.

The **median** is the middle score (or mid-point) of a set of scores. For example, the time taken (in seconds) for each child to complete a jigsaw puzzle in rank order (from lowest to highest) is:

12, 12, 17, 17, 17, 18, 18, 21, 24, 25, 26

In this example the median is 18. When there is an even number of scores, the median is the average of the two middle scores. For example, if the two middle scores are 20 and 21, the median would be 20.5.

The median is a particularly useful descriptive statistic if there is a limited amount of data, but if there is a large amount, determining the median can be time consuming and often impractical. The median is also a useful statistic when many very high or very low scores occur in the set of scores because the median is not affected by extreme scores. For example, the test scores shown in Table 1.10 on the next page were obtained when a psychology teacher gave her class of 10 students a test on research methods in psychology.

The calculation of the mean score on the test does not provide an accurate impression of the average score on the test, because the inclusion of three very high scores inflates the mean figure. When such outliers are present in a set of scores, the median is a more accurate reflection of the 'typical' score on the test as it is closer to the majority of scores in the set of data.

Table 1.10 Test scores

Rank	%
1	98
2	91
3	91
4	60
5	59
6	57
7	57
8	57
9	56
10	54
Total	680
Mean	68
Median	58

Mode

A third measure of central tendency is the mode. In everyday language, the word mode means 'common'. This term accurately describes what the statistical mode is; that is, the **mode** is the most frequently occurring score in a set of scores.

Consider the scores again for the children completing the jigsaw puzzle:

12, 12, 17, 17, 17, 18, 18, 21, 24, 25, 26

The mode would be 17 because it occurs three times.

The mode is infrequently used in statistics because it is often not typical or representative of a complete set of data. For example, if a set of scores is 1, 1, 6, 7, 8, 10, the mode would be 1, which is not a representative score of the entire group. If one of the scores of 1 is changed to 10, the mode shifts completely to the opposite end of the scale.

Thus, a single score can alter the mode dramatically, which is in contrast to the median, and to a lesser extent the mean, where individual score changes tend to have less of an effect.

When to use the mean, median and mode

Generally, when most of the scores in a set of data cluster around a central score or value, the *mean* is a fairly reliable indicator of a typical score and therefore usefully represents the data.

The median is not affected by extreme scores. Therefore, when these are present in a set of data, the *median* tends to be a more representative measure of central tendency.

The *mode* provides a useful indicator of a 'common' or 'usual' score because it is the most frequently occurring score. It describes what happens most often in a set of scores – what is the 'typical' score for that group. However, the mode can be very misleading because only the most frequent score is used. The mode does not provide any information about the other scores. The mean and the median make greater use of all the scores – the evidence that is available.

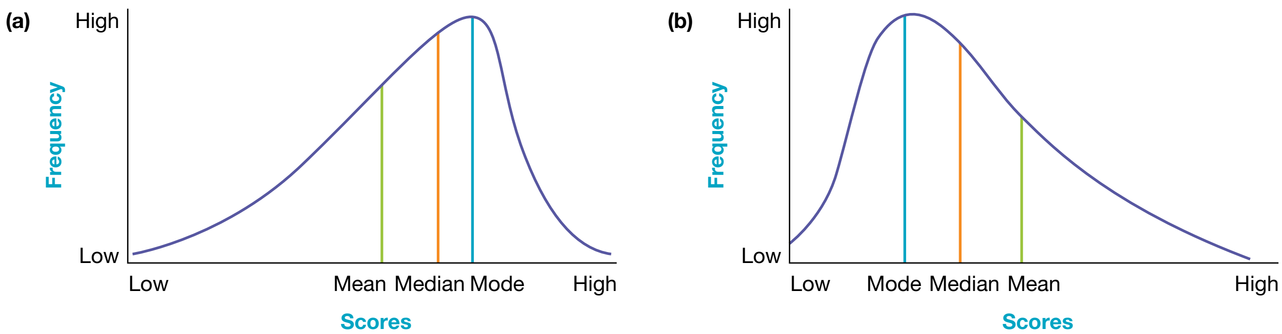


Figure 1.80 Note how the value of mean, mode and median can vary according to the distribution of scores. For example, (a) shows a distribution with a large number of high scores (called a negatively skewed distribution) and (b) shows a distribution with a large number of low scores (called a positively skewed distribution). The median is often a more accurate measure of central tendency when there is a skewed distribution of scores.

1.15 LEARNING ACTIVITY 1

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.39; © VCAA

The mean is a measure of central tendency often used in psychological research.

The mean can be a misleading representation of data if

A. the frequency of each score has not been calculated.
B. the range of the scores is much greater than anticipated.
C. it contains outliers, very small or large values in the scores that are not typical.
D. there is not an equal number of scores whose values lie above and below its value.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.13; © VCAA

Ravi hypothesised that an avoidance strategy would be more likely to result in a bigger increase in levels of stress. Which of the following supports Ravi's hypothesis?

	Mean change score for avoidance strategy	Mean change score for approach strategy
A.	+2.2	+6.2
B.	+6.2	+1.5
C.	–2.2	–3.2
D.	+2.2	–1.5

Question 3 (1 mark)

Source: VCAA 2016 Psychology Exam, Section A, Q.17; © VCAA

Rylee decided to use the mean as a statistical measure to examine the effect of the consumption of energy drinks on the time taken to complete a jigsaw puzzle.

The use of the mean is suitable if the scores are

A. clustered around the extreme values.
B. clustered around a central score.
C. unevenly distributed.
D. widely spread.

Question 4 (1 mark)

Source: VCAA 2015 Psychology Exam, Section A, Q.61; © VCAA

As part of an experiment, a psychologist records the number of correct responses on a memory test.

He records the following scores: 11, 15, 17, 24, 19, 28, 27, 28, 15, 15, 15, 19, 16.

The mode for this set of data is

A. 15.
B. 17.
C. 19.
D. 27.

Question 5 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.62; © VCAA

As part of an experiment, a psychologist records the number of correct responses on a memory test.

He records the following scores: 11, 15, 17, 24, 19, 28, 27, 28, 15, 15, 15, 19, 16.

The median for this set of data is

A. 15
B. 17
C. 18
D. 19

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1.15.3 Standard deviation as a measure of variability

Variability

If you collected data on the ages of a sample of year 7 or 8 students, there would be very little variability. However, if you collected data on the heights or other physical characteristics of the same students there would be much greater variability. Most research data are made up of measures or values (such as scores) where there is some **variability**. There is a spread of scores and not all scores are the same.

Suppose, for example, that two psychology teachers discussed the abilities of their respective classes. The teacher of Class A explained that the mean of her students' scores for a test was 78%. The teacher of Class B replied that the mean of his students' results for the same test was 68% and that his students must therefore be less capable than his colleague's. 'But how do you know I'm not just an easy marker? One of my students got 97%. Then again, another student got 18%,' responded the Class A teacher. The Class B teacher was surprised: 'The lowest mark in my class was 53%, but my highest mark was only 81%,' he said, 'so how do we know which class has the better abilities?'

The discussion between the teachers indicates that a mean, on its own, doesn't provide a complete description of the data.

The mean describes the 'central' value of a set of scores. In order to more accurately represent the data, a measure of variability may be used.

Measures of variability

A **measure of variability**, also called *variation*, indicates how widely scores are distributed or scattered around the central point. For example, the sets of scores in Figure 1.81 below both have the same mean, but they differ in variation; that is, how far the scores are either side of the mean. The distribution of Class A scores shows that it is tightly packed around the mean, indicating *low variability* (or *variation*). The distribution of Class B scores is more widely spread from the mean, indicating *high variability* (or *variation*).

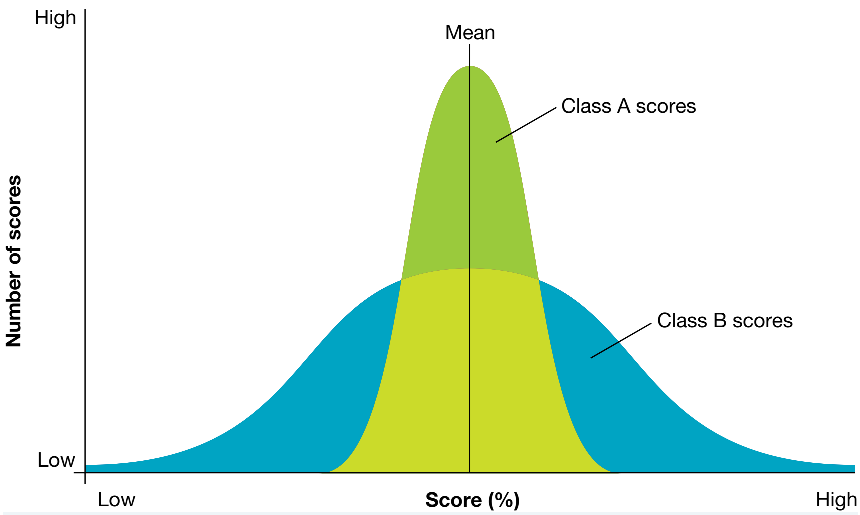

Figure 1.81 Class A and Class B both have the same means. The distribution of scores for Class A (green) shows low variation, as indicated by the clustering of scores around the mean. The distribution of scores for Class B (blue) shows high variation, as indicated by a greater spread of scores from the mean.

Consider variability in relation to the results of research. Suppose, for example, an experimenter tests a hypothesis that texting when studying produces lower performance in a test of the material being studied than does studying the same information without any distraction. Two groups of students participate in the experiment — one group study while texting with five friends over a 30-minute period (experimental group) and the other group study without any distraction (control group).

Calculating a mean score on the test for each group of participants will assist the experimenter in deciding whether their hypothesis is supported. So why should the experimenter look at the variability of the scores?

Measuring the variability of the scores provides researchers with information about how *reliable* any difference between two means is (such as the difference between the experimental and control group).

If the sets of scores are highly variable (widely spread) then any difference between the means of the two groups is less reliable and is more likely to have occurred by chance. However, if each set of scores has a low variability (with scores clustered around the mean), any difference between the means of the two groups is more likely to be due to the effects of the independent variable (rather than chance).

There are several different ways of measuring variability. The more precise and therefore widely used measure of variability is standard deviation.

Standard deviation

The **standard deviation** summarises how far scores within a set of scores spread out, or 'deviate', from the mean for those scores. If all the scores in a set of scores were the same, there would be no variation and the standard deviation would be zero because none of the scores would be spread out from the mean.

A low standard deviation indicates that there is little variation in the scores and that most scores are clustered around the mean. In this case, the mean represents the scores well, as does the mean score for curve C in Figure 1.82. The higher the standard deviation, the greater the variation there is among the scores. For example, in Figure 1.83 on the next page, curve A has the highest standard deviation.

The standard deviation is a particularly useful statistic in that it provides a point of comparison between the means and the spread of two or more different sets of scores. For example, suppose a replacement teacher comes to a new school hoping for an easy day's work. The replacement teacher is offered either of two classes, both of which have a mean IQ score of 100. There appears to be no difference between the two classes.

The teacher is then informed that the standard deviation of IQs in one class is 1 and the standard deviation in the other is 3. Since a higher standard deviation means more variability, the class with the standard deviation of three may take more effort to teach because students vary more in ability.

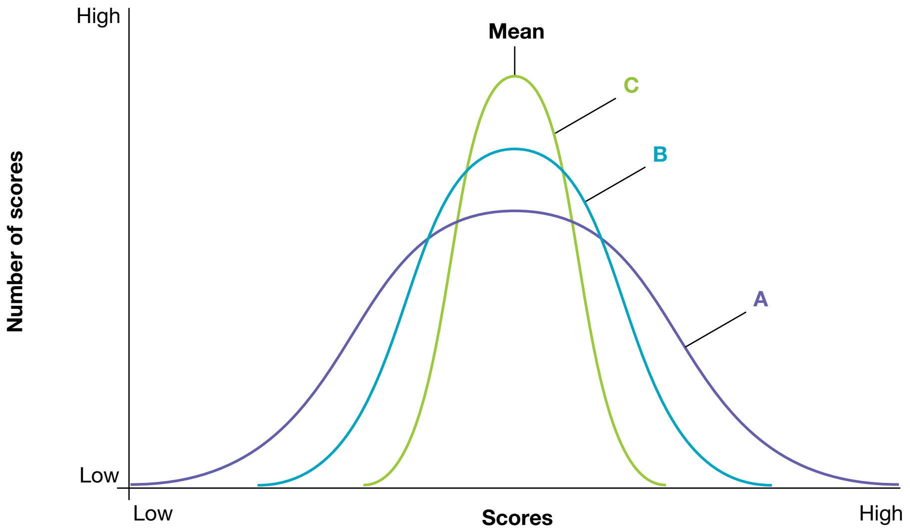

Figure 1.82 This graph shows three distributions of scores, each with a different standard deviation. The purple curve (A) has the highest standard deviation and the green curve (C) has the lowest standard deviation.

In sum, when considering standard deviations, it is important to recognise that:

- although two or more different sets of scores (or data sets) may have the same mean, they may not have the same degree of variation (or 'spread') in the data; and
- a higher standard deviation represents a greater variation (or 'spread') in a set of scores (and vice versa).

Note also that, in a normal distribution of any set of scores, 68.26% of the scores lie within one standard deviation of the mean and 95.44% of the scores lie within two standard deviations of the mean. These and other standard deviation values are shown in Figure 1.83. For example, 68.26% of the scores will fall within one standard deviation either side of the mean; 95.44% of the scores will fall within two standard deviations either side of the mean. These percentages apply consistently in a normal distribution curve, irrespective of the size of the standard deviation.

Although you need to be able to calculate percentages, percentage change and measures of central tendency in VCE Psychology, calculation of standard deviation is not required. But you do need to demonstrate an understanding of standard deviation as a measure of variability (VCE Psychology Study Design p.13.)

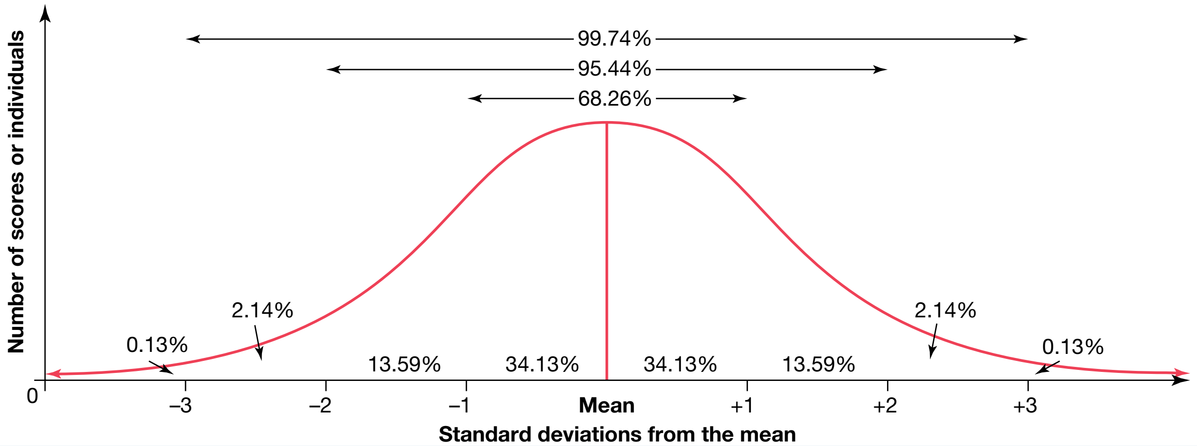

Figure 1.83 Standard deviations in a normal distribution. When standard deviations are represented on the *x* (horizontal) axis of a normal distribution curve, the percentage of scores falling between the mean and any given point on the axis is always the same.

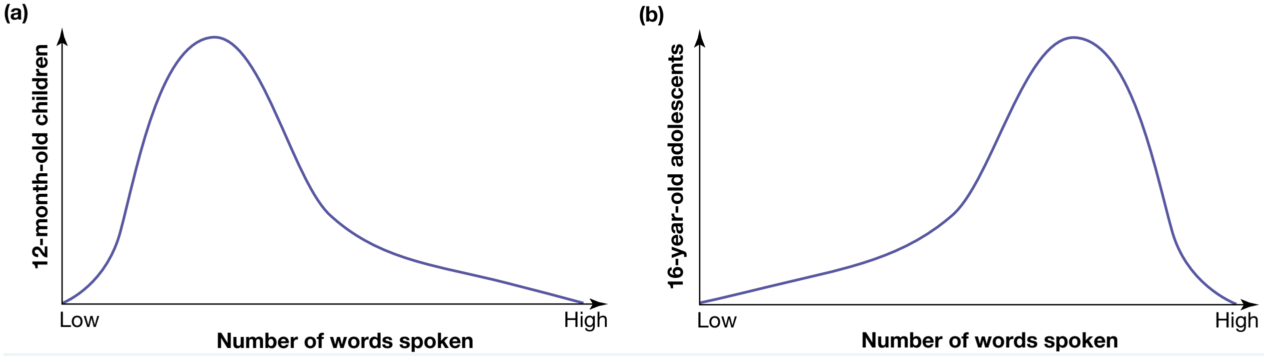

Figure 1.84 The normal distribution curve in Figure 1.83 is a 'theoretical ideal' and rarely occurs. Often, the scores or other values are unevenly distributed and cluster to the left or the right ends of the graph in a skewed distribution. This may occur naturally for a sample. For example, as shown in (a), if the number of words 12-month-old children spoke were plotted, it is highly likely that many of the scores would cluster towards the lower end (left) of the graph producing a positively skewed distribution with a disproportionate number of low scores. In contrast, as shown in (b) if the number of words 16-year olds know were plotted, many of the scores would cluster at the higher end (right) of the graph producing a negatively skewed distribution with a disproportionate number of low scores.

1.15.4 Outliers

An **outlier** is an extreme measurement, one that significantly differs from all others in a data set. For example, suppose an experimenter administered a test with a maximum possible score of 20 to a randomly selected sample. If most individuals obtained a score near the mean of 11 but one has a score of 19 which is way higher than the mean, then that latter score would be an outlier.

Outliers may be found in the results for any measurement, especially when there is a larger sample.

Identifying an outlier

When evaluating data and research methods, you need to be able to identify outliers. The examples previously described in relation to measures of central tendency and variability show how they can greatly influence results. For instance, the mean and standard deviation can be pulled severely towards outliers and distort the true results and the validity of the research. Correlations are also sensitive to the effect of outliers.

Outliers are not typical of the rest of the measurements in a data set. They mostly look unusual or out of place, unlike the other scores. In many cases, they can be spotted though a simple visual assessment, especially if it's your own data because you're likely to know it well and the variables to which it relates.

In VCE Psychology you are required to use 'data visualisation' to 'recognise whether outliers are present' in a set of measurements. You also need to be able to 'reflect on how these outliers would affect the testing efforts and validity of the research' (VCE Psychology Study Design p.21).

Note the examples of outliers shown in Figures 1.85, 1.86 and 1.87. Graphing your data helps spot outliers. So does organising the data, as compared to sifting through unprocessed raw data.

The presence of one or more outliers does not necessarily mean that there is an error or something wrong with the data or the investigation. An outlier may occur due to chance and it may be true score. There may be inherent, 'naturally occurring', variability in the data. For example, a participant can perform way better or worse than all others in the sample entirely because of their ability on that measure. However, any outlier needs to be checked to identify a possible error or underlying cause.

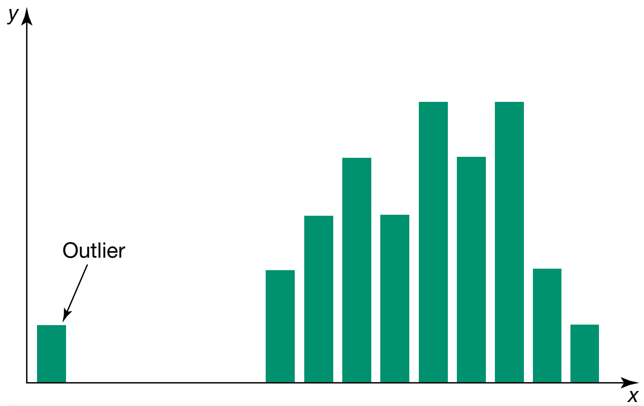

Figure 1.85 Example of an outlier in a bar graph

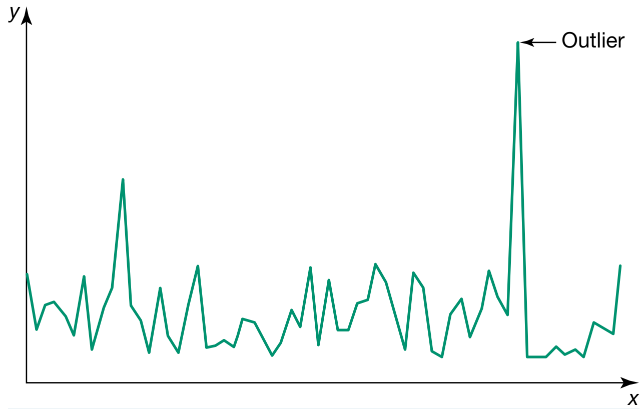

Figure 1.86 Example of an outlier in a line graph

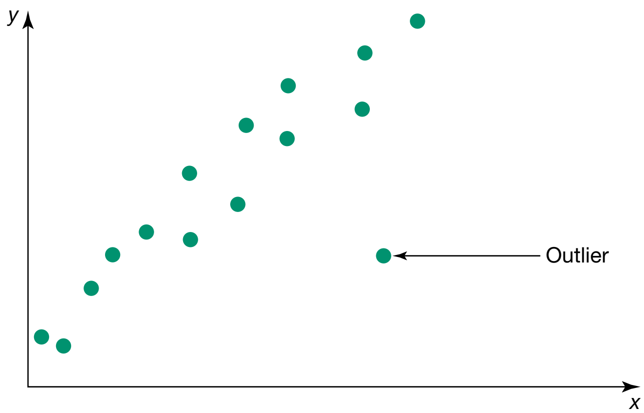

Figure 1.87 Example of an outlier in a scatter plot

Outliers must be accounted for rather than automatically dismissed. In VCE Psychology you are expected to point out outliers and consider them as part of your discussion and evaluation of data in the report of your investigation.

Generally, an outlier will be due to a random error, a systematic error or a personal 'human' error. For example:

- a measurement error, e.g. a mistake or oversight when making an observation
- a recording error, e.g. a mistake when recording the data or transferring the data from one record to another
- a data processing error, e.g. a mistake when calculating a percentage or mean
- a naturally occurring unusual but true score
- a skewed distribution of scores, e.g. the test used to measure the DV was too easy or too hard
- sample size, e.g. increases probability of an outlier through random chance — the larger the sample size, the more it resembles its population, so the more likely it is that there will be outliers
- sample bias, e.g. unintentionally sampling from a different population or selecting a sample who do not represent the target population (such as too many highly able students in a school sample required to complete a problem-solving test)
- non-standardised instructions or procedures, e.g. the measurement is taken in a manner that is inconsistent with all others or there is unexpected interference during the measurement procedure due to a random event

What to do about an outlier

When an outlier is identified a decision must be made as to what to do about it. Three possible actions are to

- fix the error that caused the outlier
- include the outlier in the data
- exclude the outlier from the data.

Other than closely examining possible causes and effects of its presence, there are no 'rules' for what should be done.

Generally, the action will depend on the cause of the outlier and the nature of the research investigation and its data. For example, if an outlier is due to a miscalculation, then the correction can be made to the data. This 'fix' is due to a personal error and would not have to be referred to or discussed in your report. However, if an outlier is due to a measurement error, then repeating the measurement may be an option.

If a faulty measurement cannot be repeated, then it could be excluded from the data because it's an incorrect value. This may also apply to other known incorrect values, such as a score due to an unexpected random event that adversely affected a participant's responses. However, this would have to be accounted for in the report. The reason for deletion would have to be explained.

In some cases, the researcher may provide results with and without the outlier(s). This may occur when there is uncertainty about whether an outlier should be excluded. Again, an explanation for doing so would be included in the report. And a discussion that compares both sets of results could be useful.

If an outlier is due to natural variation in the data for the sample, then it should not be excluded. This extreme value may provide a valuable insight about the variability of the target population which could be discussed in the report.

An outlier is sometimes deleted when there is a large set of scores and deletion will not affect the results. For example, excluding the outlier in Figure 1.87 would not have as big an influence on the correlation coefficient as it would with a small sample. Of course, the score and reason for deletion would need to be mentioned in your report.

1.15 LEARNING ACTIVITY 2

Review

1. What does a measure of variation (variability) indicate?
2. a. What information does the standard deviation provide about the distribution of scores?
   b. Explain why the standard deviation is useful for comparing two or more data sets obtained from research that have very similar or even identical means.

3. What percentage of scores lie within one standard deviation of the mean? Two standard deviations?
4. For each of the following examples, indicate whether you believe there is likely to be high or low variability among the data from Australian samples.
   a. age when infants first walk unassisted
   b. age when infants utter their first sound
   c. age when people go on their first date
   d. speed at which people successfully navigate a complex maze
   e. goal shooting accuracy of professional netballers who usually play a goal attack or goal shooter position but under a condition of high arousal
5. a. Two classes sat the same practice Psychology exam. The following descriptive statistics were calculated from the students' results in each class:
   Class A: mean 75%
   Class B: mean 75%
   On the basis of the mean scores alone, what might teachers of these classes conclude about the knowledge of students in each Psychology class? Explain your answer.
   b. Suppose the teachers then calculated the standard deviations for their respective classes and obtained the following results:
   Class A: mean 75%; standard deviation: 0.1
   Class B: mean 75%; standard deviation: 2.5
   On the basis of this additional information, what conclusions might the teachers now draw about the knowledge of the students in each Psychology class? Explain your answer.
6. a. How do outliers affect the standard deviation, if it all?
   b. What is a simple and often accurate way of recognising an outlier?
   c. List three possible causes of outliers.
   d. If you recognise an outlier in one of your own investigations for which you are required to submit a report, what are three actions you should take?

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1.15.5 Reliability and validity

An important goal of research is to obtain results that are both reliable and valid. This will mean that the results are dependable and accurate. It also means that the results are of value and use. Reliable and valid results can be achieved when the research, its data collection procedures and measurement tools are also reliable and valid.

Although researchers may refer to a study or results as either 'reliable' or 'not reliable', 'valid' or 'not valid', reliability and validity are not necessarily 'present-or-absent' features of a research design, its measurement tools or the results. Instead, they are considered to vary in degree on a scale ranging from low to high. Both are ways of assessing the quality of a research investigation, the specific tools or procedures used to collect data, and the results obtained.

Reliability

In everyday language, the word reliability is used to refer to something that is dependable and will be 'around about the same' or give the same outcome every time. For example, we may refer to a car as reliable when we are confident that it will start every time and get us to and from wherever we want to go whenever we use it. Similarly, we may refer to a friend as reliable when we trust that they are dependable. They have proven to be consistent and

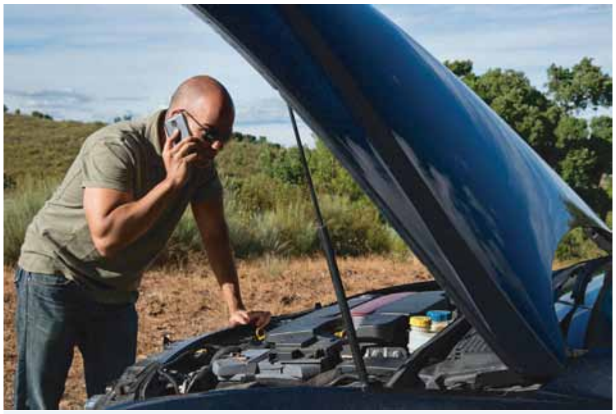

Figure 1.88 We consider a car to be reliable when we can depend on it to start every time and get us to and from wherever we want to go whenever we use it.

stable in character and behaviour over time and are unlikely to change suddenly for no good reason.

In research, reliability involves the same qualities. **Reliability** refers to the extent to which a measure (or 'measurement tool') produces results that are consistent, dependable and stable. For example, if your body temperature was measured with an oral thermometer while you were laying down in a resting state and the reading was double checked straight away, you should expect the same result. If so, the measurement tool and its data are reliable.

Similarly, if you take a reaction time, vocabulary, intelligence or personality test two times under the same conditions, your scores on the two occasions should be very similar. If so, the test can then be described as reliable. If more than one person is observing behaviour or some event in an observational study, all observers should agree on what was observed and recorded. If so, the data are reliable.

In sum, the reliability of any measure used in psychological research is the extent to which it gives consistent measurements for any individual or group. The greater the consistency of the tool each time it is used, the greater its reliability.

At a more general level in relation to a research investigation, if you conducted an experiment on a group of participants to measure some behaviour of interest and repeated it again with a similar group under the same conditions, you should expect the results to be very similar on each occasion the experiment is conducted.

Because conducting an experiment with multiple participants is a more complicated process than measuring the blood alcohol content of an individual, it is not likely or expected that the results will be identical each time the experiment is repeated. The main reason is individual differences within another sample. However, if the results are to be considered reliable, then they should be similar (e.g. within a narrow range of values) each time the experiment is conducted in the same way.

The researcher does not want to obtain significantly different results whenever they repeat a study and measure the same event under the same conditions. This will lead to different conclusions each time so that they will not know which conclusions are correct. Unreliable data or results are 'untrustworthy' in the sense that they reflect error and lead to inconsistent conclusions.

A researcher always sets out to conduct reliable research, use reliable measures and to obtain reliable results. However, when their study is repeated, it may be found that the results are not reliable. This is more likely to occur when, for example:

- the study uses a measure of relevant variables that produces random errors,
- the sample size is too small,
- there is an insufficient number of trials, and/or
- when the study is not repeated in the same way in which it was first conducted.

Repeatability and reproducibility

The VCE Psychology Study Design emphasises that the data and results for a truly scientific investigation must be more than one-off findings. They should be repeatable and reproducible so that reasonable conclusions can be drawn. Irreplicable results may lack credibility.

Both repeatability and reproducibility indicate reliability. Furthermore, the results are considered to be stronger when the research investigation can be both repeated and reproduced.

Repeatability refers to the degree to which a specific research investigation obtains similar results when it is conducted again under the *same* conditions on all occasions. Conditions that should be the same include:

- the observer, e.g. the same researcher
- the instructions
- the measurement instrument, e.g. data collection tool
- the measurement procedure, e.g. research method, type of experimental design, number of experimental and control groups
- the setting, e.g. laboratory or field
- the location, and
- repetition over a short period of time.

Reproducibility refers to how close the results are to each other when an investigation is replicated under *changed* conditions. Conditions that should be different include:

- the observer, e.g. a different independent researcher
- the measurement instrument, e.g. data collection tool

- the measurement procedure, e.g. research method, type of experimental design, number of experimental and control groups
- the setting, e.g. laboratory or field
- the location, and
- the time.

Validity

Validity refers to the extent to which a measure (or 'measurement tool') accurately measures what it is supposed to be measuring. For example, a breathalyser should measure blood alcohol content and report the level accurately to be considered a valid measure, an intelligence test should measure intelligence and not something else such as motivation, mood state or personality traits, and a VCE exam should actually measure the knowledge and skills it claims to measure. Similarly, if a research investigation is considered valid, this means that it has accurately measured the behaviour or mental process that it claims to have measured.

Validity also relates to the results obtained from an investigation and the conclusions (including any generalisations) the researcher makes. Validity means that the results represent true findings among similar individuals in the population from which the sample was drawn.

Furthermore, the conclusions are specifically based on those variables that the research was investigating and the results that were obtained. The variables that were measured and the data collected were based on valid measures and not unduly influenced by extraneous or confounding variables.

For example, if a researcher concludes that a new drug they tested in an experiment reduces symptoms of depression, or that participants in a taste-preference study preferred Coca-Cola™ over Pepsi™, the research is valid only if the new drug really works or if the participants really did prefer Coca-Cola™. These results should also apply to each sample's population (and better still, to similar individuals in the wider population).

As with seeking reliability, researchers always attempt to conduct valid research, use measurement tools that measure what they are supposed to measure, and to draw accurate conclusions from the data they collect. Yet often, despite a researcher's best intentions, their research lacks validity or is not as valid as it could have been. This can occur for a number of different reasons.

Figure 1.89 If a researcher concludes that participants in a taste-preference study preferred Coca-Cola over other colas, the research has a high level of validity only if the participants really did prefer Coca-Cola.

Sometimes a researcher may draw a conclusion from their data that cannot actually be drawn; that is, the data do not actually justify, support or 'back up' the conclusion. Another reason that research and its results may lack validity is because one or more extraneous variables have not been adequately controlled, have become a confounding variable, and have therefore influenced the results in an important way. For example, in an experiment, a confounding variable and the IV may both affect the results. When this happens, the researcher will find it difficult to separate the effects of the IV and the confounding variable and therefore cannot be certain whether it was the IV or the confounding variable that caused the change in the DV.

Note that a measure can be reliable even though it is not valid, but a measure cannot be valid unless it is reliable. For example, if you measured your biceps

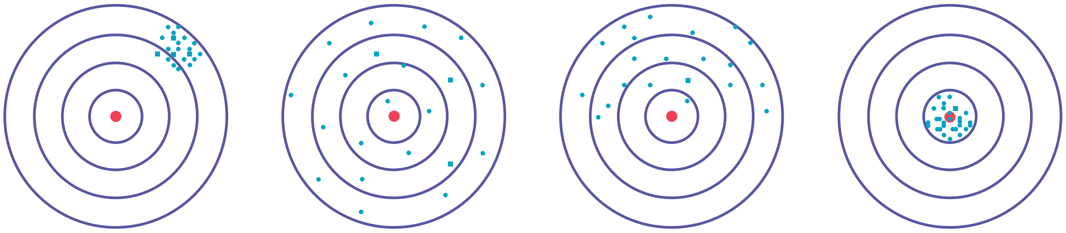

Figure 1.90 Researchers seek to conduct investigations that are both reliable and valid. Reliability is a necessary condition for validity.

with a cloth tape measure that had been left outside in the open weather for a long time and had become inaccurate through stretching, the result would not be a valid measure of your true bicep size. The inaccurate cloth tape measure, however, is reliable as it will give you the same result each time it is used (even if inaccurate). Similarly, it is possible to obtain a reliable measurement for skull size using a stretched cloth tape measure, but that would not be a valid measure for intelligence.

Internal and external validity

Researchers often distinguish between the internal and external validity of their investigations. They consider both internal and external validity in judging the overall validity of a study. Strengths and limitations of different types of investigations and their results can be discussed in terms of these aspects of validity.

Internal validity refers to the extent to which an investigation actually investigated what it set out to investigate and/or claims to have investigated. If an investigation is said to have internal validity, then it is free from flaws and the results obtained are actually due to the design of the investigation and its procedures and not some other factor. For example, if an experiment has internal validity, the experimenter can be confident that the measured change in the DV was produced solely by the IV and not by any confounding variable, nor was the change due to chance.

If an investigation has gaps or flaws in its procedures or measures, such as the use of a sampling technique that resulted in an unrepresentative sample when it was important to have a representative sample, then it may be considered as lacking in internal validity.

Similarly, if participants were required to rate facial attractiveness, then the researcher needs to be confident that the procedures or tools actually and only measured facial attractiveness. Internal validity may be lost if participants did not understand the rating procedure or their ratings partially reflected the style of dress worn by each person in a photo.

Internal validity can be improved in a number of ways, especially use of a research design that is appropriate for testing the research hypothesis and by controlling the potential impact of extraneous variables and confounding variables; for example, by using appropriate sampling techniques for selection and allocation of participants, as well as counterbalancing, blind procedures, placebos and standardised instructions and procedures when appropriate to do so.

External validity refers to the extent to which the results obtained for a study can be applied beyond the sample that generated them, specifically to individuals in a different setting and over time.

Lack of external validity means that the results of the research may not apply to individuals who are different from the study's population. For example, if research has been conducted on some behaviour or mental process with only male participants, it cannot be assumed that similar results will apply to female participants.

For external validity, it is also important that the results should not be time-dependent; that is, the results should apply across time and be found in the future if the research were to be replicated under the same conditions.

Generally, the bigger and more representative a sample is of the overall, general human population, the more confident the researcher can be in applying the results from the sample to the population. Conversely, the more specialised the sample, the less likely will it be that the results are highly generalisable to other individuals, situations, and time periods.

Conducting an experiment in a real-world setting that is appropriate to the research question of interest and therefore more like an event in 'real life' can also improve external validity.

Internal and external validity are related. Internal validity is a precondition of external validity, which means that a study cannot have external validity without internal validity. Furthermore, a study that is said to have external validity is also said to have internal validity. It does not necessarily follow, however, that an effect observed in a strictly controlled laboratory experiment with a high level of internal validity will also have the same effect in a real-world situation.

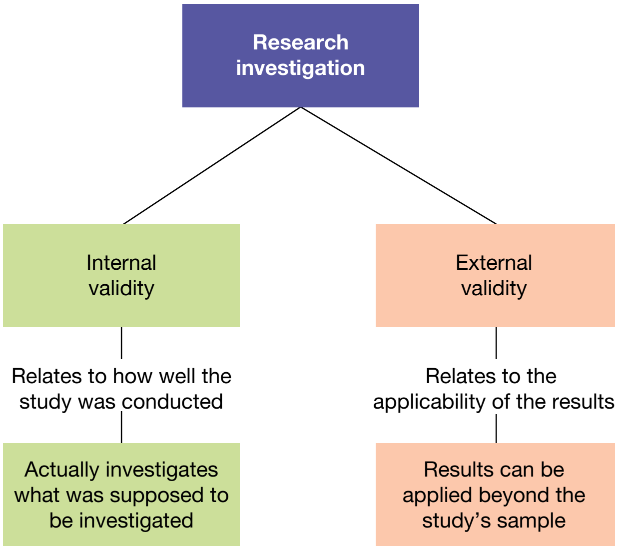

Figure 1.91 Distinguishing between internal and external validity

Figure 1.92 The term ecological validity is specifically used to refer to the extent to which the findings of a research study are able to be generalised to everyday, common real-life behaviours and natural settings. Studies that take place under highly controlled artificial conditions are often closely evaluated for ecological validity. Consider Zimbardo's (1971) Stanford Prison Experiment. The study took place in a very realistic prison environment set up in the basement of the university's psychology building and participants displayed realistic behaviour. However, it was an artificial environment and not a real prison. To what extent did this situation reflect real life in a real prison? Did the results generalise to prisons in the outside world? How likely is it that participants were influenced by demand characteristics and simply behaved in ways they thought they should be behaving in that setting and acted out their assigned roles? Do you think the research is high or low in ecological validity?

1.15 LEARNING ACTIVITY 3

Multiple-choice questions

1. A study that produces the same results each time it is conducted is said to be
   - A. valid.
   - B. internally valid.
   - C. externally valid.
   - D. reliable.
2. Angela designed a test to measure the IQ of her students. The test included a mathematical skills section and scientific knowledge section. When her students completed the test, she noticed that the students who had very strong English skills performed quite poorly on the test. She had the students complete the test again three weeks later. The results achieved by the students were very similar both times the test was taken. She concluded that the test needed to be revised as it did not measure IQ but, instead, measured only mathematical ability and scientific knowledge. Therefore, this test would be said to have
   - A. high reliability and validity.
   - B. low reliability and validity.
   - C. high reliability and low validity.
   - D. high validity and low reliability.
3. A test that effectively measures the effect that an IV has on the DV under different conditions at different times is said to be
   - A. correct.
   - B. valid.
   - C. reliable.
   - D. both valid and reliable.
4. The term _____ is used to describe how close the results are to each when an experiment is repeated under changed conditions.
   - A. reproducibility
   - B. repeatability
   - C. replicability
   - D. precision
5. The term _____ is used to describe the degree to which an experiment obtains similar results whenever repeated under the same conditions.
   - A. reproducibility
   - B. repeatability
   - C. replicability
   - D. precision

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1.15.6 Conclusions and generalisations

When the results have been evaluated, conclusions need to be drawn. Generally, in relation to research, a **conclusion** is a decision about what the results obtained from a research investigation mean. All conclusions must be based on evidence (the results), be consistent with the evidence, relevant to what was actually investigated, and take account of the quality of the evidence and potential limitations of the research.

Limitations usually refer to the validity and authority of the data and sources of possible errors and bias. These should be identified, described and explained. Reasons must be suggested about why the particular results were obtained and what they mean, including whether they can be applied to other groups or situations. In addition, suggestions for further research and evidence are often made

One type of conclusion relates to whether the hypothesis is supported on the basis of the results obtained. This requires careful examination of the results so that an objective ('unbiased') decision can be made. Although the results alone may indicate that the hypothesis is supported, the DV and therefore the results may have been influenced in a significant way by one or more variables other than the IV (or in addition to the IV). Therefore, uncontrolled extraneous variables and potential confounding variables also need to be considered when drawing a conclusion. The researcher must be confident that any change in the DV was due to the IV alone and not any other variable.

The conclusion about the hypothesis is expressed as a statement in the research report. In psychology, when investigating behaviour and mental processes, the statement refers to whether the hypothesis is supported or refuted on the basis of the research results.

Another type of conclusion that can be made is called a generalisation. In research, a **generalisation** is a decision about how widely the results of an investigation can be applied, particularly to other members of the population from which the sample was drawn. Because the research usually tests a sample from a population of interest rather than the whole population, making a generalisation is a process of forming an idea about whether results obtained for a limited number of cases (the sample) can be extended to apply to the entire class of objects, events or people (the sample's population).

In experimental research, generalising the results from the sample to its population (or any other population, including the whole population) is risky if the sample is not representative of the population.

Like any other conclusion, a generalisation must also be based on the results obtained and must consider the potential extraneous and confounding variables, as well as any other problems with the study.

When drawing conclusions about the results and making generalisations, researchers try to avoid making errors or overstating what the results mean. For example, they attempt to ensure that:

- all conclusions are consistent with the results
- all conclusions are relevant to what was actually investigated
- any influential extraneous variables or confounding variables have not been overlooked (which means that possible random and systematic errors have been considered)
- analysis and interpretation of the results enables an accurate finding about whether the hypothesis is supported or refuted
- any gaps in the results and further evidence that may be required are identified
- limitations of the sample used in the study have been considered
- any generalisations are reasonable
- the explanation of the findings is reasonable and supported by the results.

Figure 1.93 These children were participants in a research investigation on sleep patterns conducted by VCE students. They were part of a sample of eight participants who all attended the same eastern suburbs preschool. Can the results obtained from this sample be generalised to all preschoolers at the centre in the year of the study (i.e. the sample's population)? To all children enrolled at the preschool the following year? Can the results be generalised to wider populations, such as all preschoolers in the eastern suburbs? In the Melbourne metropolitan area? In Victoria? Other populations?

All these aspects relate to the reliability and validity of their research. They also provide the basis of suggesting improvements for further research and evidence, in particular, possible ways of reducing the likelihood of random and systematic errors. For example, suggestions may refer to refinements or changes to the research design and its procedures, including sample size and composition, sampling techniques, measurement tools, data collection procedures and how stricter control may have been achieved if required.

Comments about personal errors should not be included in the report. These include personal errors at any stage of the investigation, from planning, through data analysis and evaluation to report writing. Comments on personal errors such as 'I should have taken more care', 'I should have paid closer attention', 'I ran out of time' and 'I miscalculated the mean score' are mistakes made by the researcher, not random or systematic errors associated with the research.

However, random and systematic errors, if any, must be discussed. As described previously, random errors reduce both the reliability and validity of the results, whereas systematic errors reduce the validity of the results (but not reliability).

Finally, keep in mind that a conclusion based on evidence derived from scientific research is different from ones based on opinion or anecdote. In VCE Psychology, it is important to understand the difference.

An **opinion** is a point of view that is not necessarily based on verifiable evidence and is disputable. Opinions involve a judgment about a person, object, event and so on that may suggest it is based on at least some data or facts. However, they are vulnerable to change because they are not deeply based on unquestionable or overwhelming evidence.

For example, if someone holds an opinion that 8-year-old girls are taller than boys of the same age, then statistical evidence can be produced to show that this is incorrect. Similarly, early in the last century, various 'experts' expressed opinions that heredity had little to do with the development of psychological characteristics. Over time, scientific research through correlational studies in particular, obtained evidence of the significant contribution of genetic influences on how we think, feel and behave.

In contrast, an **anecdote** is an informal verbal report of an event that has been casually observed. Anecdotes tend to be accepted as useful information but are not based on scientific evidence and are therefore considered to be scientifically inadequate.

In psychology, reports of young children's abilities early in the last century were largely based on anecdotes. Investigations using scientific methods subsequently found that children's mental abilities in particular had been largely underestimated.

Although anecdotes are personal accounts and not necessarily reliable or valid reports, they can offer clues about aspects of behaviour and mental processes that may be investigated through scientific research.

Figure 1.94 Opinions and anecdotes are not necessarily based on scientific evidence.

1.15 LEARNING ACTIVITY 4

Review

1. Why must potential extraneous and confounding variables be considered when drawing conclusions from results obtained in a study?
2. Distinguish between each of the following in relation to a research investigation.
   a. validity and reliability
   b. external validity and internal validity
   c. reproducibility and repeatability
   d. opinion and anecdote
   e. conclusion and generalisation
3. What does reliability mean in relation to an instrument used to measure responses to the DV in a psychological investigation?
4. Give an example of when the results of a research investigation would not be considered reliable.
5. What does validity mean in relation to a measure of the DV?
6. A researcher concludes that their hypothesis is refuted. What does this mean?
7. Explain the meaning of chance factors in relation to research with reference to an example.
8. List three procedures that could adversely impact on the internal validity of an experiment.
9. What is an important procedure to help ensure experimental results will have external validity?
10. Which of the three types of error — random, systematic and personal — should be discussed in a research report?
11. Explain, with reference to an example, why:
    a. reliability is possible without validity but validity requires reliability.
    b. internal validity is possible without external validity but external validity requires internal validity.

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1.15 LEARNING ACTIVITY 5

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.23; © VCAA

Dr Dhanial investigated the effect of leading questions on recall. In the first week of the semester, university students were randomly allocated to two groups (Group A and Group B) and asked to estimate how often they ate chocolate during the summer holidays. Different forms of the question were used for each group:

- 'Did you eat chocolate frequently and, if so, how much per week?'
- 'Did you eat chocolate occasionally and, if so, how much per week?'

The table below represents Dr Dhanial's results.

Group	Leading word	Estimate of chocolate consumption per week
A	frequently	4.1
B	occasionally	0.8

Which one of the following outlines a criticism of Dr Dhanial's study?

A. Participants were deceived by the use of leading questions.
B. It is unlikely that the results of the investigation will be able to be replicated.
C. Order effects may have an impact on participants' responses due to boredom or fatigue.
D. Using participants from one specific source means the results may not be generalised to the wider population.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.39; © VCAA

Cora, a university student, conducts an experiment in a classroom to test the effectiveness of bright light therapy on adolescent boys with a circadian phase disorder. She recruits nine 16-year-old boys from a suburban boys' school to participate in her experiment. Cora measures daytime sleepiness every morning for three days using the Karolinska Sleepiness Scale, which gives a score out of 9, with higher scores indicating greater sleepiness. On the fourth day, Cora asks the boys to wear bright light therapy glasses for two hours every morning from the time they wake up. After one week of using the bright light therapy glasses, Cora measures the adolescents' daytime sleepiness for another three days.

If Cora were to replicate the experiment, what could she do to improve the likelihood of being able to generalise her results?

A. Conduct the experiment in a controlled sleep clinic.
B. Use both male and female adolescents in the sample.
C. Use a control group to control for extraneous variables.
D. Include a larger sample of adolescent boys from both suburban and rural schools.

Question 3 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.8; © VCAA

A psychologist wanted to investigate people's responses to being pricked by a needle. Details of the investigation were provided to a group of 10 participants prior to the investigation. The investigation involved blindfolding participants and pricking each participant's finger over several trials.

The psychologist repeated the investigation on another group of participants using exactly the same procedure and obtained similar results.

What do the similar results suggest?

A. low validity
B. high reliability
C. no confounding variables
D. few participant differences

Question 4 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.50 (adapted); © VCAA

In the written report of their experiment, the psychologist noted that using university students as participants made it difficult to

A. ensure the results were valid.
B. ensure the results were reliable.
C. draw conclusions from the results.
D. generalise the results to the wider population.

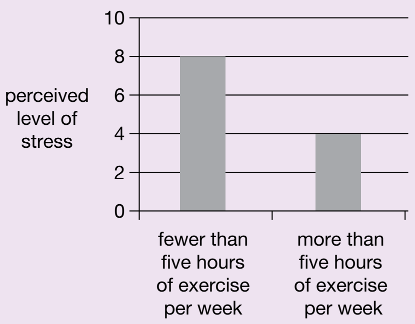
Question 5 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.50 (adapted); © VCAA

Which one of the following statements represents an appropriate conclusion for the experimental results shown in the graph at right?

A. The perceived level of stress was greater for those who exercised more than five hours per week than for those who exercised fewer than five hours per week.
B. The perceived level of stress was greater for those who exercised fewer than five hours per week than for those who exercised more than five hours per week.
C. People with a higher perceived level of stress did more hours of exercise per week than those who had a lower perceived level of stress.
D. People with a lower perceived level of stress did fewer hours of exercise per week than those who had a higher perceived level of stress.

Perceived level of stress reported by participants



To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

1.16 Review

Key terms

accuracy p. 86
aim **p. 7**
anecdote p. 150
bar chart p. 128
behaviour p. 4
beneficence (in research) p. 113
between subjects experiment p. 40
biased sample p. 25
case study p. 75
conclusion p. 148
confidentiality (in research) p. 114
confounding variable p. 89
control condition p. 36
control group p. 36
controlled experiment p. 12
controlled variable p. 14
correlation p. 50
correlational study p. 49
correlation coefficient p. 51
counterbalancing p. 97
data p. 120
debriefing (in research) p. 114
deception (in research) p. 115
demand characteristic p. 101
dependent variable (DV) p. 13
double blind procedure p. 103
ethical concept p. 113
ethical guideline p. 112
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zero correlation p. 51

Note: The **References** for the entire title can be accessed in learnON and are also available as a downloadable PDF.

on Resources

Digital documents Key terms glossary — Topic 1 (doc-38533)
Key diagrams PowerPoint — Topic 1 (doc-38534)

Exam question booklet Exam question booklet — Topic 1 (eqb-0134)

1.16 Topic 1 test

Section A: 35 marks **Section B:** 30 marks **Total:** 65 marks

Access learnON to answer the following test questions online and receive **immediate feedback**.

Section A – Multiple-choice questions

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

The following information relates to questions 1–3.

Professor Dominique wants to test an intervention for stress management. She plans to recruit participants from the university community and randomly allocate them to groups of four. Participants will be told that they will be locked in an escape room until they either solve the puzzles in there or an hour passes. After reading the participant information sheet about the specific purposes of the study and signing a consent form, the groups will be further randomised to either the experimental condition or the control condition.

The groups in the experimental condition will be given a 30-minute presentation by one of her research assistants on effective coping strategies to help alleviate stress, then put into the escape room. The groups in the control condition will immediately go into the escape room after providing consent.

Immediately after leaving the escape room, the participants will rate their feelings of stress across the study period, then Professor Dominique plans to discuss the findings with the participants and any uncomfortable experiences they had. The groups will be assessed on how long it took them to escape and their self-reported stress. The key outcome will be the difference between the two conditions.

Question 1

Source: VCAA 2021 Psychology, Section A, Q.37; © VCAA

Based on the information provided above, what is an aspect of the design that might create bias in the findings?

A. poor reliability of measurement
B. conditions are not counterbalanced
C. inconsistent procedures between conditions
D. participants were not randomly sampled from the population

Question 2

Source: VCAA 2021 Psychology, Section A, Q.38 (adapted); © VCAA

Which experimental research design and sampling procedure is Professor Dominique adopting?

A. within subjects with random sampling
B. between subjects with stratified sampling
C. between subjects with convenience sampling
D. within subjects with random stratified sampling

Question 3

Source: VCAA 2021 Psychology, Section A, Q.39; © VCAA

The ethics review panel requested modifications when it first received Professor Dominique's study proposal.

Based on the information provided above, what did Professor Dominique fail to consider?

A. deception
B. debriefing
C. informed consent
D. withdrawal rights

Question 4

Operationalising the variables for an experiment involves

A. strictly controlling all variables that can impact on the dependent variable.
B. deciding on the importance of all the experimental variables.
C. identifying all potential extraneous and confounding variables before the experiment is conducted.
D. defining how the independent and dependent variables will be manipulated or measured.

Question 5

Which of the following procedures is an essential feature of any type of controlled psychological experiment?

A. random allocation
B. two groups
C. double blind
D. counterbalancing

Question 6

A random sample of VCE students in a school could be achieved by selecting

A. every tenth student walking out of a VCE assembly.
B. all students who walk to school.
C. all students who are enrolled in three or more science studies.
D. all students whose VCE candidate number ends with an even number.

Question 7

Heart rate can be an independent variable in a controlled experiment because

A. everyone has a heart.
B. a researcher can manipulate heart rate.
C. heart rate can be measured.
D. participants can control their heart rate.

Question 8

Source: VCAA 2018 Psychology, Section A, Q.36 (adapted); © VCAA

A researcher was investigating the effects of a new medication agonist in the treatment of a specific phobia. Group A, the experimental group, received the medication. Group B, the control group, received a placebo. Concerned about experimenter bias, the researcher used a double blind procedure with the help of a research assistant who worked directly with the participants.

Which one of the following identifies the double blind procedure used in this investigation?

A. Only the researcher knew who would receive the placebo.
B. Only the research assistant knew who would receive the medication.
C. Only the researcher and the control group knew who would receive the placebo.
D. Only the researcher and the research assistant knew who was in the experimental group and the control group.

Question 9

Source: VCAA 2013 Psychology, Section A, Q.11; © VCAA

Experimental research was conducted to trial medication for the management of schizophrenia. This medication was in a tablet that was given to participants.

Participants drew an odd or even number from a hat. Participants who drew odd numbers formed the control group; participants who drew even numbers formed the experimental group. A double - blind procedure with a placebo was used.

In this research, the placebo could be defined as

A. the effect of the medication.
B. the tablet containing no medication.
C. a participant's expectation of the effect of the medication.
D. the tablet containing the medication that was being trialled.

Question 10

A researcher gives vitamin C to one group of research participants and a placebo to another group to measure the effect of vitamin C on the common cold.

The frequency of colds is

A. the independent variable.
B. the dependent variable.
C. an extraneous variable.
D. a confounding variable.

Question 11

An experiment was conducted to assess the effectiveness of a new technique for learning Greek words. One group used the learning technique and another group did not. Both groups were then given the same test of recall of Greek words.

The results showed that the group using the learning technique recalled more Greek words than did the group who did not use the learning technique. In this experiment, _____ is the independent variable, whereas _____ is the dependent variable.

A. using the learning technique; number of Greek words correctly recalled
B. number of Greek words correctly recalled; using the learning technique
C. number of Greek words learned; number of Greek words correctly recalled
D. number of Greek words correctly recalled; number of Greek words learned

Question 12

Random allocation and random sampling

A. are avoided by researchers as they are haphazard procedures.
B. are both used to select participants for an experiment.
C. differ in that random allocation is used to place participants in groups and random sampling is used to select participants for the research.
D. differ in that random sampling is used to place participants in groups and random allocation is used to select participants for the research.

Question 13

In a within subjects experiment, each participant is exposed to

A. all conditions of the experiment.
B. the independent variable only.
C. the independent variable repeatedly.
D. the dependent variable repeatedly.

Question 14

A researcher selects participants by randomly sampling different groups from a target population. The researcher believes that the sex and religious beliefs of participants will be influential on the results, so the researcher ensures these characteristics are proportionally represented in the sample.

This type of sampling procedure is best described as

A. biased.
B. random.
C. stratified.
D. stratified random.

Question 15

Ethical standards in psychological research are intended to ensure that

A. participants are responsible for the research.
B. participants can comment on the results whenever they want to.
C. the rights and wellbeing of the researcher are safeguarded.
D. the rights and wellbeing of participants are not compromised in any way.

Question 16

The ethical concept of non-maleficence involves

A. consideration of the value of all people.
B. avoiding all possibilities of harm to participants.
C. avoiding any type of deception in research.
D. commitment to searching for knowledge.

Question 17

Which of the following researcher behaviours would be considered unethical?

A. informing participants about the results of the experiment
B. preventing a participant from opting out midway through the experiment
C. checking up on the age of a participant when there is doubt that the participant may not be old enough to give informed consent
D. publishing the results of the experiment without obtaining informed consent from the participants

Question 18

Source: VCAA 2006 Psychology 2, Section A, Q.22 (adapted); © VCAA

Dr Dalling is conducting a university classroom exercise on the effect of pain on the recall of information. She follows accepted ethical guidelines to obtain informed consent from 40 adults.

Group 1 is given a list of words to memorise, and asked to recall them in the order in which they were learnt.

Group 2 is given the same list of words to memorise, but is given a painful pinprick on the back of the hand every two minutes while attempting to learn the words.

The participants are then asked to recall the words in the order in which they were learnt.

Dr Dalling's prediction is that Group 2 will recall more words than Group 1.

Dr Dalling's research hypothesis for this study includes operational definitions and would be

A. participants who recall fewer words will, most likely, have experienced pain while learning.
B. participants in Group 2 will remember more words than participants in Group 1.
C. participants who experience a painful pinprick on the back of the hand while memorising information will recall fewer words than participants who do not experience a painful pinprick on the back of the hand while memorising the same information.
D. participants who experience a painful pinprick on the back of the hand while memorising a list of 40 words will recall more words than participants who do not experience a pinprick.

Question 19

The standard deviation summarises the

A. differences in means of a set of scores.
B. scores that differ in variation.
C. spread of scores from the mean for the set of scores.
D. most commonly occurring score in a set of scores.

Question 20

Which of the following measures is most affected by extreme scores?

A. mean
B. median
C. mode
D. variability

Question 21

The term _____ is used to describe how closely a set of measurement values agree with each other.

A. accuracy
B. precision
C. repeatability
D. reproducibility

Question 22

A researcher intentionally arranged the order in which the conditions of a within subjects experiment were experienced. This was done to control a practice effect that was expected to occur.

This procedure is commonly called

A. manipulation.
B. control.
C. counterbalancing.
D. experimenter bias.

Question 23

Which if the following statements about measurement errors is correct?

A. Random errors are predictable and therefore controllable.
B. Systematic errors occur by chance and are therefore unpredictable.
C. Systematic errors affect all measurements to the same degree.
D. Random errors are faults entirely sourced with the researcher.

Question 24

When drawing a line graph for the results of an experiment,

A. the dependent variable is represented on the horizontal axis, whereas the independent variable is represented on the vertical axis.
B. the independent variable is represented on the horizontal axis, whereas the dependent variable is represented on the vertical axis.
C. a line of best fit can be used to illustrate the underlying relationship between the independent and dependent variables.
D. the trend line must always show a causal relationship between the independent and dependent variables.

Question 25

Generalising from of the results of research involves

A. overstating the true meaning of the results.
B. determining the reliability and validity of the results.
C. applying the results to the sampled population.
D. drawing a conclusion about whether the results support the hypothesis.

Question 26

Which of the following is an example of a self-report?

A. journal notes kept by a person of research interest with a phobia
B. the researcher's raw data collected for their study
C. the researcher's formal report on their study
D. the researcher's records in an observation checklist

Question 27

If research procedures are standardised, then

A. the results will be valid.
B. the research will be conducted ethically.
C. all participants will understand what the experiment is requiring of them.
D. the procedures used in a specific condition will be the same for all participants.

Question 28

A researcher uses test scores as a measure of their dependent variable. The test scores are best described as _____ data.

A. primary and quantitative
B. primary and subjective
C. secondary and quantitative
D. primary and qualitative

Question 29

Before conducting an experiment, a researcher identified all extraneous variables with the potential to affect the dependent variable, then refined the experiment's design to control the influence of these variables. The researcher did this to help ensure that

A. the independent variable could be manipulated.
B. the dependent variable could be measured.
C. the experiment would be reliable.
D. there would be no confounding variables.

Question 30

If research procedures are standardised, then

A. the results will be valid.
B. the research will be conducted ethically.
C. all participants will understand what the experiment is requiring of them.
D. the procedures used in a specific condition will be the same for all participants.

Question 31

In an experiment on memory, a psychologist collected the data shown below from 10 different participants. The data were scores on a test of the number of items in a list of 10 words that could be remembered one month after first learning the words.

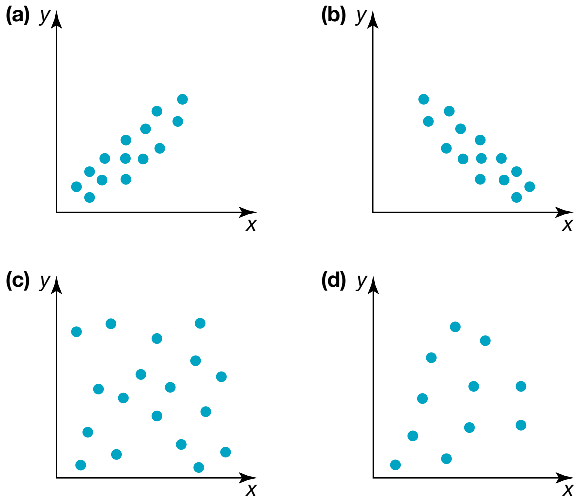
1, 4, 7, 5, 7, 2, 3, 7, 1, 3

The median for the scores is

A. 4.
B. 3.
C. 3.5.
D. 3.8.

Question 32

Which scatter plot shows the strongest negative correlation?



A. Plot (a)
B. Plot (b)
C. Plot (c)
D. Plot (d)

The following information relates to questions 33–35.

Doctor Goode conducted an experiment to investigate the claim that a particular herb helps people to focus their attention. She used a between subjects design experiment with randomly allocated participants. The participants were not told whether they had been allocated to the experimental group or the control group.

She began with a test of attention (Attention Test A) to establish a baseline measure for all participants. Then, for the experiment, all participants were given a drink of water in identical cups. The drinks given to the experimental group also contained the herb which was treated to remove its taste and smell.

Finally, all participants sat a different version of the attention test (Attention Test B).

The results of Attention Test B indicated that the experimental group had improved its ability to focus attention compared to the initial baseline measure, but the control group had not.

Question 33

Source: VCAA 2010 Psychology 1, Section A, Q.41 (adapted); © VCAA

Doctor Goode used a single blind procedure to control for

A. placebo effects.
B. practice effects.
C. individual differences.
D. experimenter expectations.

Question 34

Source: VCAA 2010 Psychology 1, Section A, Q.42 (adapted); © VCAA

It is likely that the results of this experiment were due to

A. the effect of the independent variable on the dependent variable.
B. lack of counterbalancing.
C. the order effect.
D. biased allocation.

Question 35

Source: VCAA 2010 Psychology 1, Section A, Q.43 (adapted); © VCAA

To control for experimenter expectations, Doctor Goode could have used

A. a within subjects experimental design.
B. a between subjects experimental design with counterbalancing.
C. a between subjects experimental design with a double blind procedure.
D. a mixed experimental design with a single blind procedure.

Section B – Short answer questions

Question 1 (1 mark)

What is the main purpose of using a control group in an experiment?

Question 2 (2 marks)

Explain the difference between a conclusion that can be drawn from an investigation that uses an experimental design and an investigation that measures the correlation between variables.

Question 3 (4 marks)

a. Distinguish between an extraneous variable and a confounding variable. 2 marks

b. Explain why confounding is evident in the following data. 2 marks

Participants		Group 1 (IV present)	Group 2 (IV absent)
Number		50	50
Sex	Males	40	10
	Females	10	40
Mean age (years)		35	70
Mean score on an intelligence test (IQ)		100	130

Question 4 (2 marks)

How does random allocation in an experiment minimise the likelihood of individual participant differences becoming a confounding variable?

Question 5 (2 marks)

Describe one advantage and one limitation of a case study.

Question 6 (2 marks)

Explain an important consideration when drawing conclusions for an investigation that had a small sample size.

Question 7 (4 marks)

Distinguish between:

a. internal and external validity in relation to research. 2 marks

b. experimenter effects and demand characteristics. 2 marks

Question 8 (2 marks)

Consider the following extract from a student's report on a research investigation.

> *To ensure randomisation, questionnaires were handed out at many different places and at different times throughout the day. Moreover, by choosing to sample a relatively large population, we were able to ensure that the average results of many individual results would produce a stable result.*

Explain whether or not the researcher actually 'ensured randomisation'. 2 marks

Question 9 (5 marks)

Mardi conducts an experiment to find out if colour preference can be influenced by associating a colour with a pleasant experience such as eating. She delivers a supply of red, orange, yellow, green and blue feeding bottles to some mothers of newborn infants and the regular transparent feeding bottles to the mothers of other newborn infants in the sample. The mothers have consented to let their infants be participants in Mardi's experiment.

a. How many experimental groups does Mardi have in her experiment? 1 mark

b. Which participants make up the control group? 1 mark

c. What are the independent and dependent variables in Mardi's experiment? 2 marks

d. Identify an extraneous or potential confounding variable that should be controlled. 1 mark

Question 10 (6 marks)

To test the effectiveness of a new sleeping pill, a researcher conducts an experiment at the participants' homes rather than in a sleep laboratory.

Eighteen volunteer adult participants, who reported that they have been suffering from sleep-onset insomnia (i.e. difficulty falling asleep) for more than a year, are each given a packet of 14 pills and asked to take one each night for 14 consecutive nights, 15 minutes before their usual sleeping time. They are also given a special apparatus to record the time they fall asleep. The apparatus, worn on the body, measures various physiological responses associated with sleep–awake states, has a timing device and has been reported by participants in previous studies as not being uncomfortable in any way.

The participants do not know that they have been randomly allocated to either of two groups. The researcher's assistant is also unaware of the group to which each participant has been allocated. Group 1 has nine participants whose pills are arranged in the pack so that pills 1 to 7 are the new sleeping pills, and pills 8 to 14 look and taste like the sleeping pills but do not contain the sleep-inducing chemical. Group 2 also has nine participants, but their pills are arranged so that pills 1 to 7 are the fake pills and pills 8 to 14 are the new sleeping pills.

The results are shown in the following table.

Table 1 Time taken to fall asleep

Group	Mean time (minutes)	
	Sleeping pills	Non-sleeping pills
1	37	64
2	78	31

a. Identify the independent and dependent variables in the experiment. 2 marks
b. Explain an ethical standard that should have been followed for this particular experiment. 1 mark
c. Explain the difference between a placebo effect and an experimenter effect in relation to this particular experiment. 2 marks
d. Name the experimental research design used by the researcher. 1 mark

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on Resources

Go to learnON to access answers to the Topic 1 test. A customisable Word version of the test can also be downloaded from the **Digital documents** tab of the Resources panel.

learnMORE | Outline of VCE Psychology

VCE Psychology is made up of four units, each with different content. Units 1 and 2 can be studied in any order and are not prerequisites for Units 3 or 4.

As a science study, there is an emphasis on the development of key science skills in all four units. These skills are described on pages 12-13 of the Psychology Study Design and covered in Topic 1.

There are different areas of study in each unit, including requirements to undertake scientific investigations, either individually or with others. The areas of study are described in a way that reflects the inquiry nature of VCE Psychology.

Units 3 and 4 course outline

The Units 3 and 4 areas of study are:

Unit 3: How does experience affect behaviour and mental processes?

Area of Study 1 *How does the nervous system enable psychological functioning?*

- Nervous system functioning
- Stress as an example of a psychobiological process

Area of Study 2 *How do people learn and remember?*

- Approaches to understand learning
- The psychobiological process of memory

Unit 4: How is mental wellbeing supported and maintained?

Area of Study 1 *How does sleep affect mental processes and behaviour?*

- The demand for sleep
- Importance of sleep to mental wellbeing

Area of Study 2 *What influences mental wellbeing?*

- Defining mental wellbeing
- Application of a biopsychosocial approach to explain specific phobia
- Maintenance of mental wellbeing

Area of Study 3 *How is scientific inquiry used to investigate mental processes and psychological functioning?*

- Design and conduct a scientific investigation related to mental processes and psychological functioning, and present an aim, methodology and method, results, discussion and conclusion in a scientific poster.

ASSESSMENT

Each unit has a set of learning outcomes that students are required to achieve in order to satisfactorily complete the unit.

All assessments for Units 3 and 4 are school-based and use a variety of assessment tasks.

The assessment tasks available for Outcomes 1 and 2 in both Units 3 and 4 are:

- analysis and evaluation of at least one psychological case study, experiment, model or simulation
- analysis and evaluation of generated primary and/or collated secondary data comparison and evaluation of psychological concepts, methodologies and methods, and findings from three student practical activities
- analysis and comparison of two or more contemporary media texts

For *Outcome 3 in Unit 4:*

- design and conduct a scientific investigation related to mental processes and psychological functioning, and present an aim, methodology and method, results, discussion and conclusion in a scientific poster.

Schools must report each student's result for each unit to the Victorian Curriculum Assessment

Authority (VCAA). The result is reported as either S (Satisfactory) or N (Not Satisfactory). The student's level of achievement (e.g. grade) for each unit is also determined by the school, but this is not reported to VCAA.

on Resources

Weblink VCAA Psychology
Savannah - just in case this isn't in site checklist: https://www.vcaa.vic.edu.au/curriculum/vce/vce-study-designs/Psychology/Pages/Index.aspx

learnMORE | Operational definitions

In psychology, as in any other science, definitions of the concepts under investigation (and any other descriptions) must be clear and precise. Consider the statement 'the research is about crime'. 'Crime' could refer to riding a bicycle without an approved helmet, parking in front of a fire hydrant, shoplifting, assaulting someone, committing armed robbery, smuggling protected Australian birds out of the country, and so on. Like many of the words that we use in everyday conversation, the term 'crime' covers a broad range of behaviours and is therefore too inexact to use for research purposes.

Similarly, a term such as 'generous', while appropriate to use in everyday conversation, is too imprecise for research purposes because generosity can be demonstrated in many different ways, such as donating money to a charity, volunteering to coach a junior sports team, or spending time with a friend who is unwell or facing difficult times.

Researchers overcome this problem by defining their subject matter in terms of the way they observe or measure it — they define *what* they are measuring by describing precisely *how* they are measuring it.

The resulting definitions are called operational definitions. An *operational definition* is a definition of a variable, condition or some other observable event. It defines an observable event in terms of the specific procedures (or 'operations') used to measure that variable. Operationalisation of the IVs and DVs in an experiment essentially involves stating their operational definitions.

Consider, for example, a researcher who is interested in the conditions under which a rat turns left rather than right in a maze. It may seem relatively simple to determine the direction a rat turns in a maze. But what exactly is a *turn*? What will the researcher *observe*? How will the researcher *measure* the turn of a rat in a maze? Will the rat sticking its nose around the corner be considered a turn? What if it gets most of its body around the corner and then reverses back? Does the rat's tail have to make it all the way around? As basic as it may seem, the researcher would have to operationally define a *turn in a maze* by specifying exactly how it will be measured. For the purposes of this study, the operational definition of a *turn* might be 'when a rat's tail makes it all the way around a corner'. And, for the examples of *crime* and *generous* referred to previously, *crime* might be operationally defined as 'any act listed as a felony by Australian law', and *generous* might be operationally defined as 'donating more than 5% of one's annual salary to charity'.

A researcher will operationally define a turn in a maze by specifying exactly how it will be measured.

learnMORE | Types of scientific investigation methodologies

Methodology	Description
Case study	An investigation of a particular activity, behaviour, event or problem that contains a real or hypothetical situation and includes the complexities that would be encountered in the real world. Case studies can take various forms: historical, involving the analysis of causes and consequences, and discussion of knowledge learned from the situation; a real situation or a role-play of an imagined situation, where plausible recommendations are to be made; or problem-solving, where developing a new design, methodology or method is required.
Classification and identification	Classification is the arrangement of phenomena, objects or events into manageable sets, whereas identification is a process of recognition of phenomena as belonging to particular sets or possibly being part of a new or unique set.
Controlled experiment	An experimental investigation of the relationship between one or more independent variables and a dependent variable, controlling all other variables. This may include the use of control groups.
Correlational study	Planned observation and recording of events and behaviours that have not been manipulated or controlled to understand the relationships/associations that exist between variables, to identify which factors may be of greater importance and to make predictions.
Fieldwork	Based on inquiry or the investigation of an issue, fieldwork involves observing and interacting with a selected environment beyond the classroom, usually to determine correlation, rather than a causal relationship. It may be conducted through a range of methods, including direct qualitative and/or quantitative observations and sampling, participant observation, qualitative interviews, questionnaires, focus groups, and yarning circles.
Literature review	Involves the collation and analysis of secondary data related to other people's scientific findings and/or viewpoints. Their purpose is to answer a question or provide background information to help explain observed events, or as preparation for an investigation to generate primary data.
Modelling	Involves the construction and/or manipulation of either a physical model (such as a small- or large-scale representation of an object) or a conceptual model that represents a system involving concepts that help people understand or simulate the system.
Product, process or system development	Design or evaluation of an artefact, process or system to meet a human need, which may involve technological applications in addition to scientific knowledge and procedures.
Simulation	A process of using a model to study the behaviour of a real or theoretical system. The modelling and manipulation of variables in a real system is useful because often the variables cannot be controlled as the system may be too complex, too large or small, too fast or slow, not accessible, or too dangerous.

Source: 2023 VCAA Psychology study design, p. 14.

learnMORE | Convenience sampling

For some research studies, it is not convenient, suitable or possible to obtain a representative sample. In such cases, a convenience sample may be used and the researcher may use anyone who is available or present at the time of the study.

Convenience sampling, also called *opportunity sampling* or *accidental sampling*, involves selecting participants who are readily or most easily available. There is no attempt to make the sample representative of a population. For example, a representative sample of illegal drug users or homeless teenagers is not often easily available. Consequently, the researcher may go to locations known to be frequented by the required participants and simply select the first individual they come across who is in the target population and who is willing and available to participate. They may also ask this participant to identify others who would possibly be suitable for the study and agreeable to inclusion (which is called *snowball sampling*).

Similarly, a researcher seeking to conduct a study on drivers who do not obey red traffic lights at a particular intersection at a particular time could use convenience sampling. Participants will be the drivers observed to disobey a red traffic light, and they are simply entered into the study until the desired sample size is reached.

Psychology students often use convenience sampling; for example, when selecting participants they can study, such as other students sitting in the library at their school, people walking by in the street, children who happen to be playing in the school yard at a local primary school, friends, parents or relatives.

In most cases, convenience sampling produces a biased sample because only those people present and available at the time and location of the study will have a chance of being included in the sample. If a researcher used convenience sampling at a local shopping centre, they may select only those shoppers who appear cooperative to be in the sample and ignore those who appear uncooperative. Shoppers left out of the sample might think, feel or behave differently from those who are selected in the sample, yet these thoughts, feelings and behaviours will not be represented in the sample.

Since convenience sampling involves sampling bias and the resulting sample is not representative of the target population under investigation, the data obtained can be misleading and the results of the study cannot be legitimately generalised to the entire population.

Despite these limitations, convenience sampling is widely used in psychology. Participants are readily available, so it tends to be quick (time-efficient), simple and inexpensive compared to other sampling procedures. Sometimes it is the only way to access participants to conduct a study. Convenience sampling can also be of considerable value to identify possible trends or patterns in results or when conducting research to pilot, or 'test', procedures or to gain a preliminary indication of possible responses before conducting the actual study.

Many researchers regard convenience sampling as an adequate sampling procedure when investigating aspects of mental processes or behaviour that are assumed to be similar in all 'normal' individuals, despite individual differences. For example, all 'normal' adults are capable of reflecting on their personal experiences and using language to communicate what they think or feel. Similarly, all normal adults are capable of seeing, hearing and responding reflexively.

learnMORE | How to construct a rating scale

The following steps enable you to construct a Likert scale to collect quantitative data for your own research on an attitude or other topic of interest. Although your scale is likely to be a useful measure for your research questions, it will not be valid or reliable. This means that you will have to be careful with the conclusions you draw from the results obtained. The steps are written with reference to attitude measurement and a scale varying in strength of agreement or disagreement. However, the steps can be adapted to construct a Likert scale for any topic.

Step 1

Identify an attitude towards an object, group, issue or event of interest or importance to you.

Step 2

Write a list of different aspects of the attitude topic. For example, the Likert scale on illegal drugs in Figure 1.36 is based on aspects such as crime, punishment, civil liberties, privacy laws and impact on Australian society. If you have difficulties in generating a list, you may find it helpful to discuss your topic with others.

Step 3

Use your list to develop a group of attitude items (questions or statements) on the topic. Although Likert scales usually contain about 20 items, you should consider a scale based on about six or eight items. Generally, the list should consist of items which deal with different points of view on the topic. Consider the following guidelines.

- Write items that are unlikely to be agreed with by everyone or no-one. About half of your items should be favourable towards the topic and the other half unfavourable. The more effective items will be those that tend to push respondents towards the strongly agree or strongly disagree ends of the scale. Try to avoid including items which are neutral and likely to cluster responses in the uncertain category (i.e. 'neither agree nor disagree').
- Use simple, clear language that is suited to the experience, age, and educational and cultural background of the participants whose attitudes you are measuring.
- Write your items in such a way that only one interpretation is possible.
- Write each item so it contains only one complete idea.
- Avoid using words such as 'all, 'always', 'none' and 'never' within items.

Note that Likert scale items may also have other answer options, depending on what is measured.

For example:

Level of concern	Frequency
• Not at all concerned • Slightly concerned • Somewhat concerned • Moderately concerned • Extremely concerned	• Always • Often • Sometimes • Rarely • Never
Belief	**Quality**
• Almost always true • Usually true • Occasionally true • Usually not true • Almost never true	• Excellent • Very good • Good • Fair • Poor
Level of awareness	**Effect**
• Extremely aware • Moderately aware • Somewhat aware • Slightly aware • Not at all aware	• Major effect • Moderate effect • Neutral • Minor effect • No effect

Knowledge of action	Level of acceptability
1. Never true 2. Rarely true 3. Sometimes but infrequently true 4. Neutral 5. Sometimes true 6. Usually true 7. Always true	1. Totally unacceptable 2. Unacceptable 3. Slightly unacceptable 4. Neutral 5. Slightly acceptable 6. Acceptable 7. Perfectly acceptable
Level of appropriateness	**Level of importance**
1. Absolutely inappropriate 2. Inappropriate 3. Slightly inappropriate 4. Neutral 5. Slightly appropriate 6. Appropriate 7. Absolutely appropriate	1. Extremely important 2. Very important 3. Moderately important 4. Neutral 5. Slightly important 6. Low importance 7. Not at all important
Level of difficulty	**Level of influence**
1. Very difficult 2. Difficult 3. Neutral 4. Easy 5. Very easy	1. Not at all influential 2. Slightly influential 3. Somewhat influential 4. Moderately influential 5. Extremely influential

Step 4

When you have written your items, trial ('test') them with people who will not be a part of your sample but who have personal characteristics in common with those likely to be in your sample. This will assist you to identify problems with your items which you may not have noticed.

- Form your items into a list, with columns for respondents to indicate whether, and to what extent, they agree or disagree with each item. Randomly distribute positive and negative items in the list to avoid a pattern of responses.
- Present the items in a questionnaire format. The questionnaire should have a short introduction that includes instructions for respondents. For example: Here is a list of statements about. . . Please read each statement quickly but carefully, then indicate whether you agree or disagree with each one by putting a circle around one of the following:
  SA = Strongly agree
  A = Agree
  N = Neither agree nor disagree
  D = Disagree
  SD = Strongly disagree

Step 5

- Make several copies of your questionnaire and test your questions again by asking two or three people with similar backgrounds to those in your sample to rate each response.
- Determine their scores for each response and then calculate their score for the entire scale. Score responses by allocating 1 for the most negative response, through to 5 for the most positive response for each item.
- Analyse the responses to determine which items you should include in the final scale. The best items are those that have a very high or very low relationship with the total score for all items. You may wish to rewrite or even replace items that seem to cluster responses in the neutral/unsure category.

Adapted from Grivas, J., & Lawrie, P. A. (1991). *Psychology: Experiments and activities.* Marrickville, NSW: Harcourt Brace Jovanovich, pp. 401-403.

learnMORE | A case study of an individual diagnosed with Anton's syndrome

Case study research in the late 19th century led to the identification of a rare disorder involving blindness without any awareness of being blind. A common pattern of symptoms emerged and the disorder was subsequently called Anton's syndrome, named after the Austrian neurologist and psychiatrist Gabriel Anton who first reported the disorder in 1893 (Förstl, Owen & David, 1993).

People with *Anton's syndrome* are cortically blind but do not realise that they are blind. Cortical blindness means that they are unable to see because of severe damage to their visual cortex, the part of the brain that initially receives and processes incoming visual sensory information.

An unusual aspect of Anton's syndrome is that individuals do not have any damage to their eyes or visual pathways to the brain. However, they believe that they can still see and have an explanation for why they cannot. For example, someone with Anton's syndrome may claim that they can't see because there is insufficient light in the room where they are being examined (Andrewes, 2001).

Each case study published on Anton's syndrome since it was first reported has enhanced understanding of the disorder. For example, a more recent case involved an adult female patient called H. S. to maintain confidentiality.

H. S. was of particular interest to the researchers because her visual cortex was entirely destroyed. Despite all the evidence that H. S. was completely blind, she would deny her blindness and describe her sight as only 'unreliable'. She reported that sometimes things around her would appear very clearly, only to disappear a few minutes later. Sometimes she would reach out for an object, such as a cup, only to find that it was not where she expected it to be (Goldenberg, Mullbacher & Nowak, 1995).

The researchers believed that H. S. might have been mistaking her visual imagery of objects for sight, believing that what she was imagining was what she was actually seeing. They tested their imagery hypothesis by making sounds that related to various objects — for example, the sound of rattling keys or scissors opening and shutting — and then placing the object out of sight. At other times, they let H. S. touch the object and then placed the object out of sight.

Each time they did this, the researchers would ask H. S. whether she saw the object. When not allowed to hear or touch the object, H. S. would say that she couldn't see anything, but she would report seeing the object if the object was within her field of vision.

The following dialogue, in which R. is the researcher and H. S. is the patient, reveals the test. Although by this time H. S. had recovered some of her vision, she still only had a 5° visual window on the right side. Apart from this, she is functionally blind.

R. [Moves bunch of small keys, producing sound.] *I am holding an object. Do you have any idea what it might be?*

H.S. *Could that be a key?*

R. [Silently moves the keys beneath the table. The part of the conversation printed in italics takes place while the keys are hidden from view.] *What does it look like?*

H.S. *On top there is a big ring, and it has a dark key-bit.*

R. *Do you see the key well?*

H.S. *I am seeing the key.*

As can be seen from these notes, the case study of H. S. gives researchers much insight into different aspects of brain function, as well as providing evidence for a number of different aspects of brain function. For example, the visual cortex is shown to have a crucial role in vision, given that H. S.'s was entirely damaged and she consequently had no vision. Despite believing that she could still see objects, as indicated in her conversation above with the researcher, H. S. was blind — her description of the key was incorrect. However, she had excellent visual imagery, despite having no visual cortex.

This suggests that visual imagery and visual perception do not necessarily depend on the same brain structures and processes, and that the relationship between visual imagery and visual perception is not as close as some psychologists have proposed. Furthermore, H. S. recovered some of her vision over time (and recovery may continue). This provides evidence for the plasticity of the brain; that is, the capacity of the brain (specifically its neurons) to take over part or all of a function of an area responsible for that function, but which has been damaged (Andrewes, 2001).

Gabriel Anton (1858–1933)

learnMORE | Cross-sectional studies – comparing groups at a single point in time

In a cross-sectional study, the researcher selects and compares different groups of participants on one or more variables of interest at a single point in time. It is commonly used in psychology to study age-related differences. For example, to study the use of rules in games played by children, groups of children representing each age group from 3 to 7 years inclusive can be selected and observed at about the same time. Or, to study age differences in how much information can be held in short-term memory, groups of people selected at 10-year intervals from 10 to 80 years old could be tested and the results compared.

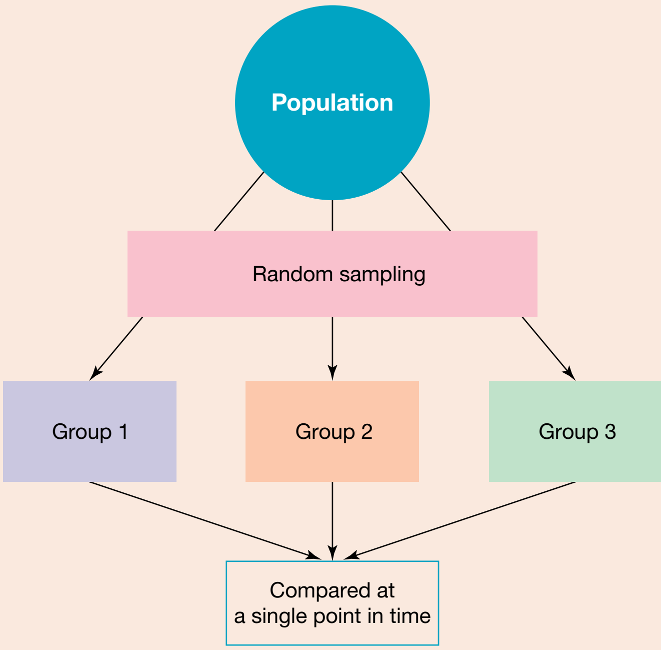
A cross-sectional study may also be used to determine the prevalence of some variable of interest; for example, the number of cases of a particular issue or problem in the population at a given point in time. In addition, it may be used to study differences between groups in any one of a wide range of variables at a specific time. For example, samples may be selected based on one or more mental abilities, personality types, family environments, mental health characteristics, sleep habits, cholesterol levels, dietary intake, drug use, physical health, social media use, cultural background and so on. In all such studies, the data will be collected at one point in time (or within a short time frame).

A cross-sectional study uses an independent groups design and is sometimes called a quasi-experiment because of its resemblance to an independent groups experiment. However, it is not a true experiment because participants cannot be randomly assigned to experimental and control groups. Instead, a cross-sectional study uses existing, naturally formed or occurring groups. For example, in a cross-sectional study investigating age-related differences, the researcher can select participants from different age groups of interest but cannot randomly assign people to be a particular age. In addition, the researcher observes and measures characteristics or events that already exist or occur naturally in a sample (or population), without manipulating any variables.

A cross-sectional study may be repeated periodically to study a trend. It may therefore also involve repeated measures but this does not mean it is the same as a repeated measure experiment.

A major advantage of a cross-sectional study is that multiple segments of the population can be compared on one or more variables relatively quickly. Compared to other research methods, it tends to be simpler to undertake, not too time-consuming and less expensive. For example, a researcher can study differences in one or more variables of interest in 5-, 10- and 15-year-olds at one time over a short period, instead of tracking them over 10 years to complete their investigation. In this way, a snapshot of age-related differences can be obtained without having to conduct follow-up studies and ultimately wait many years for the results.

Another advantage is that a cross-sectional study provides a means of researching certain topics that are unethical and/or impractical to conduct through experimentation. For example, to study the effects of exposure to a major stressor on mental health, the researcher could access one or more groups who have been exposed to a war zone or natural disaster and assess their mental health. Unlike an experiment, in a cross-sectional study, participants are not deliberately exposed to any IV treatment, so there are seldom ethical issues.



An example of a cross-sectional study that uses random sampling and an independent groups design. The cross-sectional study enables comparison of one or more variables in existing groups at a single point in time.

Cross-sectional studies also provide a useful means of determining the prevalence of a variable of interest within a population (or subgroups) and for identifying relationships that can then be more rigorously studied using other research methods. A major limitation of cross-sectional studies is that a cause–effect relationship between variables cannot be tested or determined.

In addition, when age differences are studied, variables other than age can influence the results. Differences found between age groups may be due to factors other than age such as the particular backgrounds and life experiences of participants in each age group. For example, genetic make-up, number of siblings, family environment and schooling can cause differences in a cross-sectional study of language development in young children.

learnMORE | Longitudinal studies – tracking changes over time

A longitudinal study tracks the same group (or groups) of people over an extended period of time, observing changes that occur in behaviour and/or mental processes at several points in time. Some longitudinal studies are relatively brief, lasting for 1 to 2 years; others can last a lifetime.

Usually, the same group(s) of participants is studied and re-studied at regular intervals, thereby involving a non-experimental, repeated measures design. For example, *Growing up in Australia: the Longitudinal Study of Australian Children* is being conducted by the Australian Institute of Family Studies in conjunction with other organisations. The study commenced in 2004 and follows the development of 10 000 children and families from all parts of Australia. There are two groups with about 5000 in each — families with 4- to 5-year-old children and families with infants aged 0 to 1 years.

The study is investigating the contribution of children's social, economic and cultural environments to their adjustment and wellbeing. Parents, childcare providers, teachers and the children themselves provide information. Families are visited for a face-to-face interview every two years. Various aspects of the children's development are also measured, including their physical development, emotional wellbeing, and intellectual and social development.

The longitudinal method is particularly useful when studying development within certain periods or across the entire lifespan. These studies provide information to help psychologists understand changes in behaviour and mental processes over time. For example, whether intelligence test scores (IQ) change with age or remain stable, whether temperament remains relatively unchanging after birth, whether memory declines with age, whether regular physical or mental exercise inhibits the onset of a dementia such as Alzheimer's disease, risk factors that may be associated with parents not reading to their children at certain ages, how identical twins reared together or apart may differ on a variety of variables, or how symptoms of a mental health disorder may progress over time. Because longitudinal studies use the same group(s) of participants, they also allow researchers to study the ways in which early development *may* influence later development.

The longitudinal method also has limitations. For example, it can be expensive and take a long time to get results. Keeping in touch with the same group over a long period of time can also be difficult — participants may lose interest in a study and withdraw, move to another location where they are unable to be contacted, or even die.

						Cross-sectional study
						Participant's age
						5 years 10 years 15 years 20 years
Longitudinal study	Participant's age	5 years	10 years	15 years	20 years	25 years
	Year of testing	2005	2010	2015	2020	2025

In a longitudinal study, the same participants are tested at different points in time over an extended period (e.g. 2005, 2010, 2015, 2020, 2025). In contrast, for a cross-sectional study investigating age-related differences, different participants in different age groups are tested at a single point in time (e.g. 2025).

on Resources

Weblink Growing Up in Australia: The Longitudinal Study of Australian Children

learnMORE | Animals in psychological research

Although psychology is primarily interested in people, about 7–8% of psychological research involves the use of animals. About 90% of the animals used have been rodents and birds, mostly rats, mice and pigeons. About 5% of the animals are monkeys and other primates. Use of dogs and cats is rare (APA, 2017).

Research with animals has and continues to have an important role in psychology. Discoveries through animal research have advanced our understanding of human behaviour and mental processes in a diverse range of areas. For example, behavioural and bodily changes that occur when stressed; basic learning processes; the neurobiology of learning and memory; processes of recovery after neural damage; brain plasticity; mechanisms that control hunger and thirst; behavioural and psychological effects of medications used in the treatment of various mental disorders; addiction to illegal drugs; how the senses function and physiological influences on perception; the critical role of early experience in development; attachment; aggression; emotion and cognition (APA, 2017).

The main reasons animals are used in psychological research to achieve the kinds of benefits described are:

- Some studies cannot be conducted with humans due to the risk of psychological and/or physical harm that may be caused, or because suitable human participants are unavailable. Various examples are included throughout this text.
- Bodily systems and/or behaviours of some animals are similar to those of humans; therefore, using animals can be a 'starting point' for learning more about human behaviour.
- Animals have practical advantages over people for use as research participants. For example, studying the effects of ageing from birth through to 'old age' is not generally practical in humans because most people live more than 75 years, compared with rats which have an average life expectancy of two years, or monkeys which live for 15–20 years. Another advantage is that some animal species breed a lot faster than humans.

About 7–8% of psychological research involves the use of animals.

For instance, rats produce a new generation every three months and can be used to study the development of certain behaviours over successive generations within a relatively short period of time. Animals can also be kept for long periods of time in captivity in laboratories and it is easier to observe their behaviour under these conditions.

- The behaviour of animals can usually be controlled to an extent not possible with human participants. For example, a rat can be raised from birth in a cage. The rat can then be used in a learning experiment and the psychologist will have a good idea of what it has already learned before the experiment is conducted.
- When certain experiments require large numbers of participants who have, for example, the same genetic background, animals are more easily obtained than humans.
- Participant expectations can influence the results of an experiment; however, animals don't usually have expectations and they are not able to guess the purpose of an experiment. Many arguments have been presented against the use of animals in psychological research. One argument is that it is not possible to generalise the results of animal studies to humans because the species are not the same even though there may appear to be similarities. An issue for researchers is how far they can generalise about human mental experiences and behaviour from the results of animal studies. If laboratory animals die after prolonged sleep loss, would humans? If a drug causes a brain disorder in animals, should it be banned for human use? Another argument is that humans should respect animals and protect them from harm rather than use them in research. It is also suggested that humans do not have the right to dominate other species.

In order to ensure that all reasonable steps are taken to minimise the discomfort, illness and pain to animals used in research, ethical guidelines have also been established for the use of animals in research. The use and care of laboratory animals must be directly supervised by a person competent to ensure their comfort, health and humane treatment. Importantly, the care and use of animals in research in Australia is governed by the NHMRC *Australian code for the care and use of animals for scientific purposes 8th edition (2013).*

The purpose of the Code is 'to promote the ethical, humane and responsible care and use of animals for scientific purposes'. An obligation to respect animals is central in the Code.

According to the Code (p.1), 'This obligation brings with it a responsibility to ensure that the care and use of animals for scientific purposes is ethically acceptable, balancing whether the potential effects on the wellbeing of the animals involved is justified by the potential benefits to humans, animals or the environment. The use of animals for scientific purposes must have scientific or educational merit; must aim to benefit humans, animals or the environment; and must be conducted with integrity. When animals are used, the number of animals involved must be minimised, the wellbeing of the animals must be supported, and harm, including pain and distress, in those animals must be avoided or minimised.'

on Resources

Weblink NHMRC Code for research using animals
https://www.nhmrc.gov.au/about-us/publications/australian-code-care-and-use-animals-scientific-purposes

learnMORE | Sample consent form for research participants

SAMPLE ONLY

CONSENT FORM TO PARTICIPATE IN RESEARCH

TITLE OF RESEARCH: ....

DESCRIPTION OF RESEARCH: Insert an outline of the research and other relevant information. Include:

- aim/purpose/reasons for the investigation
- method used to collect data
- how the data will be analysed, described and presented
- what the participants will need to do and time commitment
- how confidentiality will be maintained
- whether the participant will have a chance to see and comment on the final report
- what will happen to the final report
- who will read the report and have access to it
- withdrawal right
- name(s) of researcher(s), supervisor/teacher and school
- status of the researcher(s).

I, ..., consent to taking part in the research investigation described above. I understand my rights as a participant in this research. The aim and procedures of the study have been explained to me and I understand them.

[*Where deception is used a clause such as the following should be included.*]
I understand that it is sometimes essential for the validity of research results not to reveal the true purpose of the research to participants. If this occurs, I understand that I will be debriefed as soon as is possible after my participation and, at that time, given the opportunity to withdraw from the research and have records of my participation deleted.

I have been advised the results of the research will be presented in a formal written report but that my personal details will remain confidential.

I voluntarily consent to participate but I understand that I may discontinue participation from the study at any time without giving a reason.

If you have any questions, comments or complaints to make on this research, please contact [*insert the researcher's name and/or the Psychology teacher's name*] at [*insert the researcher's and/or the Psychology teacher's contact details, including phone number(s)*].

Name of Participant: ....

Signature: ....

Name of Researcher: ....

Signature: ....

Date: ....

on Resources

Teacher weblinks Online templates for psychology research consent forms
Template for psychology research consent forms 1
https://documents.uow.edu.au/content/groups/public/@web/@raid/documents/doc/uow014904.pdf
Template for psychology research consent forms 2
https://www.flinders.edu.au/search?q=psychology%20research%20consent%20forms%20psychology

learnMORE | Human Research Ethics Committees

The National Statement requires that all research that carries more than a low level of risk to human participants must first be reviewed and approved by an ethics committee. This type of committee is formally called a *Human Research Ethics Committee (HREC)*.

A HREC has a minimum of eight members, with a mix of researchers and non-researchers (including community members). Its main purpose is to assess research proposals for approval purposes, and then monitor the conduct of the research (if approved) to ensure all relevant ethical standards are adopted and followed.

Generally, the roles and responsibilities of the HREC include:

- deciding whether a research proposal meets all the requirements of the National Statement and is therefore ethically acceptable
- deciding whether the researcher(s) is adequately experienced and qualified (or the researcher is supervised by a qualified person if there are concerns about their experience and qualifications)
- monitoring approved research (e.g. through progress reports, random inspections of research sites, interviews with participants)
- handling complaints (e.g. from participants, the wider community)
- ensuring the researcher is accountable (e.g. the researcher understands, accepts and maintains responsibility for all aspects of their research).

If the committee is satisfied that all ethical questions and issues raised by the research have been dealt with satisfactorily, approval will be given for the research to proceed. If the committee has concerns about some aspects, it can highlight these and return the application to the researcher so the concerns can be addressed, possibly with suggestions on how. If the proposal has ethical issues that cannot be addressed, then the research will not be allowed to proceed.

HRECs are usually established by organisations (public, not-for-profit or private) that conduct a considerable amount of research involving humans. Universities and hospitals are the most common of these organisations. Not all organisations which conduct human research, however, have their own HREC. Some organisations and individual researchers use the services of HRECs within another organisation.

Human research considered to be at a low level of risk, where the only foreseeable risk is one of discomfort, does not have to be submitted to a HREC. In such cases, a research proposal may be reviewed by ‘a competent person or group’ familiar with the National Statement and other relevant ethical standards.

The NHMRC also requires the use of ethics committees for research involving animals. These are called Animal Ethics Committees (AECs) and members have roles and responsibilities similar to those of HRECs.

learnMORE | Australian Privacy Principles

The *Privacy Act 1988* is an Australian law that regulates the handling of personal information about individuals. This includes the collection, use, storage and disclosure of personal information, and access to and correction of that information.

Personal information is information or an opinion about any individual who can be identified; for example, information about someone's racial or ethnic origin; health; genetics; political opinions; religious beliefs and sexual orientation or practices (Office of The Australian Information Commissioner, 2017).

The Privacy Act includes 13 *Australian Privacy Principles* (APPs) which set out standards, rights and obligations for the handling of personal information, some of which apply to psychology research. The APPs include requirements such as:

- *Open and transparent information management* — how personal information will be handled must be clearly expressed and made available
- *Anonymity* — ensure individual participants cannot be personally identified
- *Data collection* — collect personal information only if necessary; ensure informed consent
- *Data use* — use only for the purposes specified
- *Data quality* — ensure information is accurate, complete and up to date
- *Data security* — protect the information (e.g. from loss or unauthorised access) and destroy or permanently de-identify personal information if no longer needed.

learnMORE | Safety and wellbeing in VCE Psychology

As part of this study, teachers and students may be involved in teaching and learning activities that may include potentially sensitive topics. VCE Psychology is informed by a strengths-based approach and teachers should ensure students are supported to develop knowledge and skills that nurture their own health and wellbeing. Teachers should ensure that students have opportunities to consider topics systematically and objectively, and to become aware of the diversity of views held on such matters. Students should not be asked to disclose personal information about their own or others' health status and behaviours and students should be provided with information as appropriate about sourcing available support services within and outside school.

VCE Psychology engages students in critical inquiry processes that assist them to research, analyse, apply and appraise psychological knowledge and research. It is important however that students are clearly and specifically advised that they are neither trained nor equipped to diagnose problems, including their own, or offer any counselling or therapy. Teachers and students may consider different psychological assessments including standardised psychological tests, which are designed to be administered only by trained psychologists, but teachers must limit access to such tests and ensure that students understand that such tests should only be administered by a qualified psychologist.

It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students undertaking the study. Teachers and students should observe appropriate safety precautions when undertaking practical work. All laboratory work should be supervised by the teacher. It is the responsibility of schools to ensure that they comply with health and safety requirements.

Relevant acts and regulations include:

- *Occupational Health and Safety Act 2004*
- *Occupational Health and Safety Regulations 2017*
- *Occupational Health and Safety Management Systems (AS/NZ 4801)*
- *Dangerous Goods (Storage and Handling) Regulations 2012*
- *Dangerous Goods Storage and Handing Code of Practice 2000*
- *Hazardous Substances Code of Practice 2000*
- *Electrical Safety Act 1998*

Source: *VCE Psychology Study Design: 2023-2027, pp.9*

on Resources

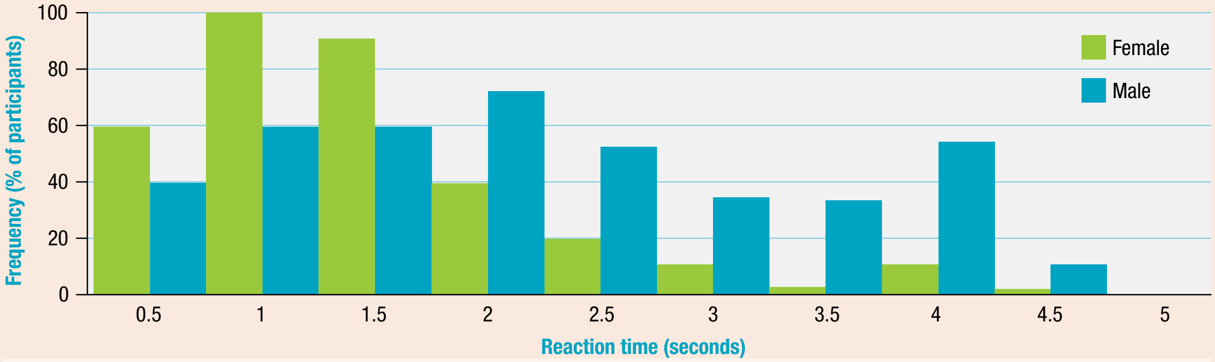
Weblink VCAA Psychology Study Design
https://www.vcaa.vic.edu.au/curriculum/vce/vce-study-designs/Psychology/Pages/Index.aspx

learnMORE | Histograms and pie charts

A histogram is a graph that shows the frequency with which a particular score (or range of scores) occurs in a set of data. It usually has the types of categories (e.g. sex, age groups) plotted on the horizontal (X) axis and the frequency (how often/many of each score) plotted on the vertical (Y) axis. Rectangular bars are used to indicate the frequency of a particular score and each rectangular bar is the same width, as shown below.

Histograms look like bar graphs but they differ in two main ways — first, in histograms the bars touch; second, the type of information or variables described on the X axis is continuous and usually numerical, such as age, time or the amount of something. Thus, the X axis of a histogram can be plotted as individual numbers (e.g. 0.5) or as intervals (e.g. 0.5–1, 1–1.5 etc.).

For example, a histogram could be used to show the data collected in an experiment on sex differences in reaction time. The experimenter wanted to find out if there are sex differences in how quickly information passes from the eye to the brain and then on to the hand so they conducted an experiment. The experimenter measured reaction time for how quickly male and female participants responded to a red light appearing among written text on a computer screen. Participants were asked to press the space bar on the keyboard as soon as they saw the red light. The time taken from the appearance of the red light to pressing the space bar was electronically recorded. As shown below, the data collected for the two groups of participants was presented in the same histogram using a different colour or pattern to identify the responses of different groups.

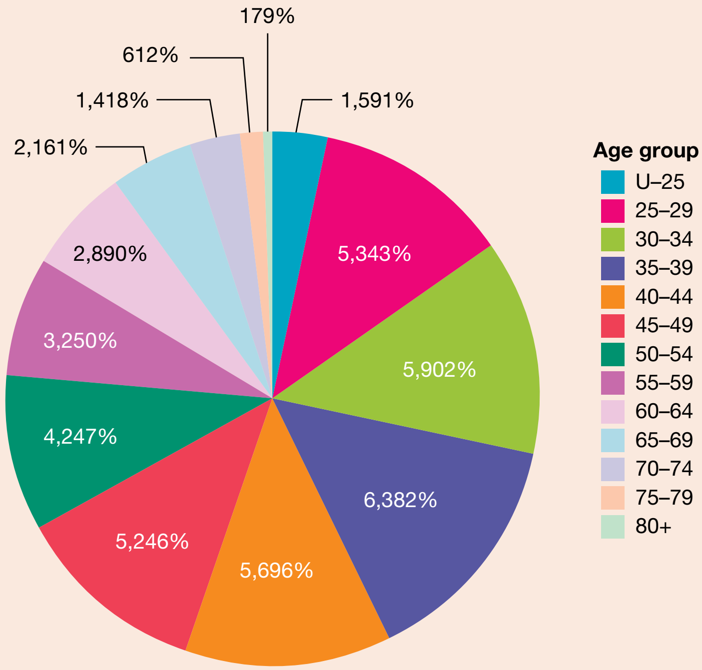


An example of a histogram showing sex differences in reaction time.

A pie chart (or pie graph) is a circular diagram that shows the proportions of values or scores for different categories of data. Each category is shown as a 'slice of the pie'. The different-sized 'slices' represent the differences between categories. As shown below, a pie chart doesn't use a set of axes to plot data and the data are usually shown as percentages.

A pie chart is best used to compare different parts of the same whole, particularly when there is a relatively small number of categories. The circle of a pie chart represents the whole, or 100%. Each portion ('slice of the pie') within the circle represents a part of that 100%. In this way, it is possible to see how something is divided up according to categories. In the example below, a key is used to indicate each category ('slice') of the graph and the percentage for each category is clearly shown.

A pie chart can easily be constructed with Microsoft Excel®, or similar software,



An example of a pie chart showing the age groups of people registered as psychologists in Australia (at 30 June 2022).

to clearly show each category and its respective percentage. A pie chart can also be drawn by hand using a compass to construct the circle and a protractor for each portion of the circle. The circle is equivalent to 360° and each portion of the pie chart is calculated as a percentage of 360°, with 1% being equivalent to 3.6°. For example, if 20% needs to be represented in the pie chart, then 20% of 360° is 72° (or $20 \times 3.6° = 72°$). Within the pie chart, 72° would be a slice equivalent to 20% of the whole area of the pie.

2 Nervous system functioning

TOPIC CONTENT

2.1 Overview

KEY KNOWLEDGE

- the roles of different subdivisions of the central and peripheral nervous systems in responding to, and processing and coordinating with, sensory stimuli received by the body to enable conscious and unconscious responses, including spinal reflexes
- the role of neurotransmitters in the transmission of neural information across a neural synapse to produce excitatory effects (as with glutamate) or inhibitory effects (as with gamma-amino butyric acid [GABA]) as compared to neuromodulators (such as dopamine and serotonin) that have a range of effects on brain activity
- synaptic plasticity – resulting from long-term potentiation and long-term depression, which together act to modify connections between neurons (sprouting, rerouting and pruning) – as the fundamental mechanism of memory formation that leads to learning

Source: © VCAA, *VCE Psychology Study Design: 2023–2027*. p.34.

The human nervous system is a complex, highly organised network of specialised cells that enables the brain to receive information about what is going on from both inside and outside the body and to respond appropriately. Everything you sense, feel, think and do is controlled by your nervous system in some way. This includes not only your everyday sensing, perceiving, learning, remembering, thinking, imagining, speaking, moving and the vast array of other responses you voluntarily make, but also your involuntary responses such as your breathing, heartbeat, squinting when someone turns on a bright light in the middle of the night, and the 'butterflies' you may feel in your stomach when anxious or meeting someone special.

The nervous system achieves this by serving as a communication system between the body's internal cells and organs and the external world. Through its vast network of nerves distributed throughout the body, the nervous system enables the brain to obtain information about what is going on inside and outside the body and to respond appropriately. Its three main roles are to:

- *receive* information
- *process* information, and
- *coordinate a response* to information.

Although the nervous system is a single system within the body, it is made up of different sub-systems. These are commonly referred to as 'divisions' or 'branches'. Each division also has sub-divisions. Although each division and sub-division carries out identifiable roles, the nervous system functions as a coordinated whole.

As shown in Figure 2.1, the two main divisions are the central nervous system and the peripheral nervous system. They are connected by the spinal cord and constantly work together maintaining communication throughout the body, thereby enabling us to not only think, feel and act as we do, but also to keep us alive.

The brain is kept continually informed of the ever-changing external and internal environments of the body through sensory information received by the many and varied receptor cells located at or near the surface of the body and also deep within the body. These sensory receptors specialise in detecting and responding to different types of information.

Sensory information from the external environment is received through sensory receptors that are sensitive to specific types of stimuli arising outside the body. For example, neurons that function as sensory receptors at the back of the eye respond only to light for vision, the inner ear contains receptors for hearing, balance and body position, and the skin has receptors that are responsive to touch, pressure, temperature and pain.

The nervous system also receives information from within various parts of the body. For example, sensory receptors located in the muscles, joints and tendons provide information about muscle tension, position and movement, and receptors located in internal organs such as the heart, lungs, liver and intestines provide information about the body's internal environment.

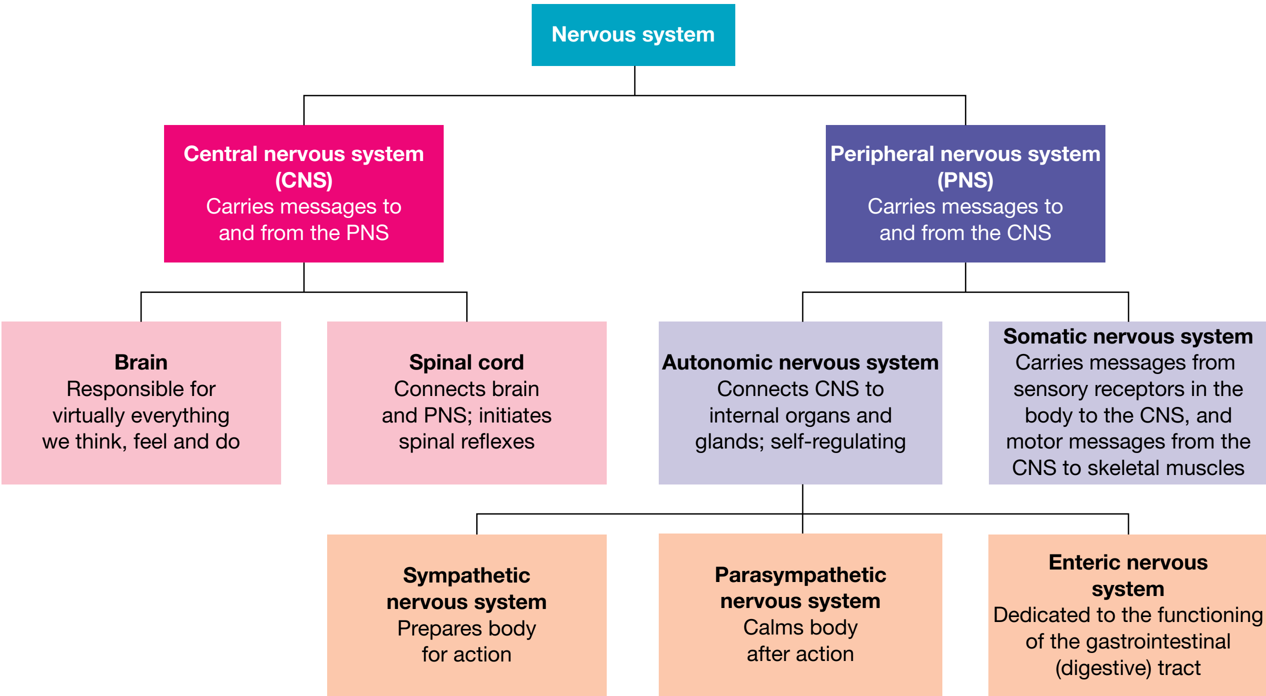


Figure 2.1 The major divisions and sub-divisions of the human nervous system

When the sensory information is received at the brain it is processed. This enables perception — interpretation of the sensory information so meaning can be assigned. Processing often involves integrating incoming information with other information already in the brain. For example, incoming auditory and visual sensory information may be combined with information stored in memory in order to recognise what was seen and heard. If required, the brain will also coordinate a response by initiating appropriate action; for example, by sending neural messages to muscles, glands and internal organs. This, in turn, enables muscles to move, causes glands to secrete hormones and initiate the responses of internal organs, thereby enabling our body systems to function effectively.

Neurons are the building blocks of the brain and the rest of the nervous system. The entire nervous system is comprised of billions of neurons organised into networks that form neural pathways or circuits of varying complexity through which information continually travels. Neurons specialise in the reception and transmission of information throughout the nervous system. They use electrical impulses and chemical signals to transmit information between different areas of the brain, and between the brain and the rest of the nervous system. Their work is supported by glia cells. Glia outnumber neurons in some parts of the brain, but neurons are the key players in the brain.

Neurons not only communicate with each other, but also with muscles and glands. When even one part of the communication process breaks down, the results can be devastating. Many brain disorders, nervous system diseases and mental health disorders have been linked to problems with neurons and communication within and between neurons.

Although the brain and nervous system cannot recover from or repair all damage, they are remarkably adaptable. From the time our brain begins to develop through to the end of life, neurons and the connections between them change in response to our experiences. Their ability to make connections is what makes each of us unique in how we think, and feel, and act.

We start this topic with an examination of the roles of different sub-divisions of the nervous system in responding to internal and external stimuli to enable conscious and unconscious responses.

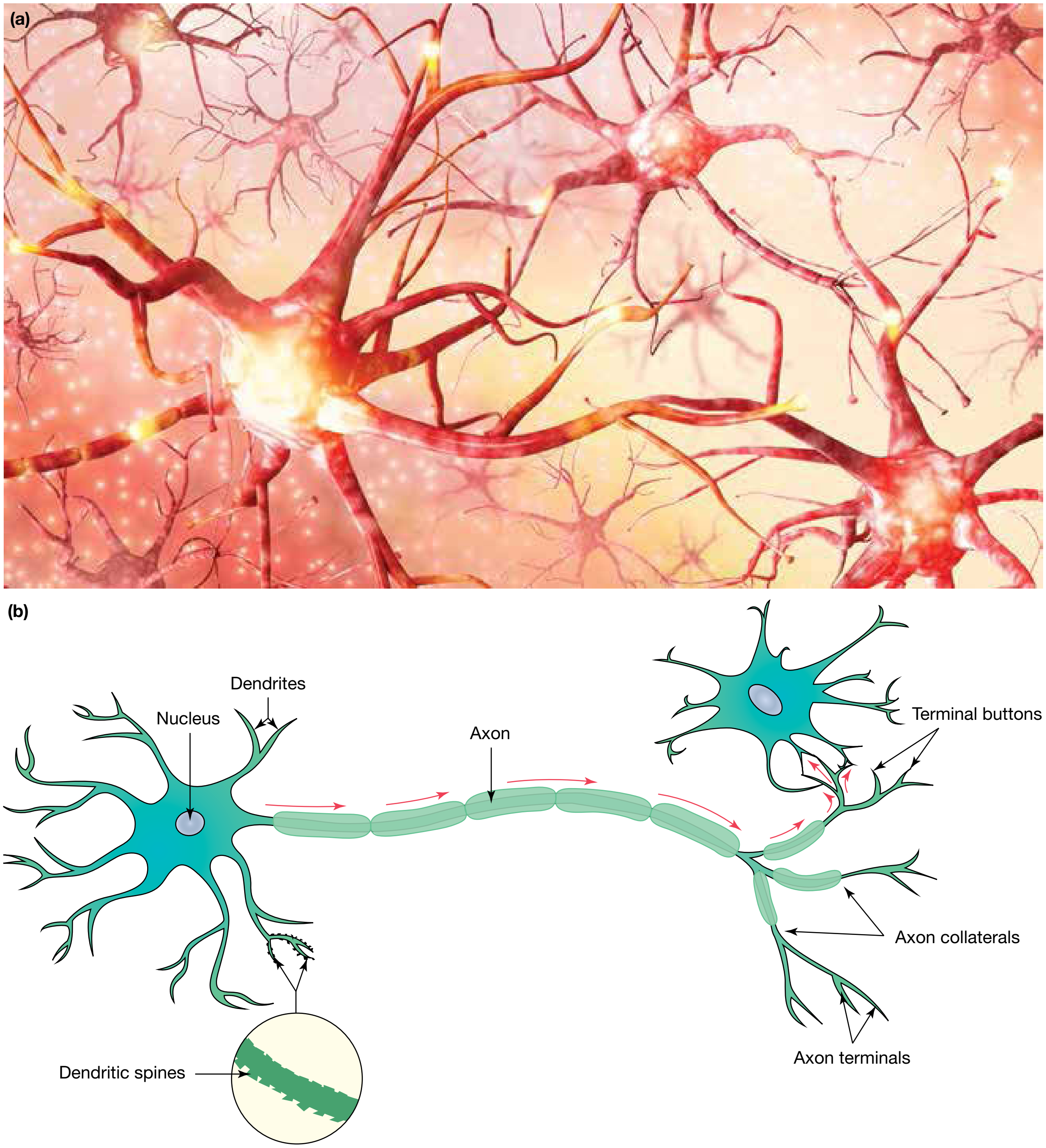


Figure 2.2 (a) Neurons are the building blocks of the human nervous system. (b) Neurons have specialised roles and vary in shape and size. However, most neurons typically have several structural features in common. These include dendrites for receiving incoming information and an axon along which outgoing information is transmitted. The red arrows show the direction of an outgoing neural message.

2.1 LEARNING ACTIVITY

Multiple-choice questions

1. The central nervous system may be sub-divided into which two parts?
   A. brain and spinal cord
   B. brain and peripheral nervous system
   C. spinal cord and peripheral nervous system
   D. sympathetic and parasympathetic nervous systems
2. Which part of the nervous system coordinates the activity of the entire nervous system?
   A. neurons
   B. the brain
   C. neural pathways
   D. autonomic nervous system
3. What connects the brain to the rest of the nervous system?
   A. spinal cord
   B. enteric nervous system
   C. peripheral nervous system
   D. autonomic nervous system
4. The major roles of the human nervous system are to
   A. receive and process incoming information.
   B. create building blocks for communication of information.
   C. receive, process and coordinate a response to incoming information.
   D. build neural pathways for communication of internal and external information.
5. What are the sub-divisions of the autonomic nervous system?
   A. brain and spinal cord
   B. peripheral and somatic nervous systems
   C. central and peripheral nervous systems
   D. enteric, sympathetic and parasympathetic nervous systems

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

2.2 Roles of different sub-divisions of the central and peripheral nervous systems

2.2.1 Central nervous system

The **central nervous system (CNS)** comprises the brain and its extension, the spinal cord. Its primary or overarching roles are to process information received from the body's internal and external environments and to activate appropriate responses.

Brain

The brain is an intricate network of cells that plays a vital role in processing information received through neural pathways from the body and in directing actions within the body. It continuously receives and analyses sensory information, responding by controlling all bodily actions and functions. Because of its crucial role in almost everything we think, feel and do, it is sometimes called the 'control centre' or 'master regulator'.

The brain is more than a mass of networked cells. Brain cells are organised into many identifiable areas (or 'regions') and structures that have specialised roles. For example, some parts are dedicated to sensory or motor functions. Most parts, however, have integrating and overlapping roles. The apparently simple task of naming a familiar object, such as a car or mobile phone, will trigger activity in multiple structures and areas throughout the brain. These include areas at the back and side to process visual information received from the eyes, areas at the front, at the sides and near the centre to recover information from memory and to identify the object, and areas towards the front involved in language and speech production to state the name of the object.

Many brain functions involve the activation of neural pathways that link different brain areas and structures. A **neural pathway** comprises one or more circuits of interconnected neurons that form a communication network. Some pathways span short distances and others extend from one side of the brain to the other. Neural pathways also connect the brain to other parts of the nervous system and the body.

Although much is known about the brain's neural circuitry, chemistry, structures and functioning, more remains unclear or unknown. For example, although it is known that different types of memory are associated with activity in distinctive parts of the brain, it is not fully understood how the brain goes about locating and retrieving specific memories when needed. Nor is it known exactly how different types of memories are actually stored.

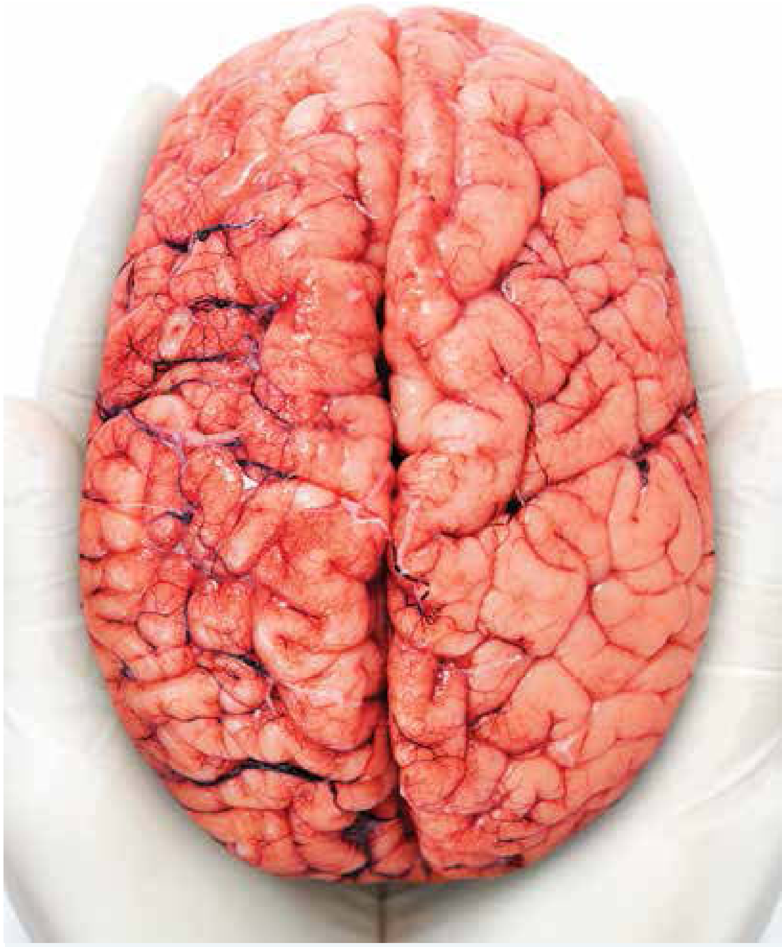


Figure 2.3 The human brain is responsible for virtually everything we think, feel and do. The wrinkly looking outer surface is a sheet of neural tissue called the cerebral cortex. The largest and most recently evolved part of this cortex is called neocortex. However, the terms cerebral cortex, neocortex and cortex tend to be used interchangeably.

Spinal cord

The **spinal cord** is the long, thin bundle of nerve fibres that extends from the base of the brain to the lower back. It is encased in a series of bones called the *vertebrae* that extend further than the actual cord. As can be seen in Figure 2.4 below, the spinal cord links the brain and the parts of the body below the neck.

Two major functions of the spinal cord are to:

- receive sensory information *from* the body (via the peripheral nervous system) and send these messages to the brain for processing. For example, an itch on your big toe, the sensation of heat as you step into a warm bath and the pain of a sprained wrist are all carried via the spinal cord to the brain area responsible for initially processing this type of sensory information
- receive motor information from the brain and send it *to* relevant parts of the body (via the peripheral nervous system) to control muscles, glands and internal organs so that appropriate actions can be taken. For example, as shown in Figure 2.5, to pick up a water bottle and bring it to your mouth for a drink, millions of neural messages are sent from the primary motor cortex

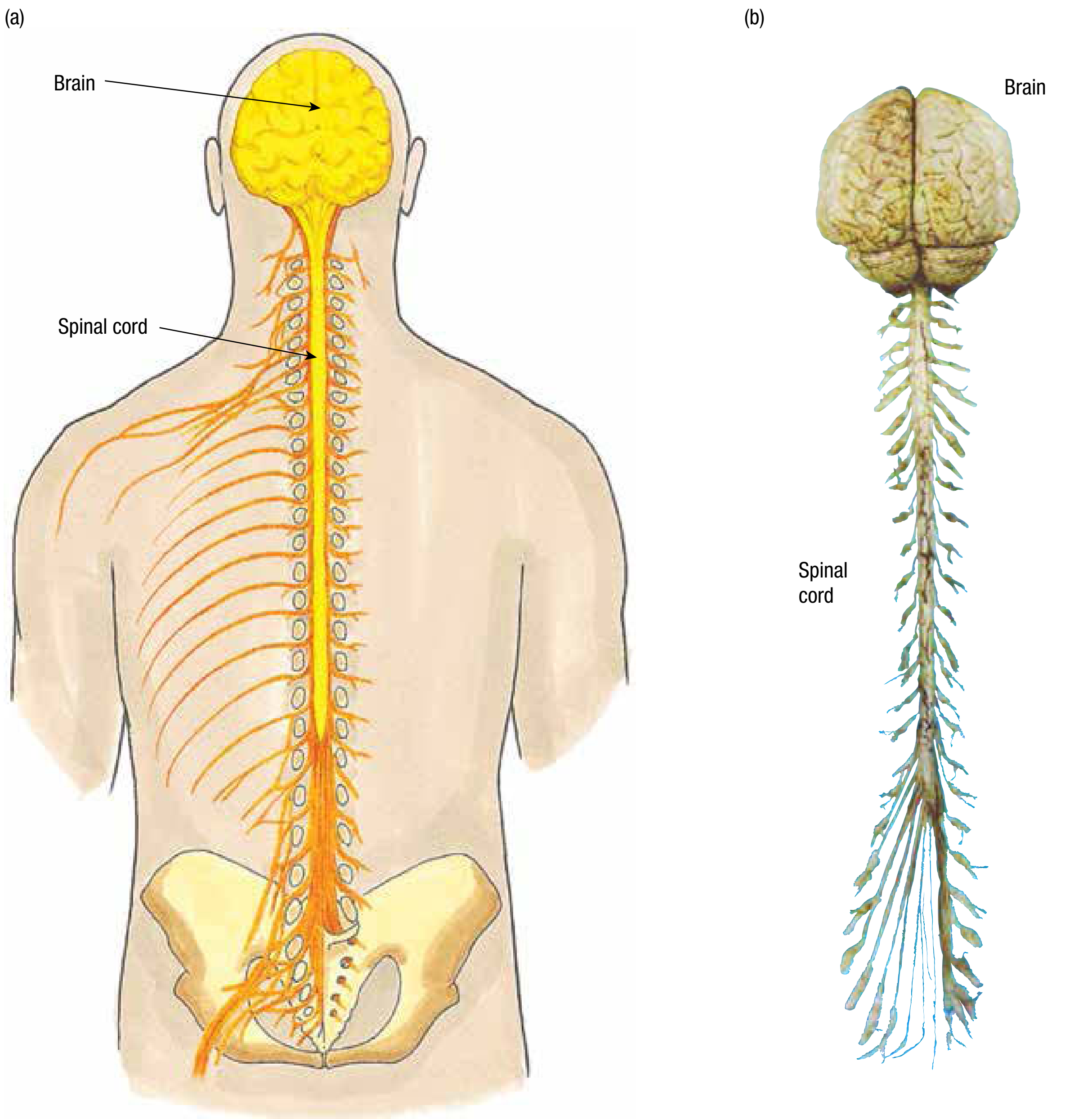


Figure 2.4 (a) The CNS consists of the brain and spinal cord. (b) Anatomically, the spinal cord links the brain and peripheral nervous system.

to the muscles in your shoulder, upper arm, forearm, wrist and fingers. This is complemented by other relevant information that has been processed by your brain such as the size, shape, texture, weight, distance and location of the bottle in relation to your eyes, mouth and hand, so that you can successfully execute a highly coordinated series of individual movements performed in one, well-timed, smooth action with just enough pressure to grasp the bottle and hold it without squeezing it too hard.

The transmission of information along the spinal cord, to and from the brain, occurs through the interconnected neurons that form neural pathways. There are *ascending tracts* (pathways) that carry sensory information up to the brain and *descending tracts* for motor information, which leaves the brain and travels down the spinal cord to exit via the spinal nerves to their destination in specific muscles, glands and/or organs. The tracts are actually nerves comprising nerve fibres that are bundled together. All nerve fibres in a given tract usually have a similar origin, destination and roles.

When the spinal cord is injured, the brain can lose both sensory input from and control over the body. The severity of feeling loss and paralysis depends on where the spinal cord is injured and the severity of the injury. Generally, the higher up on the spine the injury is, the greater the number of nerve connections between the brain and body that are disturbed.

The spinal cord has a relatively simple organisation but does more than provide pathways for messages to and from the brain. It can also initiate some simple motor reactions in the form of reflexes that occur extremely rapidly, independently of the brain. We consider the role of these *spinal reflexes* and how they occur in the next section.

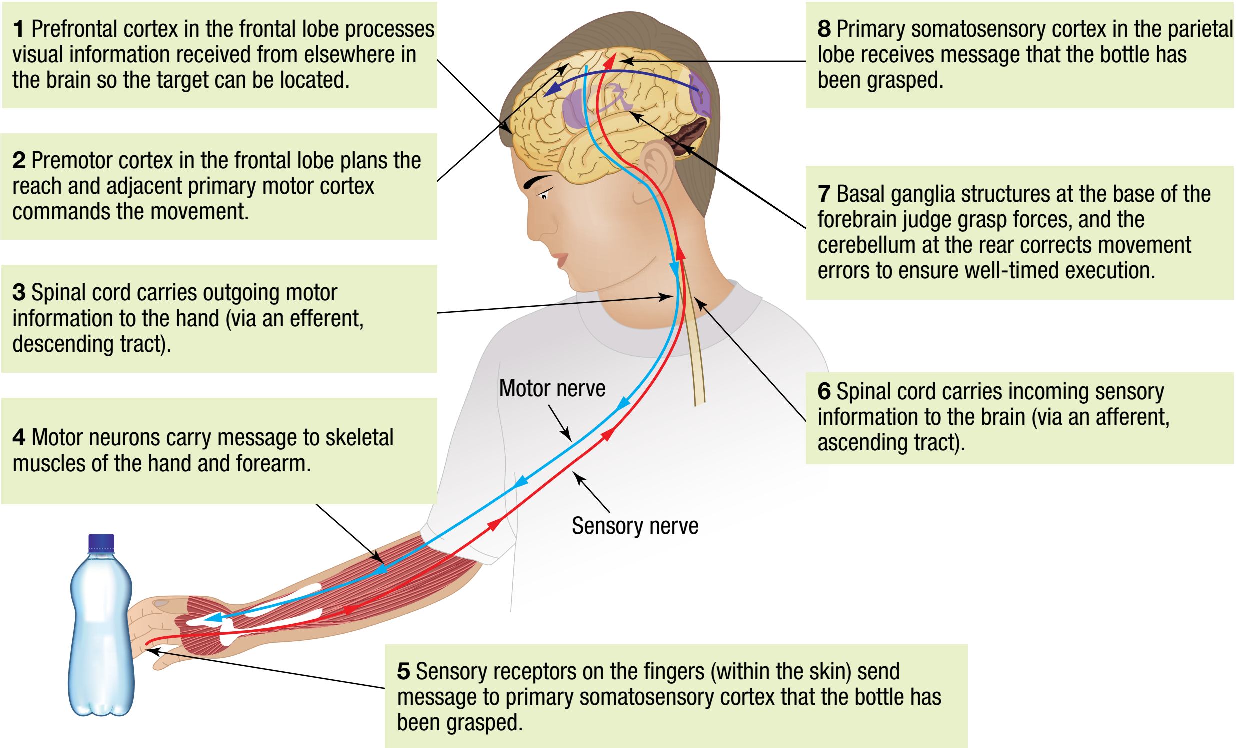


Figure 2.5 This illustration shows some of the brain processes and information transmission via the spinal cord that occur to pick up a water bottle in one, well-timed, smooth action with just enough pressure to grasp the bottle and hold it without squeezing it too hard. Note that the right arm is picking up the bottle. This means that motor information will be sent *from* the brain's left hemisphere (because it controls voluntary movements on the right side of the body) and somatosensory ('body sense') information will be sent *to* the brain's left hemisphere.

learnON

learnMORE | Brain areas, structures and roles

Access learnON for a diagram showing the location and roles of various brain areas and structures.

2.2.2 Peripheral nervous system

The central nervous system does not have direct contact with the outside world. It relies on the peripheral nervous system to link it to the rest of the body so that messages can be carried to and from the brain via the spinal cord.

The **peripheral nervous system (PNS)** is the entire network of nerves located outside the CNS. It extends from the top of the head, throughout the body to the tips of the fingers and toes and to all parts of the skin. Its primary, overarching role is to carry information to and from the CNS. More specifically, the PNS:

- carries information *to* the CNS from the body's muscles, organs and glands (about the internal environment) and from the sensory organs (about the external environment)
- carries information *from* the CNS to the body's muscles, organs and glands.

The peripheral nervous system does this through its two divisions: the somatic nervous system and the autonomic nervous system.

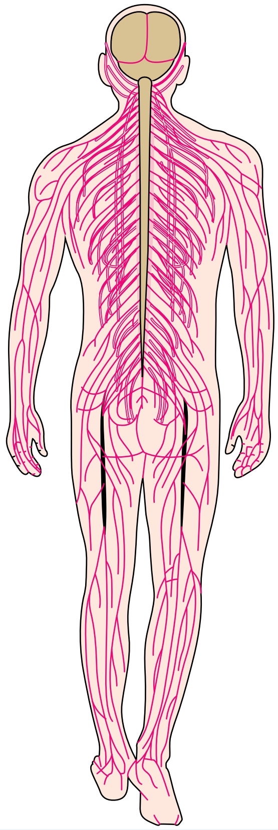


Figure 2.6 The peripheral nervous system (PNS) consists of all nerves outside the central nervous system (CNS). It carries information to and from the CNS.

2.2 LEARNING ACTIVITY 1

Review

1. A neural pathway is best described as a
   A. neuron that can receive and send information.
   B. collection of neurons that can receive and send information.
   C. circuit of interconnected neurons along which information travels.
   D. branch or sub-division of the entire nervous system.
2. The peripheral nervous system
   A. is a sub-division of the central nervous system.
   B. comprises the brain and autonomic nervous system.
   C. includes all the nerves located within the central nervous system.
   D. carries information to and from the central nervous system.
3. a. Describe the two crucial roles of the spinal cord in terms of the types of messages that travel up and down its length, and the branch of the nervous system to which it connects.
   b. What is a third role of the spinal cord?
4. Explain why spinal cord damage can result in loss of brain–body control.
5. Describe the relationship between the central nervous system and the peripheral nervous system, with reference to key roles of each of these branches.

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Somatic nervous system

The **somatic nervous system (SNS)** is a sub-division of the peripheral nervous system comprising a network of nerves that carries sensory information *to* the CNS and motor information *from* the CNS. Sensory information is received at sensory receptor sites in the body (skin, muscles, joints and tendons) and carried along sensory neural pathways by sensory neurons. Motor information is carried along motor neural pathways by motor neurons to skeletal muscles to control their activity by causing them to contract or relax. Skeletal muscles are attached to our bones and respond to messages from the CNS to initiate, change or stop movement.

The sensory information is called afferent and the motor information efferent. These terms refer to the direction of the neural information flow. More specifically, *afferent* information is sensory information coming into the CNS (incoming information), whereas *efferent* information is motor information leaving the CNS (outgoing information).

The *sensory* function of the SNS is demonstrated when someone touches your hand. The SNS sends the sensory signals about touch from the skin to your brain, resulting in the sensation of touch (or pressure on the skin). The *motor* function of the SNS is demonstrated whenever voluntary actions are performed. For example, when you text, talk, chew, shower, surf or dance, your somatic nervous system is active.

Thus, the somatic nervous system is involved in all skeletal muscle activity that enables us to participate in our relationship with the external environment. Its nerves send information to the brain from the body's various sensory receptors. These nerves also enable us to respond to these stimuli by moving through the environment.

Although motor pathways carry messages that initiate or stop movement, *voluntary* movement is controlled through the coordinated actions of *both* motor and sensory information. For example, when you use a finger to scratch your nose, your brain sends messages from the primary motor cortex via motor neurons to skeletal muscles in your arm, hands and fingers to move in specific ways. Sensory receptors in your skin and muscles send back messages through sensory neurons that help determine how much pressure is needed to hold a pen. However, your somatic nervous system does not make your heart beat faster when you are suddenly threatened, nor does it regulate your internal environment. For these reactions, the other sub-division of the PNS is required — the autonomic nervous system.

Figure 2.7 (a) Sensory receptors within the skin detect the nibbling bites in the fish spa and transmit the sensory information along the SNS to the CNS. (b) Our SNS is also active when we voluntarily move, such as when walking up a set of stairs.

2.2 LEARNING ACTIVITY 2

Review

1. Describe the two main roles of the somatic nervous system.
2. Give an example of each of these roles, using examples not referred to in the text.
3. Distinguish between the afferent and efferent information with reference to the type of information and the direction in which it is transmitted.
4. Whenever you reach to pick up a glass of water on a table, both the sensory and motor functions of the somatic nervous system are involved. Explain both the sensory and motor roles in grasping the glass.
5. The tennis player shown below has restricted movement due to paraplegia caused by spinal cord damage. Explain this athlete's restricted movement with reference to the somatic nervous system.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

2.2 LEARNING ACTIVITY 3

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2014 Psychology, Section A, Q.39 (adapted)*; ©VCAA*

The sensory function of the somatic nervous system can be demonstrated by

A. all activity within the spinal cord.
B. moving your hand away from a hot stove reflexively.
C. the homeostatic response to an increase in body temperature.
D. experiencing the sensation of heat when holding a cup of coffee.

Question 2 (1 mark)

Source: VCAA 2010 Psychology 1, Section A, Q.9; ©VCAA

The motor function of the somatic nervous system can be demonstrated by

A. experiencing the cold sensation of ice on your skin.
B. reflexively moving your hand away from a hot stove.
C. feeling muscle soreness after playing sport.
D. scratching your head.

Question 3 (1 mark)

Source: VCAA 2009 Psychology 1, Section A, Q.8; ©VCAA

The peripheral nervous system contains

A. the skeletal muscles.
B. the brain and spinal cord.
C. all the nerves of the central nervous system.
D. all the nerves outside the brain and spinal cord.

Question 4 (1 mark)

Source: VCAA 2006 Psychology 1, Section A, Q.10; ©VCAA

The somatic nervous system carries information from _____ to the _____.

A. the peripheral nervous system; autonomic nervous system
B. the sympathetic nervous system; parasympathetic nervous system
C. skeletal muscles; sensory receptors
D. sensory receptors; CNS

Question 5 (5 marks)

Source: VCAA 2019 Psychology, Section B, Q.1; ©VCAA

Finn was standing near a camp fire with his friends when he noticed the fire becoming hotter against the skin of his legs. To avoid getting burnt by the growing flames, he took a step away from the camp fire.

The human nervous system has two major divisions.

Identify the subdivision of one of these major divisions that activates Finn's responses and outline how the subdivision is involved in Finn's responses.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

Autonomic nervous system

The **autonomic nervous system (ANS)** is a subdivision of the peripheral nervous system that connects the CNS to the body's internal organs (such as the heart, stomach and liver) and glands (such as sweat, salivary and adrenal glands), providing feedback to the brain about their activities.

The ANS is called 'autonomous' because many of the organs, glands and processes under its control are self-regulating and therefore occur without conscious effort and are not usually under our voluntary control. For example, your heartbeat, breathing, digestion and perspiration occur without your conscious activation or control of them.

While skeletal muscles are completely inactive in the absence of motor neuron messages from the brain, the muscles involved in the activity of internal organs and glands (called *visceral muscles*) have built-in mechanisms for generating and maintaining their activity and do not depend on voluntary control by the brain.

This is an important feature of the ANS, as it functions continuously — whether we are awake, active, asleep, under an anaesthetic or even in a coma. Regardless of our level of awareness or alertness, the ANS keeps the vital organs and systems of our body functioning, thereby maintaining our survival.

Unlike the somatic nervous system, which is responsible for *initiating* skeletal muscle movement, the ANS *regulates* the activity of the visceral muscles, organs and glands. This means that the messages carried between the CNS and the visceral muscles, organs and glands either increase or decrease their respective activities in response to the varying demands placed on the body throughout each day.

You often become consciously aware of ANS functions when you experience emotions such as fear, anger and excitement at intense levels because this is when there is heightened ANS activity. For example, think about how you can feel your heart and breathing rates change when you suddenly become very frightened, or during exhilarating moments on a roller-coaster ride. Recall also the physiological changes you can instantly feel when the fear or exhilaration start to diminish. Your heart rate noticeably slows and your breathing becomes more regulated. Any goosebumps on your skin or feelings of butterflies in your stomach will also eventually disappear.

The ANS is not completely self-regulating. It is linked to the brain's cerebral cortex so we can voluntarily control a few autonomic responses at certain times. For example, with conscious effort, you could control your breathing rate right now.

Figure 2.8 In outer space, the temperature is extremely cold and there is no oxygen. Astronauts wear special space suits to restrict heat loss and to maintain adequate oxygen pressure for brain function. On Earth, these functions occur automatically through the activity of the autonomic nervous system.

2.2 LEARNING ACTIVITY 4

Review

1. a. Why is the autonomic nervous system described as autonomous?
   b. Is 'autonomous' a truly accurate term for describing this division of the nervous system? Explain with reference to an example.
2. Describe the relationship of the autonomic nervous system to the central nervous system with reference to a physiological response.
3. How do skeletal and visceral muscles differ?
4. How do we manage to keep alive, breathing and with the heart beating, while we are asleep?
5. Which is more important in maintaining our survival without conscious awareness or effort: the autonomic nervous system or the central nervous system? Explain with reference to an example.
6. Indicate whether each of the following responses is primarily a role of the somatic nervous system (S), autonomic nervous system (A), or both (S & A). Answer in the spaces provided.
   a. ____________ blinking
   b. ____________ talking on the phone
   c. ____________ pressing a key to send an email
   d. ____________ laughing at a joke
   e. ____________ sweating before having to give an important speech
   f. ____________ feeling your heart race when startled by a loud noise
   g. ____________ washing the dog
   h. ____________ eating dinner

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The ANS consists of three sub-divisions which have extensive connections to each other. These are:

- the sympathetic nervous system, which is responsible for *increasing* the activity of most visceral muscles, organs and glands in times of vigorous activity, stress or threat
- the parasympathetic nervous system, which is responsible for *decreasing* the activity of most visceral muscles, organs and glands, and restoring body functioning to its normal state
- the enteric nervous system, which is dedicated to the gastrointestinal tract and therefore helps regulate digestion.

The sympathetic and parasympathetic systems counterbalance each other's activities without conscious effort. This is demonstrated when you engage in an activity requiring physical exertion over a period of time. For example, when playing tennis vigorously, your sympathetic nervous system speeds up your heart rate to pump more blood and oxygen to your muscles. It causes your liver to release sugar (glucose) into your bloodstream for energy, and induces sweating to keep your skin cool and prevent you from overheating. Because the body is pumping more blood and oxygen to the muscles, these are diverted from non-essential functions such as digestion, so this is inhibited by signalling the enteric nervous system.

After the game, your parasympathetic nervous system takes over. Your heart rate slows, constricting the blood vessels in your muscles so the blood flow is diverted to the internal organs. Your sweat glands gradually slow down the production of sweat as the body returns to its normal state.

The sympathetic and parasympathetic systems do not function in an 'on/off' or 'either/or' way. They are both active at the same time. However, one system is usually *dominant* at any given time. For example, the sympathetic system dominates and is more active during emotional arousal, whereas the parasympathetic system is dominant and more active during rest and digestion.

Sympathetic nervous system

The **sympathetic nervous system** activates internal muscles, organs and glands to prepare the body for vigorous activity or to deal with a stressful or threatening situation. This is initiated by a stressor or fear stimulus and enhances survival by providing an immediate response, in a split second, to any kind of emergency.

When you perceive an emergency or experience a crisis, the sympathetic nervous system activates specific organs and glands to respond. Glands that are activated include the adrenal glands, which are located just above your kidneys and release hormones (such as adrenaline and cortisol) into the bloodstream. These circulate throughout your body, enhancing the effects of the sympathetic system by activating and energising various muscles, organs and other glands in preparation for dealing with the stressor or potential threat.

The result is that your heart rate and blood pressure increase, and your breathing rate increases so more oxygen can be taken in. Sugar and fat are released from storage to provide instant energy to the skeletal muscles. Your pupils dilate ('expand') to allow more light to enter the eye and enhance vision. Your sweat glands increase production of sweat to cool the body. In addition, digestion is slowed down (via nerve fibres that enter the intestinal wall and connect the sympathetic system to the enteric nervous system). The sympathetic system is also involved when you blush or get goosebumps, making the hairs on your body stand on end.

Figure 2.9 The sympathetic nervous system is dominant in both these animals at this time.

Parasympathetic nervous system

In times of minimal stress and in the absence of threat, the **parasympathetic nervous system** helps to maintain the internal body environment in a steady, balanced state of normal functioning. The parasympathetic system generally has the effect of counterbalancing the activities of the sympathetic system. It restores the body to a state of calm, once the need for sympathetic nervous activation has passed.

The parasympathetic system dominates the sympathetic system most of the time. It is involved in routine, everyday activities. For example, when you eat, the parasympathetic system stimulates the stomach and intestines to digest food (via its connections to the enteric nervous system). It is also involved in the protection of the visual system through the production of tears and through automatic pupil constriction in conditions of bright light. In addition, when returning the body to a balanced state (i.e. homeostasis), the parasympathetic system reduces heart and breathing rates, and minimises the release of sugar and fats into the bloodstream.

If you had to jump out of the way of an oncoming car, your sympathetic system would immediately be activated. Once the danger had passed, your parasympathetic system would take over and the various bodily systems and functions activated by the sympathetic system would gradually begin to return to normal.

The parasympathetic system takes longer to return the body to its normal state compared with the sympathetic system's immediate activation. This is because of the lingering presence of the hormones that are released when the sympathetic system is activated. These hormones remain in the bloodstream for some time after the threat has passed.

Figure 2.10 Some extreme sports activate the sympathetic nervous system. After the athlete has landed safely, the parasympathetic nervous system restores the body to a state of calm.

Table 2.1 The activities of the sympathetic and parasympathetic nervous systems

Bodily organ	Bodily function	Sympathetic nervous system action	Parasympathetic nervous system action
Pupils	Regulate the amount of light entering the eye	Dilate (expand)	Contract
Salivary glands	Digestion	Decrease salivation	Increase salivation
Heart	Pumps blood	Accelerate heart rate	Slow heart rate
Bronchioles of lungs	Breathing	Dilate (expand)	Contract
Stomach	Digestion	Decrease contractions	Increase contractions
Liver	Produces bile to aid digestion Maintains blood-sugar (glucose) level	Increase the release of glucose (sugar)	Decrease the release of glucose (sugar)
Gall bladder	Stores bile	Inhibit the release of bile	Stimulate the release of bile
Adrenal glands	Secrete the hormones adrenaline (epinephrine) and noradrenaline (norepinephrine) from the medulla	Stimulate hormone secretion resulting in increased heart rate, blood pressure and breathing rate, and relaxation of intestinal muscles	Inhibit hormone secretion
Bladder	Stores urine	Relax	Increase contractions
Intestines	Digestion	Relax	Increase contractions
Genitals	Reproduction	Excite	Relax
Sweat glands	Regulate temperature	Increase production of perspiration	Decrease production of perspiration

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Enteric nervous system

The gastrointestinal tract is the part of the digestive system that comprises the hollow organs that food and liquids travel through when they are swallowed, digested, absorbed, and leave the body as faeces. These organs include the mouth, oesophagus, stomach, small intestine, large intestine, rectum and anus. The liver, pancreas and gallbladder are the solid organs of the digestive system.

The **enteric nervous system (ENS)** is embedded within the walls of the gastrointestinal tract and is dedicated to its functioning. It is an integrated, mesh-like system composed of thousands of small clusters of neurons (called ganglia) and nerve fibres that connect them. As shown on Figure 2.11, these are located in most regions of the tract, between the oesophagus and the rectum. There are also neural circuits connecting the ENS with other parts of the nervous system and the solid organs of the digestive system.

The total number of neurons in the ENS of humans is estimated at 400–600 million, which is greater than the total of all neurons in the sympathetic and parasympathetic nervous systems combined and similar to the number of neurons in the spinal cord.

The ENS has multiple roles. Its neurons and ganglia detect the physiological condition of the gastrointestinal tract, integrate information about its state, provide outputs to control gut movement (e.g. muscle contractions that move food and waste along the gut), and perform many other functions such as nutrient management, regulating gastric acid secretions, changing local blood flow and interacting with the parts of the immune and endocrine systems that are located in the gut.

The ENS has extensive, two-way connections with the CNS, and works together with the CNS to control the digestive system in the context of local and whole body physiological demands. For example, the ENS and brain interact in controlling stomach secretions and voluntary bowel movements.

The ENS can also function independently of the brain and carry out some of its functions in the digestive process without communicating with the brain (as has been demonstrated when the vagus nerve that directly connects the brain and gut is cut). It is also capable of acting independently of the sympathetic and parasympathetic nervous systems, although it may be influenced by them.

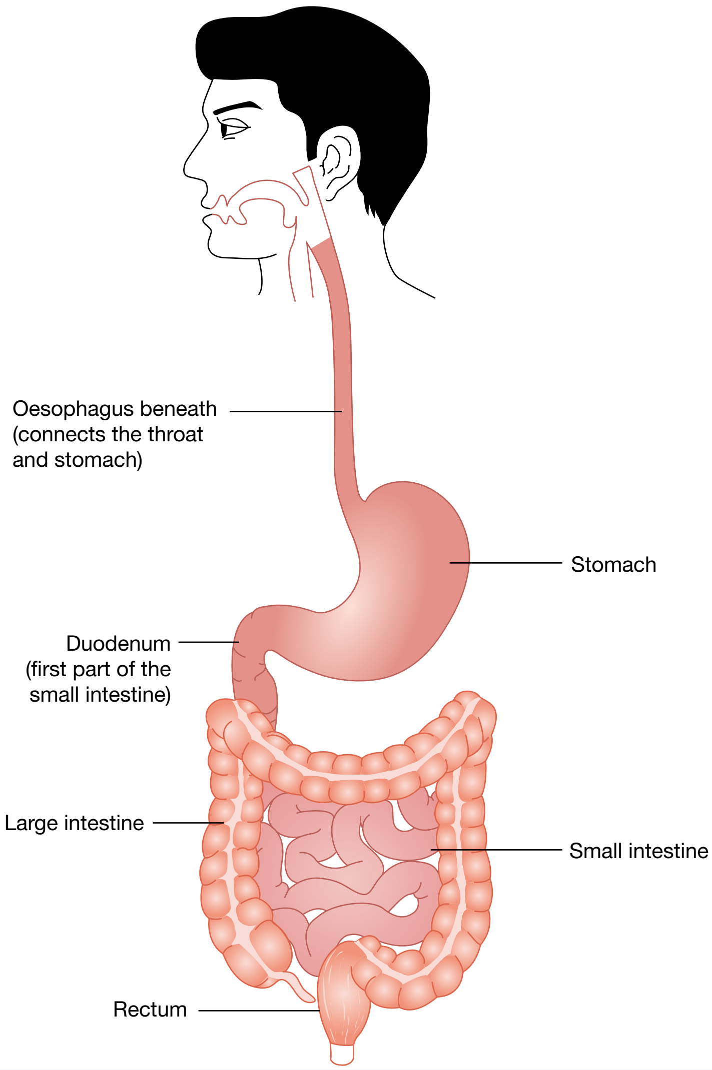

Figure 2.11 The enteric nervous system is located within the walls of the gastrointestinal tract between the oesophagus and rectum.

Source: Based on Furness, J. B. (2012). The enteric nervous system and neurogastroenterology. *Nature Reviews. Gastroenterology & Hepatology, 9*, 286–294.

ENS activity is also influenced by external factors that ordinarily affect hunger, eating and digestion, including diet, cognitions, mood, or when there are disturbances to the gastrointestinal tract, such as the presence of foreign bacteria or viruses that may cause illness. The ENS also regulates the response to the food and drink that are taken in. In the case of food poisoning, the ENS can respond by initiating vomiting and diarrhoea.

The microbiota, comprising the bacteria and trillions of other microscopic organisms that live in the gastrointestinal tract, may also influence how the ENS functions to regulate digestive processes.

Gut microbiota have been associated with various physical and psychological disorders. Examples are in the next topic which discusses stress as a psychobiological process.

The ENS is sometimes referred to as a ‘second brain’ because of its degree of autonomy (including its own memory of prior gut action), and its reliance on the same types of neurons and neurotransmitters that are found in the CNS. However, the roles of the ENS are much more restricted than the actual brain, so this analogy has limited usefulness (Furness, 2006; 2012; 2016).

2.2 LEARNING ACTIVITY 5

Review

1. Complete the following paragraph.
   The _____ nervous system arouses the body for vigorous activity or to deal with a stressful or threatening situation; whereas the _____ nervous system restores the body to a state of calm, once the need for nervous system activation has passed. When the need for nervous system activation has passed, the _____ nervous system will play a predominant role in restoring digestive processes to their normal level of functioning.
2. Which sub-division of the autonomic nervous system has its own network of neurons dedicated to its functioning?
3. In which sub-division of the nervous system would gut microbiota be found?
4. a. Give three examples of bodily functions that increase their activity as a result of sympathetic system activation.
   b. Give three examples of bodily functions that decrease their activity as a result of sympathetic system activation.
5. Give an example of a specific bodily function that is affected as a result of the action of the parasympathetic nervous system. Briefly explain the purpose of the changes if resulting from parasympathetic nervous system activation.
6. Explain why it can take longer for the parasympathetic nervous system to ‘slow down’ bodily functions than it does for the sympathetic nervous system to ‘speed up’ bodily functions.
7. Which division of the autonomic nervous system is likely to be dominant if you are in each of the following situations?
   a. lying on the beach reading a book
   b. waiting for the delivery of your VCE results
   c. feeling anxious about a blind date
   d. hearing an unexpected loud knock on the window at 2 am while watching TV alone
   e. watching a terrifying scene in a movie
8. a. Where is the enteric nervous system located?
      i. Name three organs that are part of this system.
      ii. Give an example of a digestive organ not considered a part of the system but with which it is interconnected.
   b. What is the primary role of this system?
   c. Explain, with reference to an example, whether the enteric system is entirely autonomous.
   d. Complete the following sentence.
      In general, sympathetic nervous system stimulation of the enteric nervous system will _____ gastrointestinal activity; whereas, parasympathetic nervous system stimulation will _____ gastrointestinal activity.

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2.2 LEARNING ACTIVITY 6

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.3 (adapted); ©VCAA

Vikki wakes up to the sound of something scratching at the bedroom window and becomes so frightened that she cannot move.

Vikki is likely experiencing

A. an inability to move due to parasympathetic dominance.
B. a heightened heart rate with sympathetic nervous system activation.
C. stimulation of the autonomic nervous system in preparation for running away.
D. an inability of the muscular nervous system to function effectively.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.5; ©VCAA

Masako was anxious about and excited to be competing in the last baseball game before the finals. If her team won, it would progress to the finals. Masako was new to the sport and doubted her abilities but had practised a lot and carefully listened to her coach's tips. She had also decided that this game would help increase her skills. When it came time for Masako to bat, she was concentrating so closely on the ball that she blocked out the crowd cheering her on.

Which of the following identifies the functioning of Masako's autonomic nervous system and a resulting physiological response when she was preparing to bat?

	Autonomic nervous system functioning		Physiological response
	Parasympathetic nervous system	Sympathetic nervous system	
A.	active	inactive	decreased salivation
B.	non-dominant	dominant	increased blood pressure
C.	inactive	dominant	movement of skeletal muscles
D.	inactive	active	constricted pupils

Question 3 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.6; ©VCAA

A psychologist wanted to investigate people's responses to being pricked by a needle. Details of the investigation were provided to a group of 10 participants prior to the investigation. The investigation involved blindfolding participants and pricking each participant's finger over several trials.

The main role of Nerissa's autonomic nervous system when she saw the needle was to

A. notify the brain that a decision needs to be made.
B. modify the activity of internal muscles, organs and glands.
C. maintain homeostasis in internal muscles, organs and glands.
D. ensure that the brain activates internal muscles, organs and glands.

Question 4 (1 mark)

Source: VCAA 2014 Psychology, Section A, Q.11; ©VCAA

When Geoff feels excited, which parts of his nervous system are most likely to be activated?

A. the sympathetic branch of the somatic nervous system
B. the sympathetic branch of the autonomic nervous system
C. the parasympathetic branch of the somatic nervous system
D. the parasympathetic branch of the autonomic nervous system

Question 5 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.2; ©VCAA

Daniel ran quickly across a busy road to catch an approaching bus. When he got to the other side, he noticed that his breathing rate had increased and his hands were shaking.

Which divisions of the nervous system most likely coordinated Daniel's running, increased breathing and shaking hands?

	Running	Increased breathing	Shaking hands
A.	somatic	parasympathetic	sympathetic
B.	autonomic	parasympathetic	parasympathetic
C.	somatic	sympathetic	sympathetic
D.	sympathetic	sympathetic	sympathetic

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2.3 Conscious and unconscious responses to sensory stimuli

Some people believe that we use only 10% of our brain and the rest is a huge reservoir of untapped potential for some kind of remarkable 'power'. The reality is that we ordinarily use virtually every part of the brain, and that the brain is active almost all the time.

In neurosurgery, where it is possible to observe the functions of a patient's brain under local anaesthetic while the patient is awake, electrical stimulations in virtually all parts show activity at the neuronal level, even when no sensory experience, movement or any other reaction is being observed. Moreover, no areas of the brain are completely inactive, even during sleep. If they were, it would indicate a serious functional disorder.

Our brain and nervous system are constantly processing sensory stimuli detected by sensory receptors and organs that respond to the different types of information received from both our internal and external environments. Our responses to these stimuli may be conscious or unconscious. Psychologists distinguish between these reactions primarily in terms of whether or not there is awareness.

A **conscious response** to a sensory stimulus is a reaction that involves awareness. You will have paid attention to the stimulus and therefore know about it. The response will usually be a voluntary, 'intentional' reaction. The reaction, even if momentary, is also likely to be goal directed ('purposeful') and you will be able to exercise some degree of control over it.

In the course of a typical day we make numerous conscious responses of varying complexity to all kinds of external sensory stimuli that bombard our senses. For example, when you step outside and feel the air temperature you will make a conscious response when you decide whether to put on a jacket. Similarly, if the sun is shining brightly, you may choose to wear sunglasses, a hat or both.

A conscious response may also be made to an internally sourced stimulus, as might occur if you feel a stomach ache in class at school. Depending on the severity of the ache, you may decide to ignore it, stroke your stomach, tell someone about it, excuse yourself and leave the room, or react in some other way that you believe is best.

An **unconscious response** to a sensory stimulus is a reaction that does not involve awareness. It is involuntary, unintentional, automatic and we cannot ordinarily control its occurrence. Bodily responses regulated by the ANS occur automatically without conscious effort. For example, in response to stimuli about the state of different bodily systems, your ANS is unconsciously regulating their functioning, pumping blood from your heart, digesting your food and so on. You do not consciously have to think about making your heart beat, your eyes blink or your lungs fill with oxygen. Many of these ANS functions are actually reflexive responses (called *autonomic reflexes*).

Other reflexive responses also serve to help us avoid danger and minimise harm. Sometimes, we need to react so quickly that there is no time for conscious thought. These unconscious, automatically occurring responses are reflexes involving contraction of skeletal muscles. Most are very simple responses. They occur in the same way each time and do not require learning. Of course, we may sometimes become conscious of the stimulus that activated a reflex, and this awareness may enable us to correct or avoid a potentially dangerous situation, but awareness is *not* a part of the reflex itself. It may come after the reflex action has been completed, as may occur with a spinal reflex.

Figure 2.12 When exposed to bright sunlight, putting on sunglasses and shielding your eyes is a conscious response, whereas squinting or blinking are unconscious responses.

Spinal reflexes

The spinal cord does more than provide pathways for messages to and from the brain. It can also initiate some simple responses on its own independently of the brain. These responses include spinal reflexes.

A **spinal reflex** is an unconscious, automatic response controlled solely by neural circuits in the spinal cord. It is often referred to as a *reflex arc* because the response to an incoming stimulus is automatically 'reflected back' from the spinal cord without any initial input from the brain and before the brain processes a conscious perception of the stimulus.

For example, if you were to touch the hot metal handle of a frying pan, you would automatically withdraw your hand to release the handle before the sensory information travels all the way to your brain and therefore before pain is actually experienced. The sensory receptor cells within the skin of your fingers would detect the heat and send neural messages via one or more sensory neurons to your CNS, but the first point of contact in the CNS is the spinal cord. It responds with a message via one or more motor neurons to move the appropriate muscles in your hand to release the hot object and withdraw the hand and is therefore called a *withdrawal reflex*.

The immediate response at the spinal cord enables a faster reaction time, a fraction of a second before the sensory information reaches the brain. Consequently, this type of spinal reflex involving a withdrawal reaction is believed to be an adaptive response.

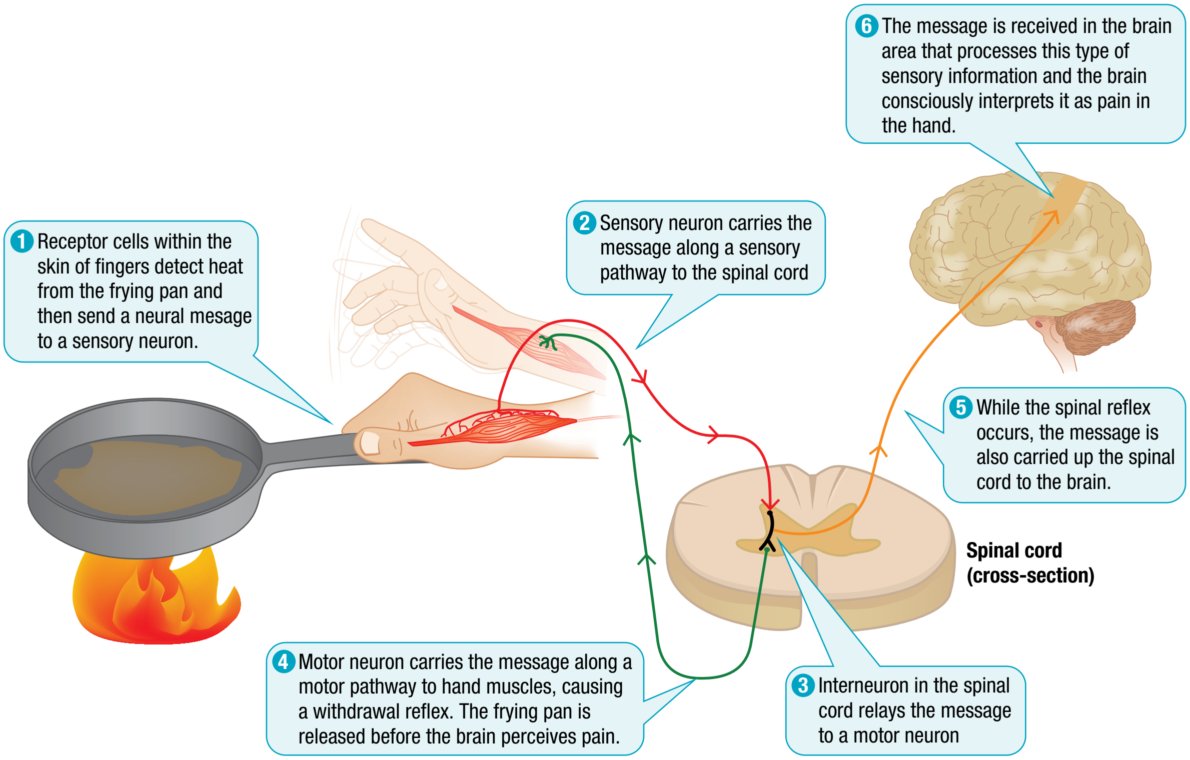

Figure 2.13 This sequence shows a spinal reflex involving a withdrawal response. Sensory receptors within the skin respond to the stimulation and initiate a neural message that is carried by a sensory neuron to an interneuron in the spinal cord. The interneuron acts as a link between sensory and motor neurons, relaying information from one to the other (because sensory and motor neurons rarely connect directly). The interneuron sends the message to a motor neuron that carries a message back to the appropriate muscles, which stimulates and causes them to contract and pull away from the stimulus. The spinal cord will also carry the message to the brain, including information about the action taken. The hot and potentially harmful pan handle is released before the brain processes the conscious perception of pain.

Spinal reflexes are considered adaptive as they save time in situations that may be very harmful to the organism. While the transmission of information from the spinal cord to the brain only takes a fraction of a second, this saved time may be important in terms of minimising harm, or even saving the life of the organism. Other examples of this type of spinal reflex are jerking your bare foot up from a hot pavement and withdrawing your hand if you touch a sharp object.

Because reflexes are normally so predictable, they provide useful information about the functioning of the nervous system and greatly assist in the diagnosis of neural disorders. Damage or disease anywhere along the reflex arc can cause a reflex to be absent or abnormal.

For example, when the knee is tapped on the patellar ligament, the sensory nerve that receives this stimulus carries the information to the spinal cord, where it is relayed to a motor nerve. This normally causes the quadriceps muscle at the front of the thigh to contract and jerk the leg up. The leg begins to jerk up while the brain is just becoming aware of the tap. Absence of this patellar reflex could indicate damage within sensory or motor pathways, or a spinal cord injury in the lower back area.

Spinal reflexes demonstrate that a response to a particular sensory stimulus can have both an unconscious and conscious component, one occurring before the other. For each reflex action, a relatively small number of neurons simply convert a sensory stimulus into action. Many involve only three neurons — a sensory neuron, a motor neuron and an interneuron that relays messages between them. The simplest of spinal reflexes (such as the patellar 'knee jerk' reflex) can involve as few as two neurons — a sensory neuron and a motor neuron.

Note that a spinal reflex typically involves muscle contraction and does not represent all types of reflexes. Nor do all types of reflexes involve muscle contractions.

Figure 2.14 The patellar 'knee jerk' reflex is a spinal reflex that involves only a motor neuron and a sensory neuron. Absence of this reflex could indicate damage within sensory or motor pathways, or a spinal cord injury in the lower back area.

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Teacher digital document Teacher demonstration of a spinal reflex

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2.3 LEARNING ACTIVITY 1

Review

1. Distinguish between a conscious and unconscious response by the nervous system to a sensory stimulus with reference to three key points.
2. a. Explain what a spinal reflex is.
   b. Why is it also called a reflex arc?
3. Why may a spinal reflex be considered to have an 'adaptive' or 'survival' role?
4. Give an example of a reflex response that you believe may *not* be involved in a spinal reflex arc. Explain your choice of example.
5. Ava is using a wet knife to remove a broken piece of toasted bread that is jammed in the toaster. She experiences an electric shock and spontaneously releases the knife and pulls her hand away from the stimulus.
   a. Will Ava experience pain? When? Explain your answer.
   b. Insert the numbers 1–6 in the spaces provided to show the correct order of the steps that enabled Ava's spinal reflex.
      ____ Motor neuron carries a message back from the spinal cord to initiate and enable knife release and hand withdrawal actions.
      ____ Brain processes the conscious perception of pain.
      ____ Knife release/hand withdrawal.
      ____ Pain stimulus of electric shock.
      ____ Interneurons transmits the message to a motor neuron and to the brain.
      ____ Sensory receptors within the skin detect and respond to the stimulus, initiating a neural message that is carried by a sensory neuron to interneurons in the spinal cord.
   c. Below is alternative sequence of steps in Ava's spinal reflex. Show these in their correct order.
      ____ Motor neuron carries a message back from the spinal cord to initiate and enable withdrawal actions, while the brain processes the conscious perception of pain.
      ____ Sensory receptors detect and respond to the pain stimulus of electric shock, initiating a neural message that is carried by a sensory neuron to an interneuron in the spinal cord.
      ____ Interneurons transmit the message to a motor neuron and to the brain.

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2.3 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.2; ©VCAA

Which statement about conscious or unconscious responses by the nervous system is correct?

A. A conscious response by the nervous system is involuntary and goal-directed.
B. A conscious response by the nervous system is voluntary and attention is given to the stimulus.
C. An unconscious response by the nervous system is voluntary and regulated by the autonomic nervous system.
D. An unconscious response by the nervous system is unintentional and is always regulated by the autonomic nervous system.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.2; ©VCAA

When someone pricks their finger and immediately withdraws it, their response demonstrates

A. the adaptive nature of the human nervous system.
B. how the spinal cord makes decisions about movement.
C. the conscious response involved in the coordination of the reflex.
D. the role of the brain in the responses of the autonomic nervous system.

Question 3 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.1; ©VCAA

The spinal reflex is

A. the brain's survival response.
B. a voluntary response to harmful stimuli.
C. an automatic response that occurs in the spinal cord.
D. a conscious response to external stimuli processed by the spinal cord.

Question 4 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.38; ©VCAA

Phil had recently bought a new pair of very expensive running shoes. He was looking forward to wearing the new shoes during an upcoming race. A few days before the race, Phil went to put on his new shoes and could not find them. He started to panic, his heart started beating quickly and sweat started to run down his face. He frantically searched his entire bedroom but could not find his new shoes anywhere.

Which one of the following best describes Phil's physiological response when he could not find his new shoes?

A. the spinal reflex
B. maintenance of homeostasis
C. slowing of the somatic nervous system
D. activation of the sympathetic nervous system

Question 5 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.11; ©VCAA

The action of writing is controlled by

A. the muscular nervous system.
B. the somatic nervous system.
C. the autonomic nervous system.
D. the sympathetic nervous system.

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2.4 Role of neurotransmitters

When neurons communicate with one another, most do so by sending neurotransmitter across the tiny space between the terminal buttons of one neuron, which release the neurotransmitter, and the dendrites of another, which receive the neurotransmitter. This tiny space is called the **synaptic gap** (or *synaptic cleft*). The synaptic gap is about 500 times thinner than a strand of hair. It is one component of the neural synapse.

The **neural synapse** (or *neural junction*) is the site where communication typically occurs between adjacent neurons. The other two components are the terminal buttons of the *presynaptic* ('sending') *neuron* and the dendrites of the *postsynaptic* ('receiving') *neuron*. The neural synapse may be referred to more simply as the synapse and its components may also be referred to more generically; for example, as an axon terminal, a dendrite and a synaptic gap.

Neurotransmitter is a chemical substance produced by a neuron that carries a message to other neurons or cells in muscles, organs or other tissue. It has its effects by attaching itself ('binding') to receptor sites of postsynaptic neurons that are specialised to receive that specific neurotransmitter. Therefore, receptors on dendrites play a vital role in the communication process.

Neurotransmitter that does not bind to receptors in the postsynaptic neuron is absorbed back into the terminal buttons by the presynaptic neuron in a process called *reuptake*. Once the postsynaptic neuron has received the neurotransmitter, any additional neurotransmitter left in the synapse will also be reabsorbed by the presynaptic neuron.

Many medications work by affecting the process of reuptake in order to increase or reduce the availability of particular neurotransmitter(s) in the brain.

Generally, a specific type of neurotransmitter will have either of two effects. Some neurotransmitters have an **excitatory effect** and consequently stimulate or activate postsynaptic neurons to perform their functions. Other neurotransmitters have an **inhibitory effect** and block or prevent postsynaptic neurons from firing. The same neurotransmitter, however, may have either an excitatory or an inhibitory effect at a particular location.

The effects of a neurotransmitter are not entirely caused by the chemical. Its effects are also due to the receptor to which the neurotransmitter binds. Therefore, whether a neurotransmitter is excitatory or inhibitory depends on the properties of the receptor at the synapse where it is released and on the receptor's location in the brain.

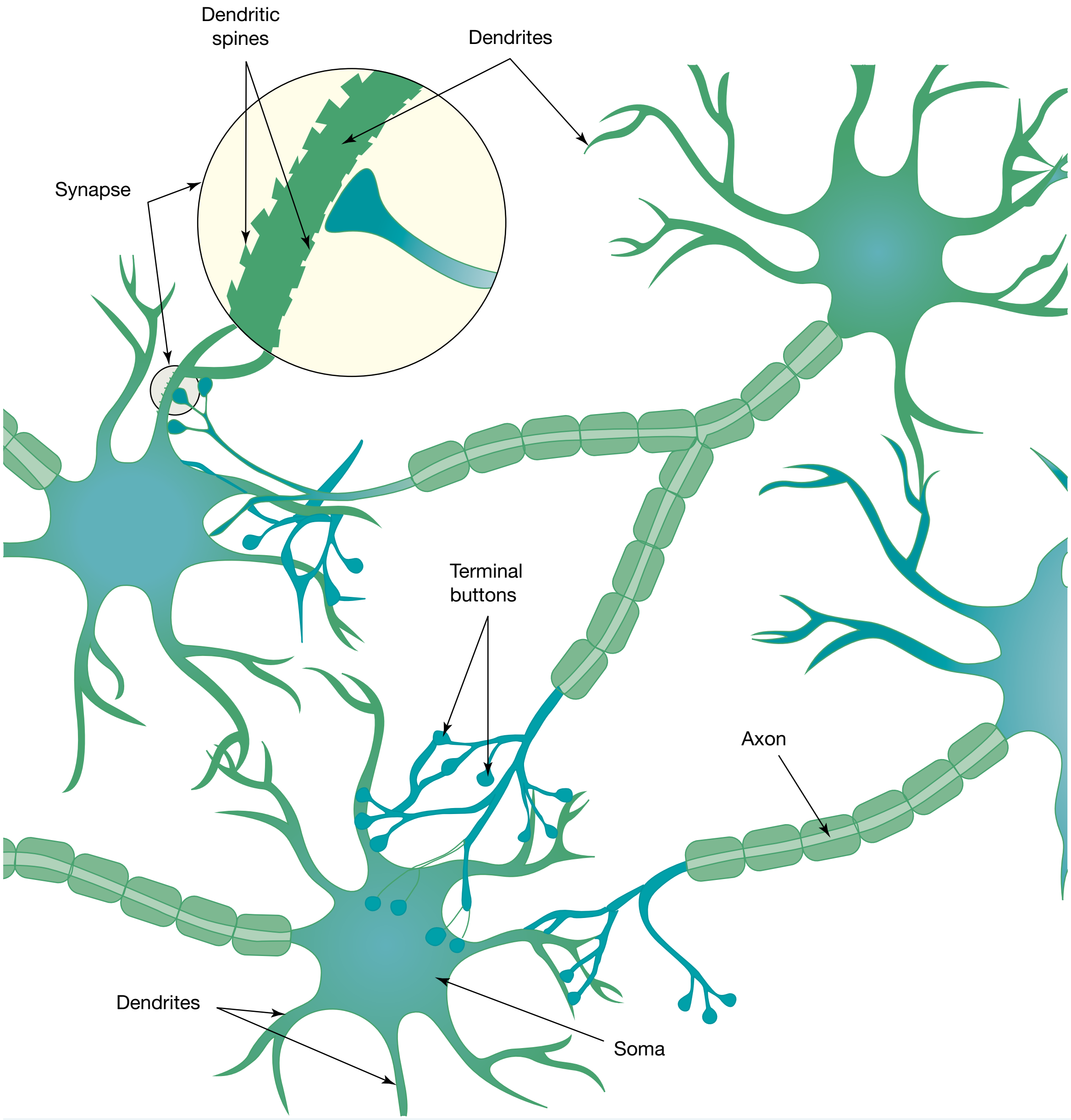

Figure 2.15 Neurons do not link together like a chain. The branches of an axon almost touch the dendrites of an adjacent neuron, leaving a tiny space called a synaptic gap.

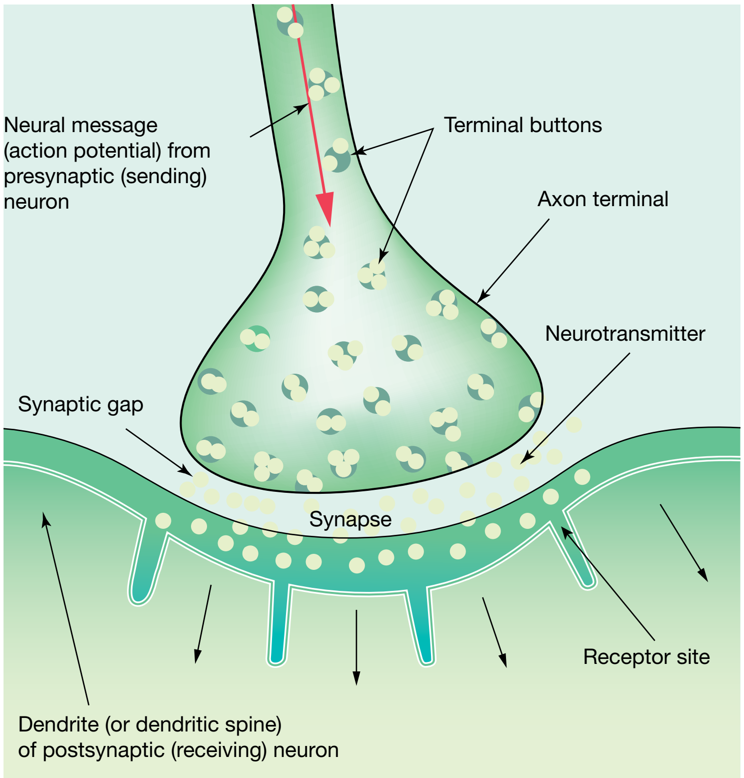

Figure 2.16 When the neural message reaches the axon terminal, neurotransmitter is released from the terminal buttons, which carries the message across the synaptic gap to the receiving neuron.

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The number of neurotransmitters that a neuron can manufacture varies. Some neurons produce only one type of neurotransmitter, whereas other neurons manufacture two or more and therefore contain more than one type of neurotransmitter at their axon terminals. This means that a single neuron may secrete one neurotransmitter at one synapse and a different neurotransmitter at another synapse. In some cases, more than one type of neurotransmitter may coexist in the same terminal button.

Although estimates vary depending on the source and how they are defined or classified, researchers have identified the presence of at least 60 different neurotransmitters in the human brain. Some researchers have estimated far more than this number. All this complexity allows for a very large number of neurotransmitters and receptor sites for them (Seal, 2008; Kolb & Whishaw, 2015).

While communication between one neuron and another is usually a chemical process involving neurotransmitters, communication between neurons also occurs in other ways. In some instances, communication between neurons is electrical; for example, when axons transmit messages directly to other axons or directly to the cell body (soma) of other neurons and when dendrites of one neuron communicate directly with the dendrites of other neurons.

Some neurotransmitters also occur as hormones, so they may be referred to as *neurohormones*. For example, noradrenaline (also called norepinephrine) is a neurotransmitter and a hormone. It is secreted as a hormone by the adrenal glands into the blood, and as a neurotransmitter from neurons.

In addition, some neurotransmitters can influence the action of other neurotransmitter. These are called *neuromodulators* and are described in the next section.

Glutamate and GABA are the most common neurotransmitters in the CNS. Neurons in virtually every brain area use these two chemical messengers to communicate with each other. They are considered the 'workhorses' of the CNS because they are found at so many synapses.

2.4.1 Glutamate

Glutamate (Glu) is the main *excitatory* neurotransmitter in the CNS. This means that glutamate enhances information transmission by making postsynaptic neurons more likely to fire. It is the second most abundant neurotransmitter in the brain and is involved in most aspects of normal brain function, including learning, memory, perception, thinking and movement.

In particular, glutamate has crucial roles in the synaptic changes that occur during learning and memory. Its excitatory effects promote the growth and strengthening of synaptic connections between neurons within a neural pathway that subsequently represents the memory of what has been learned. This role is described in the next section on synaptic plasticity.

Despite its importance, too much or too little glutamate can actually be harmful to neurons and brain functioning as a whole. 'Glutamatergic communication' requires the right concentrations of glutamate to be released in the right places for the right amounts of time. Less than this results in poor communication.

Alternatively, abnormally high concentrations of glutamate can result in overexcitation of receiving neurons. This overexcitation can lead to effects that can cause neuronal damage and/or death by overstimulating them. In turn, this can damage neural networks (Adães, 2018; Jenner & Caccia, 2019).

2.4.2 Gamma-amino butyric acid (GABA)

Gamma-amino butyric acid (GABA) is the primary *inhibitory* neurotransmitter in the CNS. It works throughout the brain to make postsynaptic neurons less likely to fire (i.e. it 'inhibits' firing). One of its roles is to fine-tune neurotransmission in the brain and maintain neurotransmission at an optimal, or 'best possible', level.

Without the inhibitory effect of GABA, activation of postsynaptic neurons might get out of control. Their uncontrolled activation could spread throughout the brain, causing seizures similar to those of epilepsy and other problems.

Anxiety symptoms such as those experienced by people with a phobia have been connected to a low level of GABA in the brain, thereby impacting on the regulation of neuronal transmission in the brain. The link between anxiety and a dysfunctional GABA system is examined in Topic 9 on specific phobia.

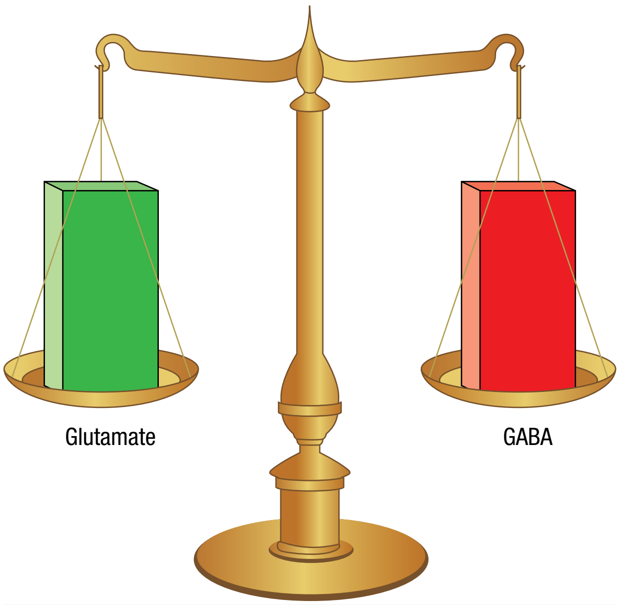

Figure 2.17 Glutamate is an excitatory neurotransmitter and makes receiving neurons more likely to fire. GABA is an inhibitory neurotransmitter and makes receiving neurons less likely to fire. The inhibitory action of GABA normally counterbalances the excitatory activity of glutamate and vice versa. Consequently, GABA and glutamate have important roles in regulating central nervous system arousal.

2.4 LEARNING ACTIVITY 1

Review

1. What is a neurotransmitter?
   A. a nerve cell
   B. a brain cell
   C. a chemical messenger
   D. the gap between neurons

2. A neural synapse is
   A. a structure found throughout the nervous system that enables neurons to pass an electrical or chemical signal to another neuron.
   B. a type of neuron that is modified when neurotransmitter exerts its influence.
   C. the part of a neuron that receives neurotransmitter.
   D. a point of communication between neurons where axons and dendrites meet.
3. The synapse is made up of which three structures?
   A. synaptic gap, terminal buttons, axons
   B. synaptic gap, axons, the soma
   C. synaptic gap, terminal buttons, dendrites
   D. synaptic gap, receptor, neurotransmitter
4. The excess amount of neurotransmitter secreted by a presynaptic neuron is
   A. redirected to other neighbouring neurons.
   B. recycled back into the presynaptic neuron.
   C. reabsorbed by the postsynaptic neuron.
   D. eliminated through evaporation over time.
5. Neurotransmitters can affect the response of
   A. neurons.
   B. muscles.
   C. glands.
   D. All of the above are correct.
6. Distinguish between excitatory and inhibitory effects of a neurotransmitter with reference to glutamate and GABA.
7. In addition to the chemical substance itself, what else influences whether a neurotransmitter will be excitatory or inhibitory at a particular synapse?
8. Match each neurotransmission term with its correct description. Insert each letter in the space provided.
   (a) presynaptic neuron
   (b) reuptake
   (c) receptor site
   (d) glutamate
   (e) neurotransmitter
   (f) inhibitory effect
   (g) gamma-amino butyric acid (GABA)
   (h) synaptic gap (cleft)
   (i) binding
   (j) excitatory effect
   (k) neural synapse
   (l) terminal button
   (m) postsynaptic neuron

   ___ tiny space between the terminal buttons of a sending neuron and the dendrites of receiving neuron
   ___ receiving neuron
   ___ when terminal buttons 'take back' neurotransmitter
   ___ where neurotransmitter is received
   ___ an excitatory neurotransmitter in the CNS sending neuron
   ___ neural message in a chemical form
   ___ communication site for adjacent neurons
   ___ where neurotransmitter is released
   ___ block or prevent a postsynaptic neuron from firing
   ___ stimulate or activate a postsynaptic neuron
   ___ attachment of neurotransmitter to a receptor site
   ___ an inhibitory neurotransmitter in the CNS
   ___ sending neuron

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

2.4 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.27 (adapted); ©VCAA

Which of the following describes the role of glutamate when learning how to play a video game?

A. Glutamate makes the post-synaptic neurons more likely to fire.
B. Glutamate stimulates the release of neurotransmitter during the learning process.
C. Glutamate excites the neurons that are involved in playing the game.
D. Glutamate makes the presynaptic neurons more likely to fire.

Question 2 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.1; ©VCAA

Which of the following correctly identifies the specialised structure and corresponding function at any given synapse?

	Structure	Function
A.	pre-synaptic neuron	releases neurotransmitters from vesicles
B.	synaptic gap	electrical charge transmits the neural message
C.	receptor site	neurotransmitters are stored
D.	post-synaptic neuron	reuptake of neurotransmitters occurs

Question 3 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.3; ©VCAA

What would be the impact on the transmission of neuronal messages if there was evidence of the thinning of dendrite branches?

A. The neuron would not function properly and could die because dendrites provide energy for the cell.
B. Electrical messages may become weaker because dendrites conduct electrical energy away from the cell body.
C. Fewer neurotransmitters may be released into the synapse because dendrites contain vesicles holding neurotransmitters.
D. The likelihood of the post-synaptic neuron being activated may decrease because dendrites receive the neurotransmitters from the synapse.

Question 4 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.1; © VCAA

The correct sequence in which information travels along a neural pathway is

A. dendrite, synapse, neurotransmitter, axon.
B. synapse, neurotransmitter, axon, dendrite.
C. axon, dendrite, synapse, neurotransmitter.
D. dendrite, axon, synapse, neurotransmitter.

Question 5 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.57; ©VCAA

During learning, the dendrites of some nerve cells will

A. release neurotransmitters into the synaptic gap.
B. receive neurotransmitters across the synaptic gap.
C. transmit impulses towards the synapses with other neurons.
D. integrate and process incoming information from other connecting neurons.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

2.5 Role of neuromodulators

Some neurotransmitters may ‘modulate’, or influence, the effects of other neurotransmitters and are therefore called modulatory neurotransmitters, or simply **neuromodulators**. For example, if a neurotransmitter has modulatory effects, it can change the reactivity of receptors to another type of neurotransmitter to enhance their excitatory or inhibitory responses.

Neuromodulators can also team up and work together with another neurotransmitter in a synapse to make the other more or less potent. However, their activity is not restricted to the synaptic gap between two adjacent neurons.

Neuromodulators do not release their chemical messengers into a single synapse. Instead, they are released into far broader areas, where they can affect a large number of neurons at once, as many as 100 000 or more. Consequently, an entire neural tissue, brain area, pathway or multiple pathways may be influenced by exposure to a neuromodulator’s action.

Neuromodulators also exert their influence over a slower time period than excitatory and inhibitory neurotransmitters at synapses with fast-acting receptors. Their effects take longer to become established and last longer. Given the nature of their activity, neuromodulators are often thought to convey global control of brain states that underlie different behaviours, such as sleep and wakefulness.

Dopamine and serotonin are two neurotransmitters that have widespread modulatory roles over neural activity in the CNS and therefore have a range of effects on brain activity, mental processes and behaviour. As with glutamate and GABA, either too much or too little of either dopamine or serotonin can have detrimental effects.

Although dopamine and serotonin work differently and differ in function, they do not work in isolation. They interact with each other in certain functions, as do the many other neurotransmitters and neuromodulators. Dopamine and serotonin can also interact by counterbalancing each other’s effects, as do glutamate and GABA.

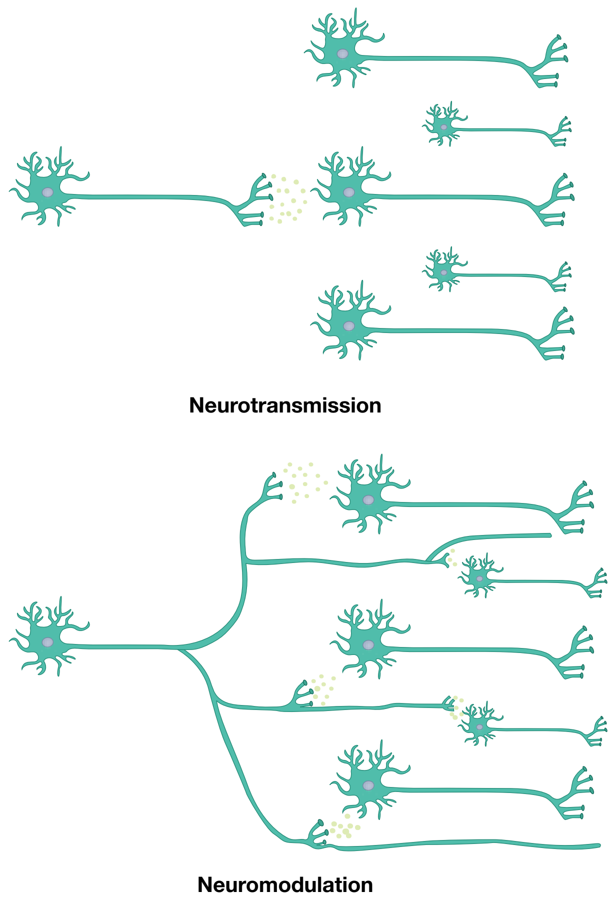

Figure 2.18 Neuromodulators influence the activity of multiple neurons at the same time

2.5.1 Dopamine

Dopamine is a modulatory neurotransmitter known to have multiple functions depending on where in the brain it acts. For example, it has important roles in voluntary movements, the experience of pleasure, motivation, appetite, reward-based learning and memory. It has also been implicated in various mental conditions, including Parkinson’s disease, addiction and schizophrenia.

Although primarily an excitatory neurotransmitter, dopamine can have either an excitatory effect at one location or an inhibitory effect at another, depending on the type of receptors that are present.

The brain has several distinct dopamine producing areas and neural pathways along which dopamine travels to convey information to different areas and exert its influence. This dopamine or *dopaminergic system* is shown in Figure 2.19 below.

One of the dopamine pathways takes part in coordinating movement. This pathway (*nigrostriatal*) has its origins in the midbrain structure called the substantia nigra. Dopamine produced by neurons in this structure carries messages that allow smooth, coordinated function of the body's muscles and movements.

When the substantia nigra is diseased or damaged, the amount of dopamine available along this pathway is markedly reduced. This means that other brain structures linked to the pathway that are involved in planning, coordinating and initiating voluntary movements receive slower, fewer and/or irregular dopamine messages about motor activity.

This can result in a condition of extreme muscle rigidity, or 'stiffness', that makes it difficult for a person to move, as occurs in Parkinson's disease. Individuals with the disease report feeling that their muscles will not do what they want them to do and that it takes a long time 'get going'. Voluntary movements are slow, particularly when initiating and executing movement and in performing repetitive movements. Tremors involving continuous, involuntary shaking (trembling) of the body can also be experienced. Drugs commonly used to treat these motor symptoms of the disease target dopamine.

Two other dopamine pathways (*mesolimbic* and *mesocortical*) overlap and are strongly associated with rewarding behaviour through the experience of pleasure. These pathways form what is commonly called the *dopamine reward system*. Behaviours that may be perceived as rewarding due to the release of dopamine include both healthy behaviours (such as eating when hungry and drinking when thirsty) and harmful behaviours that involve a loss of impulse control and have become addictive (such as gambling and video gaming).

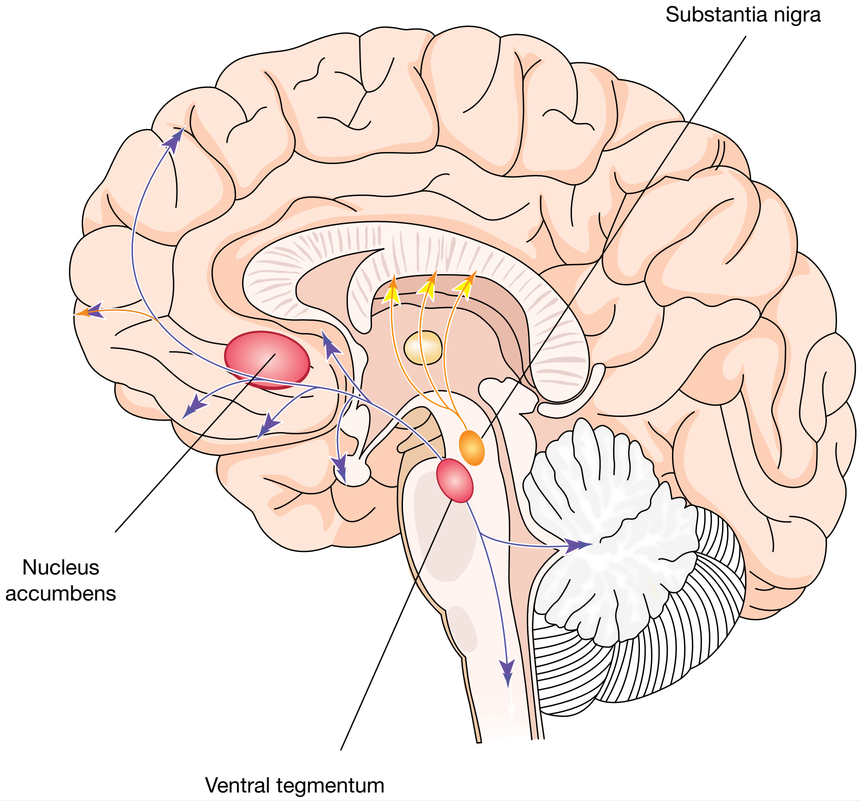

Figure 2.19 The brain has several distinct dopamine producing areas and neural pathways along which dopamine travels to convey information to different areas and exert its influence. These form the dopamine (dopaminergic) system. Two of the pathways are the nigrostriatal pathway which originates from the substantia nigra (orange) and the mesolombic pathway (purple). The dopamine reward system is located between the ventral tegmentum and nucleus accumbens.

When someone experiences something that is rewarding, the brain tends to respond by releasing dopamine, resulting in feelings of pleasure and possibly even euphoria. This primarily occurs in the pathway *(mesolimbic)* that originates in the ventral tegmental area deep within the midbrain.

Dopamine activity in this pathway in particular is thought to be involved in reward-based learning of behaviours that are associated with the pleasurable experience due to dopamine release. When we experience a behaviour with a pleasurable consequence, we are more likely to repeat that behaviour and eventually learn to associate that rewarding experience and whatever is thought to have caused it.

In addition, the anticipation of receiving a rewarding stimulus can be a motivating influence on behaviour. For example, dopamine may influence us to engage in certain behaviours to attain the pleasurable experience it can cause, based on previous experience with that type of reward. It seems that even the mere thought of doing so can trigger dopamine release under certain conditions.

An unfortunate side of dopamine stimulation in this pathway is that it has been found to be strongly associated with addictive behaviours. The intense feeling of reward some people feel when they take drugs, gamble or engage in various other harmful behaviours, or even ordinarily healthy behaviours, can lead to addiction.

Dopamine release within this pathway is not in itself entirely responsible for reward learning, its motivating effects and other influences on behaviour. The pathway has connections to limbic system structures and cortical areas that work together to produce the rewarding effect and increase the likelihood that rewarding behaviours are repeated.

The brain is a massive communication centre that continually passes messages back and forth to regulate what we think, feel and do. Brain activity in one brain area can affect activity in another area(s), so dopamine activation in a dopamine pathway may best be considered as being involved with aspects of behaviour reward rather than being entirely responsible for directly causing pleasurable experiences.

Schizophrenia has also been linked to dopamine. In particular, high levels of dopamine activity (in the mesolimbic pathway) are associated with the experience of hallucinations and delusions (which are classified as 'positive symptoms'). Drugs commonly used to treat these symptoms of schizophrenia target dopamine. However, this does not mean that a low level of dopamine necessarily causes schizophrenia or another disorder. As with pleasurable experiences and other behaviour changes, it may be a contributory factor.

2.5.2 Serotonin

Like dopamine, **serotonin** is a modulating neurotransmitter that has a wide range of functions, depending on where in the brain it acts. For example, it has important roles in mood, emotional processing, sleep onset, appetite and pain perception.

As with dopamine, seratonin has been implicated in various mental conditions, including depression, anxiety disorders and sleep disorders. In addition, there are distinct serotonin producing areas and neural pathways along which seratonin travels to convey information to different brain areas and exert its influence. The serotonin system is shown in Figure 2.20.

Unlike dopamine that can have both excitatory and inhibitory effects, serotonin only has inhibitory effects, so it does not stimulate brain activity. Its inhibitory effects can help counterbalance excessive excitatory effects of other neurotransmitters, as GABA does with glutamate.

Serotonin is widely described as a mood stabaliser, with low levels associated with mood disorders such as depression and seasonal affective disorder. Depression involves an overemphasis of negative thoughts and emotions, including prolonged feelings of worthlessness and hopelessness, and a decrease in the reward produced by pleasurable experiences.

It seems that the right amount of serotonin is required for us to feel positive, calm and have a stable mood. Serotonin's effect on mood suggests that it contributes significantly to our overall sense of wellbeing. Drugs commonly used to treat depression target serotonin and increase its availability at the synapse.

Reduced levels of serotonin in the brain have also been associated with a number of anxiety disorders, particularly obsessive-compulsive disorder (OCD). This disorder is characterised by repetitive, intrusive thoughts (obsessions) that prompt performance of ritualistic behaviour (compulsions). Most OCD medications are like those used for depression. As with depression, low levels of serotonin doesn't necessarily cause OCD.

Serotonin also seems to play an important role in the regulation of the daily sleep–wake cycle, including when we fall asleep, how much we sleep and when we wake, as well as our feeling of wakefulness throughout the day. Its effect on the sleep–wake cycle and our state of arousal is associated with the amount in different brain areas. For example, increasing the level of serotonin, as occurs with the use of drugs for treating depression, tends to reduce the amount of rapid eye movement sleep during a sleep episode.

Serotonin alone does not regulate the sleep–wake cycle. Other neurotransmitters also have contributory roles. There is also a relationship between serotonin and melatonin, a hormone that has a crucial role in sleep and wakefulness. Our brain uses serotonin in the pineal gland to produce melatonin, suggesting that too little serotonin can affect the pattern and quality of our sleep. The serotonin-melatonin relationship may also contribute to the insomnia that is common among people with depression.

While low levels of serotonin can have adverse effects, having too much can also cause problems. For example, the presence of an excessive amount of serotonin may cause serotonin syndrome, which can be life threatening in some people.

Serotonin syndrome is a collection of symptoms that includes fever, elevated heart rate, restlessness, agitation, confusion, hallucinations, delirium and seizures. It most often results from too high a dosage of medications used to increase low serotonin levels. The amount of available serotonin is at a toxic level and can result in unconsciousness. Serious cases of serotonin syndrome can be fatal if not treated. Illegal drugs such as ecstacy, cocaine and amphetamines ('speed'/'meth'/'ice') that act as stimulants in the CNS can also increase serotonin to a toxic level.

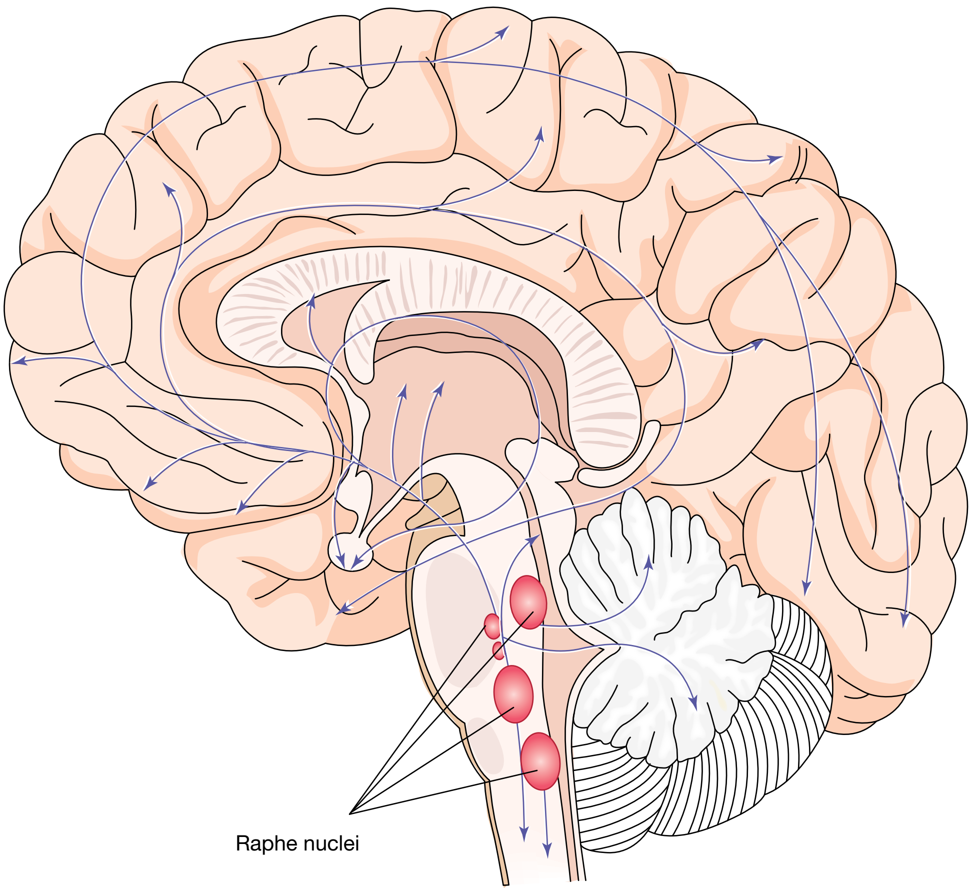

Figure 2.20 Brain structures and neural pathways that form the seratonin (serotonergic) system. Within the brain, serotonin is mostly produced in the brain stem, within the Raphe nuclei which comprise clusters of cell bodies belonging to neurons. The serotonin created by the brain comprises around 10% of the body's total amount of serotonin. The majority (over 80%) is found in the enteric nervous system within the gastrointestinal tract.

2.5 LEARNING ACTIVITY 1

Multiple-choice questions

1. Dopamine, serotonin, GABA and glutamate are collectively called
   A. neurotransmitters.
   B. neuromodulators.
   C. neurohormones.
   D. All of the above are correct.
2. A neurotransmitter that can influence the activity of another type of neurotransmitter is called a
   A. neurotransmitter.
   B. neuromodulator.
   C. neurohormone.
   D. All of the above are correct.
3. Which of the following can have a modulatory effect?
   A. GABA and serotonin
   B. serotonin and dopamine
   C. glutamate and GABA
   D. dopamine and glutamate
4. A neuromodulator can influence
   A. the size or shape of a synaptic gap.
   B. the size or shape of a synaptic connection.
   C. any activity of any neurotransmitter at a synaptic gap.
   D. how receptors react to another type of neurotransmitter.
5. When compared to the action of a typical excitatory or inhibitory neurotransmitter at a single synapse, a neuromodulator can
   A. alternate its excitatory and inhibitory effects.
   B. exert its effects outside a synapse.
   C. affect the activity of multiple neurons simultaneously.
   D. team up and work together with other neurons to form neural tissue.
6. Which of the following statements about neuromodulation is correct?
   A. A neuromodulator typically releases its chemical message into a single synapse.
   B. An entire brain area may be influenced by exposure to a neuromodulator's action.
   C. Too much or too little of a neuromodulator is unlikely to have a detrimental effect.
   D. A neuromodulator's effects are restricted to the synaptic gap between two adjacent neurons.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

2.5 LEARNING ACTIVITY 2

Analysis and evaluation of research on dopamine treatment for gambling addiction

Empirical evidence that the dopamine reward system may play a role in addictive disorders has led researchers to target this system for the treatment of people who have a gambling addiction.

While there is no 'magic pill', one medication that has been studied in relation to gambling addiction is naltrexone. Naltrexone has traditionally been used to treat alcohol dependency and addiction to heroin and other opium-based drugs. Naltrexone can inhibit dopamine activity in the dopamine reward system, thereby resulting in decreased subjective feelings of pleasure. People with a gambling addiction who are taking naltrexone are therefore possibly not compelled to seek reward stimulation through further gambling because they do not feel as much pleasure as before they were on the medication.

In one study, American psychiatrist Suck Won Kim and his colleague Jon Grant (2001) tested the effectiveness of naltrexone in the treatment of participants with a gambling addiction. Kim and Grant predicted that naltrexone would reduce the urges and behaviours associated with addiction.

Participants were recruited through newspaper advertisements. Of the 26 volunteers who were screened by the researchers in a phone interview, seven males and ten females with a mean age of 44.6 years were assessed as eligible to participate in the study. All met the criteria for having a diagnosable gambling addiction and did not have any other disorder.

All participants were prescribed naltrexone for 6 weeks and its use was monitored by the researchers to check for suitability of the dosage and potential side effects. Of the 17 participants, the involvement of three had to be terminated prematurely because of the drug's side effects (severe nausea and diarrhoea). The remaining 14 participants completed the study.

The results are shown in the following table.

Baseline and terminal visit gambling symptom data

Outcome measure	Baseline (beginning of treatment) (mean)	Terminal (end of treatment) (mean)
Total number of episodes of gambling during the past 7 days	7.56	1.69
Amount lost in the last 7 days ($US)	547.50	68.80
Gambling thought frequency [(a)]	3.94	1.24
Gambling urge frequency [(a)]	2.91	1.00
Gambling urge strength [(b)]	6.21	1.41

(a) 0 = none, 1 = once a day, 3 = three times a day, 5 = five times a day, 6 = more than five times a day
(b) 0 = none, 2 = mild, 4 = moderate, 6 = severe, 8 = extreme
Source: Kim, S.W., & Grant, J.E. (2001). An open naltrexone treatment study in pathological gambling disorder. *International Clinical Psychopharmacology, 16*(5), 287.

As shown in the table above, use of the medication naltrexone appears to have been very effective in treating the participants' gambling addiction.

a. Describe the sample and the population used for the research.
b. How were the participants selected?
c. Explain whether the sample is biased.
d. What was hypothesised for the study?
e. Briefly outline the procedure for testing the hypothesis.
f. Construct another suitable title for the table.
g. With reference to data in the table, explain why the use of naltrexone appears to have been effective in treating the participants' gambling addiction.
h. Explain a possible limitation of the study.
i. Suggest a different research method to test the hypothesis and explain your choice of method.
j. What is a limitation of the long-term use of naltrexone for the treatment of gambling addiction?

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

2.6 Neural mechanisms of memory formation and learning

Learning involves the acquisition of new information, behaviour or abilities through experience. It may occur with or without conscious awareness and is evidenced by change in behaviour, knowledge or brain function. For learning to have occurred, the new knowledge or skill must be retained in memory.

Memory is therefore very closely related to learning. The two processes are interdependent and their relationship is so close that they are often described as inseparable. The existence of memory indicates that learning has occurred. If no learning occurs there is nothing to remember. Without memory, learning would not be possible because we need the capability to retain what we have learned. Nor would learning have any value if we could not remember — we usually learn with the understanding that at some future time we will be able to recall what we learned.

Memory is essentially the outcome of learning and enables knowledge, skills and everything else acquired through experience to be stored in the brain and retrieved when needed. The close relationship between learning and memory is evident not only from a psychological perspective, but also biologically as they both involve and are influenced by many of the same neural mechanisms and processes.

Figure 2.21 Learning and memory are interdependent. If no learning occurs there is nothing to remember, and to learn requires a capability to remember what will be learned.

All memory involves neurological changes that occur as a result of learning. Memory is not a recorded 'snapshot' of an event but a neurological representation of the event. From a biological perspective, learning may be viewed as the capability of modifying information already stored in memory based on new sensory input or learning experiences. Since memory is dependent on some kind of prior experience, the first step in memory formation is learning, which occurs when our sensory systems send information to the brain.

In this subtopic we examine the neural basis of learning and memory, focusing on synaptic plasticity and changes to connections between neurons that enable memory formation and learning to take place.

2.6.1 Synaptic plasticity and changes to connections between neurons

The human brain typically follows a predictable pattern of growth and development, with different structures and abilities progressing at different rates and maturating at different points in the life span. Although our genes ensure that the basic structure and organisation of our brain are established well before birth, our brain continues to mature and change long after birth. It is not a rigidly fixed organ. Nor are the connections between neurons or neural circuits and pathways extending within and between different areas of our brain 'hardwired' like a computer or other human-made electronic device.

Neurons are soft, flexible living cells. They can change in size, shape and function. They can also change their connections with other neurons and their patterns of connections. These types of changes are influenced by the interaction of biological processes that are genetically determined and by experiences in everyday life. Our genes govern the overall architecture of our brain, but experience guides, sustains and maintains the details.

From birth through to the end of life, neurons and the connections between them change in response to our experiences. They change to represent and store this information so that we can learn and remember. This fundamental and very important ability to change is referred to as neural plasticity, neuroplasticity, or simply plasticity.

Figure 2.22 Lifelong plasticity accounts for many of the learning experiences we have throughout life, such as learning how to play a video game in young or old age.

on Resources

Weblink TEDx Talk on learning, memory and neural plasticity 14 m 24 s

Synaptic plasticity

Neural plasticity is evident in physical changes that take place at synapses where neurotransmission occurs and multiple neurons interconnect to form neural pathways. At the level of the synapse, neural plasticity is commonly called synaptic plasticity.

Synaptic plasticity refers to the ability of the synapse to change in response to experience. This controls how effectively two neurons communicate with each other. For example, synaptic plasticity enables change involving the strengthening or weakening of connections between the neurons at a synapse. Strengthening may occur through continual use of synaptic connections or through the growth of new, additional connections, whereas weakening may occur through disuse of synaptic connections resulting in the decay or elimination of a synapse.

Synaptic plasticity enables a flexible, efficient and effectively functioning nervous system. It is also the biological basis of learning and memory formation.

As we learn through the constant stream of new experiences in everyday life, our brain modifies its neural connections and pathways, thereby actually changing its structure and function by 'rewiring' itself. Existing connections between neurons can reorganise, and new networks or pathways can form and strengthen through use during the learning (and memory formation) process, thus making communication across a connection and along a pathway easier the next time.

Furthermore, through synaptic plasticity, the brain can reorganise and reassign its neural connections and pathways based on which parts of it are overused or underused. The result is a structure constantly remodelled by experience.

Canadian psychologist Donald Hebb is credited with the idea that learning involves the establishment and strengthening of neural connections at the synapse. For example, learning a list of new spelling words, to use a pogo stick, to play a harmonica or any other task will establish new neural connections, and regular practice of the task will strengthen these connections with the result that you get better at the task, become more efficient and make fewer mistakes.

Some 70 years ago, Hebb proposed that learning results in the creation of *cell assemblies* — interconnected groups of neurons that form networks or pathways and function as a unit. Neurons in a network send messages to other neurons within the network, but messages from one network may also be sent to other networks and small networks may also organise into bigger networks. Consequently, the same neurons may be involved in learning different things or in producing different patterns of behaviour, depending on which combination of neurons is active.

According to Hebb (1949), when neurotransmitter is repeatedly sent across the synaptic gap, presynaptic and postsynaptic neurons are repeatedly activated at the same time. When a presynaptic and a postsynaptic neuron are active at the same time, this changes the structure or chemistry of the synapse, strengthening the connections between these two neurons at the synapse.

When the synaptic connection is strengthened, this makes them more likely to fire together again and to transmit their signals more forcibly and efficiently in the future. Conversely, not firing together — for example, through disuse — weakens the connections between neurons and also makes them less likely to fire together at the same time in the future.

Hebb's explanation of changes to synaptic connections between neurons during learning is known as *Hebb's rule* or *Hebbian learning* and is often summarised as 'neurons that fire together, wire together'. Subsequent research in the 1970s on neurological processes during learning found that the synaptic changes underlying the formation of cell assemblies described by Hebb were also involved in the formation and storage of new memories. In particular, the discovery of long-term potentiation provided evidence in support of Hebb's rule (Kandel, 2001).

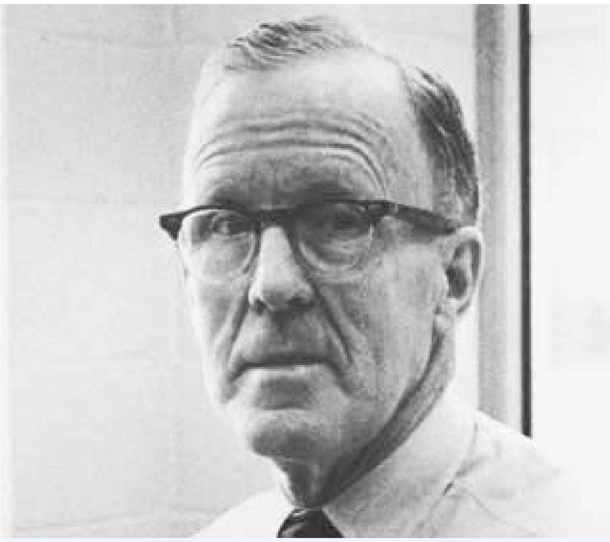

Figure 2.23 Canadian psychologist Donald Hebb (1904–1985) first proposed that the strength of a connection between neurons is determined by the neural activity of adjacent pre- and postsynaptic neurons. According to Hebb (1949, p. 62), 'when an axon of cell A is near enough to excite cell B or repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased'. This theory has become known as Hebb's rule and is often summarised more simply as *neurons that fire together, wire together*.

2.6.2 Sprouting, rerouting and pruning

It is now accepted that changes are constantly occurring at the brain's trillions of synapses. As we think, feel and behave in the course of everyday life, we are both strengthening trillions of existing synapses and creating new synapses. Generally, these changes involve reorganisation and refinement of synaptic connections, including the loss of some synapses and establishment of others.

Sprouting is the creation of new extensions on a neuron to allow it to make new connections with other neurons. This occurs through the growth of nerve endings ('sprouts') on axons or dendrites, thereby enabling new links to be made, including rerouting of existing connections.

Rerouting occurs when new connections are made between neurons to create alternate neural pathways. These alternate 'routes' may be entirely new neural pathways or connections to other pathways in the brain. The rerouting may involve the existing synaptic connections and/or new connections from the sprouts.

Pruning is the elimination of weak, ineffective or unused synapses (and therefore connections to other neurons). Experience determines which synapses will be retained and strengthened and which will be pruned. The synapses that are frequently used are retained and those that are not decay and disappear. The entire process occurs as if the rule 'use it or lose it' is being followed. Synaptic pruning can be likened to the way a gardener prunes a tree or bush to give the plant a desired shape so it can flourish.

The elimination of weaker or ineffective synapses whilst stronger ones are kept and strengthened is a naturally occurring biological process that starts early in childhood. The constant, synaptic turnover makes it possible to adapt to changing and increasingly complex environments. The new synaptic formations may not only support learning and memory of new knowledge and skills, but the pruning may also be a way of fine-tuning the brain's neural circuits to maintain efficient brain functioning.

Synaptic sprouting, rerouting and pruning also enable neurons to restore or compensate for a lost function following a brain injury and/or to maximise remaining functions. However, in order for neurons to reconnect or form new connections following brain damage, they need to be simulated through activity. Relevant types of experience during brain damage are therefore important influences on the speed of recovery.

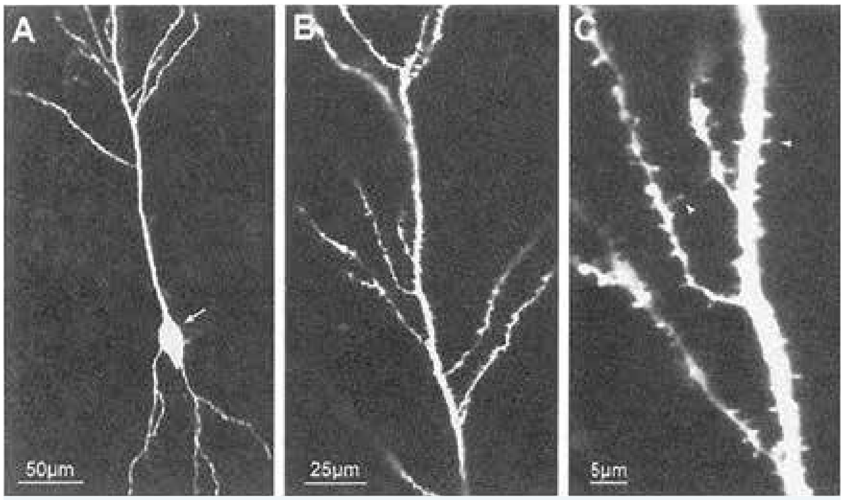

Figure 2.24 The hippocampus deep within the brain has crucial roles in learning and memory. These images show changes to synaptic connections on a postsynaptic neuron in the hippocampus of a laboratory rat when learning and forming a memory of that learning. A: the arrow is pointing to the cell body (soma). B: branches that have sprouted and grown on a dendrite. C: the dendritic branches are studded with numerous dendritic spines that have formed and enable new connections with neighbouring neurons. Sprouting may also occur on axon collaterals.

2.6.3 Long-term potentiation and long-term depression

Long-term potentiation and long-term depression are enduring changes in synaptic strength that are brought about by specific patterns of activity at the synapse. These activity-dependent changes are in themselves forms of synaptic plasticity and also influence sprouting, rerouting and pruning.

Collectively, long-term potentiation, long-term depression, sprouting, rerouting and pruning modify connections between neurons and may therefore be considered fundamental mechanisms of learning and memory formation.

Long-term potentiation (LTP) refers to the long-lasting enhancement of synaptic transmission due to repeated strong stimulation. There is significant improvement in the ability of two neurons — a presynaptic and a postsynaptic neuron — to communicate with one another at the synapse. Importantly, the improvement is stable and enduring (Bliss & Lomo, 1973).

LTP strengthens synaptic connections in a way that enables postsynaptic neurons to be more easily activated. The postsynaptic neurons become more and more responsive to the presynaptic neurons as a consequence of repeated stimulation by neurotransmitter. The more that the connection is activated, the more the connection is strengthened.

The more the connection is strengthened, the more the relevant neural pathway is strengthened, increasing the efficiency in transferring information along the pathway and decreasing the likelihood that what has been learned will be forgotten (and thereby enhancing memory storage of the information).

In addition, the more we use the information being remembered, the more the LTP process strengthens the pathway, making it easier to retrieve that information. This suggests that simple repetitive 'rote learning' when studying for an exam is worthwhile (but not necessarily more effective than other study methods).

With LTP, there also appear to be changes in the presynaptic neuron. For example, the terminal buttons on the neurons involved in LTP release more glutamate after the potentiation has been created (Thompson, 2000).

LTP was first reported in 1973 after it was observed in the brains (hippocampus) of anesthetised rabbits in a laboratory in Norway. It is the same kind of mechanism that Hebb had imagined 25 years earlier when he proposed that learning results from a strengthening of synaptic connections between neurons that fire together. The discovery of LTP confirmed Hebb's rule and helps explain in biological terms why 'neurons that fire together, wire together'.

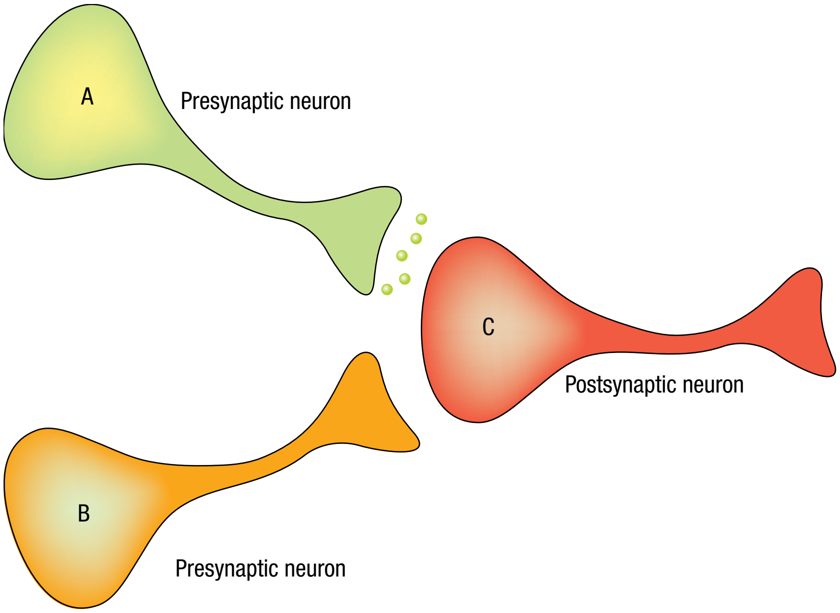

Figure 2.25 Long-term potentiation. The synapses between neuron A and neuron C and between neuron B and neuron C are initially weak. If neuron A fires and neuron C is activated immediately, and this occurs repeatedly for a sufficient number of times, neuron C will become more responsive to A than it was initially. This means that C will be more prepared to receive A's message (neurotransmitter) than B's message. In addition, the simultaneous activity between neurons A and C will grow and strengthen this synapse. Long-term depression has the opposite effect, instead weakening synaptic transmission and the responsiveness of a neuron to neurotransmitter.

Long-term depression (LTD) is the long-lasting decrease in the strength of synaptic transmission and neuronal response (which is the opposite of LTP). This results from a lack of stimulation of pre- and postsynaptic neurons or prolonged low level stimulation (but following persistent strong stimulation in the cerebellum). Generally, a postsynaptic neuron becomes less responsive to the neurotransmitter released by a presynaptic neuron and the effect is to weaken the synaptic connection and therefore weaken or even silence communication at the synapse (Bliss & Cooke, 2011; APA, 2022).

LTD was discovered in the cortex of the cerebellum by Japanese researchers in 1981, then later found to also occur in the hippocampus and elsewhere in the CNS (Ito & Kano, 1982; Ito, 1989).

It is believed that LTD may be just as important for learning and memory as LTP. The weakening or elimination of unused synapses through LTD may result in the pruning of unimportant or unwanted synaptic connections, leaving only the important connections that have been strengthened through repeated use by LTP. LTD may, for example, enable old memories or unused connections and pathways for previously learned information or skills to be cleared out. It has also been proposed that LTD in the cerebellum may return synapses that have been potentiated by LTP to a normal level so that they will be available for motor learning and memory formation (APA, 2022).

LTD may be what allows us to correct our thinking when solving a problem, or to adjust our movements when learning how to serve in tennis or ride a surfboard. It may also provide the basis of blocking or erasing unwanted, inappropriate or incorrect thoughts, feelings and behaviours

Given glutamate's excitatory effect, it has a vital role in LTP and LTD. Generally, the more often that glutamate can excite an adjacent neuron, the more it contributes to LTP (and vice versa for LTD).

Although LTP and LTD have opposite outcomes in that they result in persistent increased versus decreased synaptic excitability and one increases neurotransmitter release in presynaptic neurons and the other does not, there are a number of similarities. For instance:

- both are activity dependent; that is, more or less activity
- both involve glutamate
- both occur at glutamate synapses
- both involve changes in excitability
- both have long-lasting effects
- both are forms of long-lasting neural plasticity.

Although Hebb's rule, LTP and LTD are often described with reference to a pair of neurons, this is an oversimplification and it should be kept in mind that a single neuron in the human brain may have thousands of connections with other neurons, often in extremely complex ways. For example, a memory of a single bit of information may be stored within many connections, and each connection may be involved in several different memories.

Thus, multiple memories may be stored within a single neural pathway, and have multiple synaptic connections. Similarly, a single memory may involve simultaneously activating several different groups of neurons in completely different areas of the brain so that the information can be brought into conscious awareness.

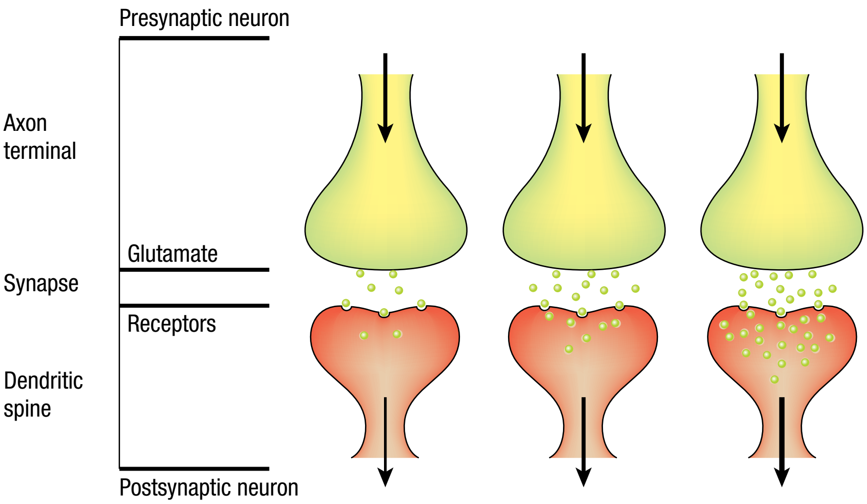

Figure 2.26 With LTP, there is an increase in the amount of neurotransmitter released by the presynaptic neurons, thereby enhancing communication.

Figure 2.27 Memory formation can be likened to the way foot traffic creates a path along a stretch of grass. The more a patch of grass is trampled as people pass along it, the clearer the path becomes and the easier it is to follow — it's as if a 'memory' of all the walking has been created. The same thing happens in the brain. The more a neural pathway is activated, the stronger the synaptic connections along the way become. Then, when a thought enters our head — say, a tropical beach — we recall related experiences or knowledge, such as putting on sunscreen and the feel of sand, as our minds funnel our thoughts along well-established neural pathways (Qld Brain Institute, 2018b).

2.6 LEARNING ACTIVITY 1

Review

1. Define the meaning of synaptic plasticity with reference to two examples of synaptic change.
2. Distinguish between sprouting, rerouting and pruning at a synapse.
3. How does neural plasticity enable learning and memory formation?
4. Explain how learning and memory occur with reference to 'connections between neurons' and Hebb's rule.
5. To how many neural pathways might the memory of a single bit of information belong? Explain your answer.
6. Complete the following table to summarise similarities and differences between LTP and LTD.

Characteristic	LTP	LTD
Definition		
Where it occurs		
How it occurs		
Change in excitability or responsiveness of postsynaptic neurons		
How enduring		
Effect on neuronal communication		
Role in learning and memory formation		

7. Explain how LTP and LTD demonstrate synaptic plasticity.
8. Why is LTP considered to be 'evidence' supporting Hebb's physiological explanation of learning?
9. Briefly explain why learning and memory may be considered interdependent or inseparable from:
   a. a biological perspective
   b. a psychological or behavioural perspective.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

2.6 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.28; ©VCAA

Orla and Anthony are focused on playing a video game and are talking to each other intently. Orla is excited and does not realise time is passing quickly.

The more Orla practices, the better she becomes at playing the video game.

This can be explained by

A. long-term depression, which strengthens the synaptic connections that allow her to move her fingers.
B. long-term depression, which improves stimulation of the neurons involved in her playing the video game.
C. long-term potentiation, which increases synaptic communication when she presses the buttons on the controller.
D. long-term potentiation, which decreases the synaptic transmission speed of the neurons involved in her playing the video game.

Question 2 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.11; ©VCAA

Which of the following identifies a difference between long-term potentiation and long-term depression?

	Long-term potentiation	Long-term depression
A.	results in a change in excitability of the post-synaptic neuron	does not involve an increase in excitability of the post-synaptic neuron
B.	occurs at the synapse	does not occur at the synapse
C.	involves the neurotransmitter glutamate	involves the neurotransmitter GABA
D.	changes are long-lasting	changes are not long-lasting

Question 3 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.3; ©VCAA

What would be the impact on the transmission of neuronal messages if there was evidence of the thinning of dendrite branches?

A. The neuron would not function properly and could die because dendrites provide energy for the cell.
B. Electrical messages may become weaker because dendrites conduct electrical energy away from the cell body.
C. Fewer neurotransmitters may be released into the synapse because dendrites contain vesicles holding neurotransmitters.
D. The likelihood of the post-synaptic neuron being activated may decrease because dendrites receive the neurotransmitters from the synapse.

Question 4 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.9 (adapted); ©VCAA

Mai began piano lessons when she was eight years old. Each time she practised, she played more accurately and made fewer mistakes. However, after two years, she lost interest and stopped her lessons. As an adult, Mai decided to take piano lessons again and found that she learnt to play the pieces she had played as a child more quickly than pieces she had never played before.

In terms of neural plasticity, Mai's increased accuracy as she practised as a child was likely a result of

A. the role of GABA.
B. the role of dopamine.
C. long-term depression.
D. long-term potentiation.

Question 5 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.4; ©VCAA

Glutamate plays a key role in synaptic plasticity by

A. releasing neurohormones into the bloodstream.
B. increasing the speed of neurotransmitter transmissions along the axon.
C. acting as an excitatory neurohormone released across the synaptic gap.
D. acting as an excitatory neurotransmitter released across the synaptic gap.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

2.7 Review

Topic summary

- **Roles of different sub-divisions of the central and peripheral nervous systems**
  - Central nervous system
    - Brain
    - Spinal cord
  - Peripheral nervous system
    - Somatic nervous system
    - Autonomic nervous system
    - Sympathetic nervous system
    - Parasympathetic nervous system
    - Enteric nervous system
- **Conscious and unconscious responses to sensory stimuli**
  - Spinal reflexes
- **Role of neurotransmitters**
  - Glutamate
  - Gamma-amino butyric acid (GABA)
- **Role of neuromodulators**
  - Dopamine
  - Serotonin
- **Neural mechanisms of memory formation and learning**
  - Synaptic plasticity and changes to connections between neurons
  - Sprouting, rerouting and pruning
  - Long-term potentiation and long-term depression

Key terms

afferent p. 174
autonomic nervous system p. 176
brain p. 166
central nervous system p. 170
conscious response p. 184
dopamine p. 195
enteric nervous system p. 180
efferent p. 174
excitatory effect p. 190
ganglia p. 180
gamma-amino butyric acid (GABA) p. 192
glutamate p. 191
inhibitory effect p. 190
interneuron p. 187
long-term depression p. 205
long-term potentiation p. 204
motor neuron p. 174
nervous system p. 166
neural pathway p. 170
neural synapse p. 189
neuromodulator p. 195
neuron p. 166
neurotransmission p. 192
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spinal reflex p. 186
spinal cord p. 172
sprouting p. 203
synaptic plasticity p. 202
synaptic gap p. 189
sympathetic nervous system p. 178
unconscious response p. 185

Note: The **References** for the entire title can be accessed in learnON and are also available as a downloadable PDF.

on Resources

Digital documents Key terms glossary — Topic 2 (doc-38530)
Topic summary — Topic 2 (doc-38531)
Key diagrams PowerPoint — Topic 2 (doc-38532)

Exam question booklet Exam question booklet — (eqb-0133)

2.7 Topic 2 test

Section A: 35 marks **Section B:** 40 marks **Total:** 75 marks

Access learnON to answer the following test questions online and receive **immediate feedback**.

Section A — Multiple-choice questions

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

A role of the spinal cord is to

A. protect the spinal column.
B. initiate voluntary muscle movements.
C. connect the brain and central nervous system.
D. connect the brain and peripheral nervous system.

Question 2

You are working quietly in the library when a friend sneaks up from behind and scares you, making your heart race. At this time, your _____ nervous system would be dominant.

A. parasympathetic
B. sympathetic
C. somatic
D. central

Question 3

Sensory pathways carry information to the _____ and motor pathways carry information from the _____.

A. somatic nervous system; peripheral nervous system
B. central nervous system; somatic nervous system
C. central nervous system; central nervous system
D. peripheral nervous system; peripheral nervous system

Question 4

Which of the following is not a form of synaptic plasticity?

A. neurotransmission
B. long-term depression
C. dendritic sprouting
D. synaptic pruning

Question 5

The neurotransmitter _____ is associated with the experience of pleasure and motivation; whereas _____ is associated with the experience of relaxation and calmness.

A. serotonin; dopamine
B. dopamine; serotonin
C. serotonin; GABA
D. glutamate; GABA

Question 6

Communication within neurons is _____; whereas communication between neurons is _____.

A. inhibitory, excitatory
B. excitatory, inhibitory
C. electrical, chemical
D. chemical, electrical

Question 7

The process through which new connections are made between active neurons to create alternate neural pathways in response to a brain injury is called synaptic

A. formulation.
B. sprouting.
C. pruning.
D. rerouting.

Question 8

A mosquito lands on your arm. You watch it carefully then move your hand to swat it. Your sensation and response are due to _____ activity.

A. spinal reflex
B. autonomic nervous system
C. somatic nervous system
D. parasympathetic nervous system

Question 9

Regulation of the sleep–wake cycle is predominanly influenced by

A. serotonin.
B. glutamate.
C. dopamine.
D. GABA.

Question 10

Too little dopamine in the brain is most strongly associated with

A. sleep disorders.
B. mood disorders.
C. Parkinson's disease.
D. schizophrenia.

Question 11

Sensory information is best described as _____ information.

A. afferent
B. efferent
C. internal
D. external

Question 12

The _____ nervous system automatically restores bodily systems to their normal level of functioning after the need for heightened activity has passed.

A. somatic
B. parasympathetic
C. sympathetic
D. central

Question 13

Jana was diagnosed with paraplegia after a horse riding accident and can no longer walk. She is unable to walk because her _____ nervous system cannot communicate with her _____ nervous system.

A. central; autonomic
B. somatic; central
C. somatic; sympathetic
D. autonomic; sympathetic

Question 14

Which of the following is not classified as being primarily an inhibitory neurotransmitter?

A. serotonin
B. GABA
C. glutamate
D. dopamine

Question 15

Which organ is not a part of the enteric nervous system?

A. intestines
B. gall bladder
C. oesophagus
D. stomach

Question 16

Neurons that are grouped together in clusters in the enteric nervous system are called

A. ganglia.
B. tracts.
C. nerves.
D. nuclei.

Question 17

The autonomic nervous system

A. controls movements of skeletal muscles.
B. initiates movements of skeletal muscles.
C. controls virtually all thoughts, feelings and behaviours.
D. controls the activities of visceral muscles, organs and glands.

Question 18

A synapse is

A. a neural connection.
B. a type of neurotransmitter.
C. the place where neurons communicate.
D. the part of the neuron on which small extensions grow.

Question 19

Which of the following can have a modulatory effect in the nervous system?

A. serotonin and dopamine
B. glutamate and GABA
C. dopamine and glutamate
D. GABA and serotonin

Question 20

The _____ nervous system initiates skeletal muscle movement, whereas the _____ nervous system regulates the activity of visceral muscles.

A. parasympathetic; sympathetic
B. somatic; autonomic
C. autonomic; somatic
D. peripheral; sympathetic

Question 21

The neurons in the spinal cord are part of the _____ nervous system.

A. central
B. peripheral
C. somatic
D. autonomic

Question 22

The peripheral nervous system transmits information between the _____ and the _____.

A. central nervous system; spinal cord
B. spinal cord; muscles, organs and glands
C. sensory receptors, muscles, organs and glands; central nervous system
D. somatic nervous system; muscles, organs and glands

Question 23

The two sub-divisions of the central nervous system are the _____ and the two sub-divisions of the peripheral nervous are the _____.

A. somatic and autonomic systems; brain and spinal cord
B. brain and peripheral system; somatic and sympathetic systems
C. somatic system and spinal cord
D. brain and spinal cord; autonomic and somatic systems

Question 24

A major function of the somatic nervous system is to

A. carry neural messages between the CNS and internal organs and glands.
B. maintain the body's internal states.
C. carry motor messages to the CNS.
D. transmit information from sensory receptors to the CNS.

Question 25

Which sub-division of the nervous system is generally self-regulating?

A. central nervous system
B. somatic nervous system
C. autonomic nervous system
D. peripheral nervous system

Question 26

Which of the following bodily functions results from parasympathetic nervous system action?

A. increased salivation
B. increased perspiration
C. increased respiration
D. decreased stomach contractions

Question 27

A difference between glutamate and GABA is that

A. glutamate is a neurotransmitter; whereas GABA is a neurohormone.
B. GABA is a neurotransmitter; whereas glutamate is a neurohormone.
C. glutamate has an excitatory effect; whereas GABA has an inhibitory effect.
D. GABA has an excitatory effect; whereas glutamate has an inhibitory effect.

Question 28

Long-term potentiation is

A. the potential to learn and form memories.
B. the long-lasting decrease in the strength of synaptic transmission.
C. the long-lasting release of glutamate at the synapse.
D. the enduring strengthening and efficient functioning of synaptic connections.

Question 29

If long-term potentiation is to occur between two neurons, then

A. the two neurons must be activated simultaneously.
B. the two neurons must be connected within a neural pathway.
C. the existing connection between the two neurons must be weak.
D. the existing connection between the two neurons must be strong.

Question 30

When learning and memory occur

A. there is a change in the structure of a neurons in the brain.
B. there is an increase in the amount of synapses produced by neurons, thereby enabling them to flow more freely within a neural pathway.
C. new neurotransmitters grow and interconnect the neurons to form a pathway for the information.
D. neurons assemble in a formation that creates a neural pathway for the learning to occur and its subsequent memory.

Question 31

Which of the following statements about learning is not true?

A. Learning causes changes at the synapse.
B. Learning can create new neural pathways.
C. Learning causes weakening of synaptic connections.
D. Learning can reorganise neural pathways.

Question 32

Long-term potentiation and long-term depression cannot occur during learning or memory formation unless

A. the organism also wants to remember the new information or skill.
B. the neurons involved in establishing a pathway already have synaptic connections.
C. prolonged simultaneous activity occurs in either adjacent presynaptic or postsynaptic neurons.
D. prolonged simultaneous activity occurs in both adjacent presynaptic and postsynaptic neurons.

Question 33

Simultaneous firing of two adjacent neurons makes those neurons

A. more inclined to fire together in the future.
B. less inclined to fire together in the future.
C. rearrange their connections.
D. prune connections that cannot adapt to the activity.

Question 34

Long-term potentiation and long-term depression are _____ dependent processes.

A. time
B. activity
C. learning
D. learning and memory

Question 35

A neurotransmitter that has an inhibitory effect causes postsynaptic neurons to

A. fire.
B. not fire.
C. reuptake.
D. excitatory.

Section B — Short answer questions

Question 1 (1 mark)

Give an example of an unconscious response to an internal sensory stimulus.

Question 2 (2 marks)

The synaptic gap is one component of a synapse. Name the other two components.

Question 3 (3 marks)

List three characteristics that distinguish neurotransmission from neuromodulation.

Question 4 (3 marks)

Describe the interrelationship of the sympathetic and parasympathetic nervous systems with reference to an example.

Question 5 (5 marks)

a. List the key steps in the spinal reflex sequence of activity that enables a withdrawal response to occur before the brain processes the conscious perception of pain. 3 marks
b. Explain why a spinal reflex involving a withdrawal response is considered to be an adaptive response with reference to conscious and unconscious responses to sensory stimuli. 2 marks

Question 6 (2 marks)

Explain why someone in a comatose state with severe brain damage may still be able to remain alive for a prolonged period without artificial life support.

Question 7 (4 marks)

a. Explain the meaning of excitatory and inhibitory effects of neurotransmitters. 2 marks
b. What primarily determines whether or not a neurotransmitter will have an excitatory or inhibitory effect? 2 marks

Question 8 (4 marks)

a. When considered from a neuronal perspective, no two human brains are identical. Explain why, with reference to neural change associated with learning and memory formation. 2 marks

b. Explain how synaptic plasticity makes learning and memory formation possible. 2 marks

Question 9 (4 marks)

Explain how long-term potentiation and long-term depression influence connections between neurons.

Question 10 (3 marks)

Explain the meaning of the phrase 'learning and memory formation involve the building of neural pathways in the brain', ensuring you refer to Hebb's rule.

Question 11 (9 marks)

A researcher conducted a clinical trial to investigate the effects of a new dopamine enhancing medication on motor symptoms of a neurodegenerative disorder. She designed an ethically approved experiment that used two groups.

Group A used the new medication for a trial period of six months, whereas Group B used a look-alike inert substance over the same period. Neither the researcher nor the participants knew who was using the real trial medication and who was not. Participants were assigned to each group by chance, and all had their motor symptoms assessed at the beginning and end of the experiment.

Assessments were based on number and severity of symptoms involving walking, talking, swallowing, speaking, blink rate in the eyes and facial expression.

a. Identify the experimental design. 1 mark

b. Identify the independent and dependent variables. 2 marks

c. Group A is the _____ group, and Group B is the _____ group. 2 marks

d. What is the technical term for the inert substance used by Group B? 1 mark

e. i. What is the technical term for assessment of symptoms at the start of the experiment? 1 mark

   ii. What is the purpose of this procedure? 1 mark

f. The researcher used a _____ procedure in the experimental design to control for expectancy effects. 1 mark

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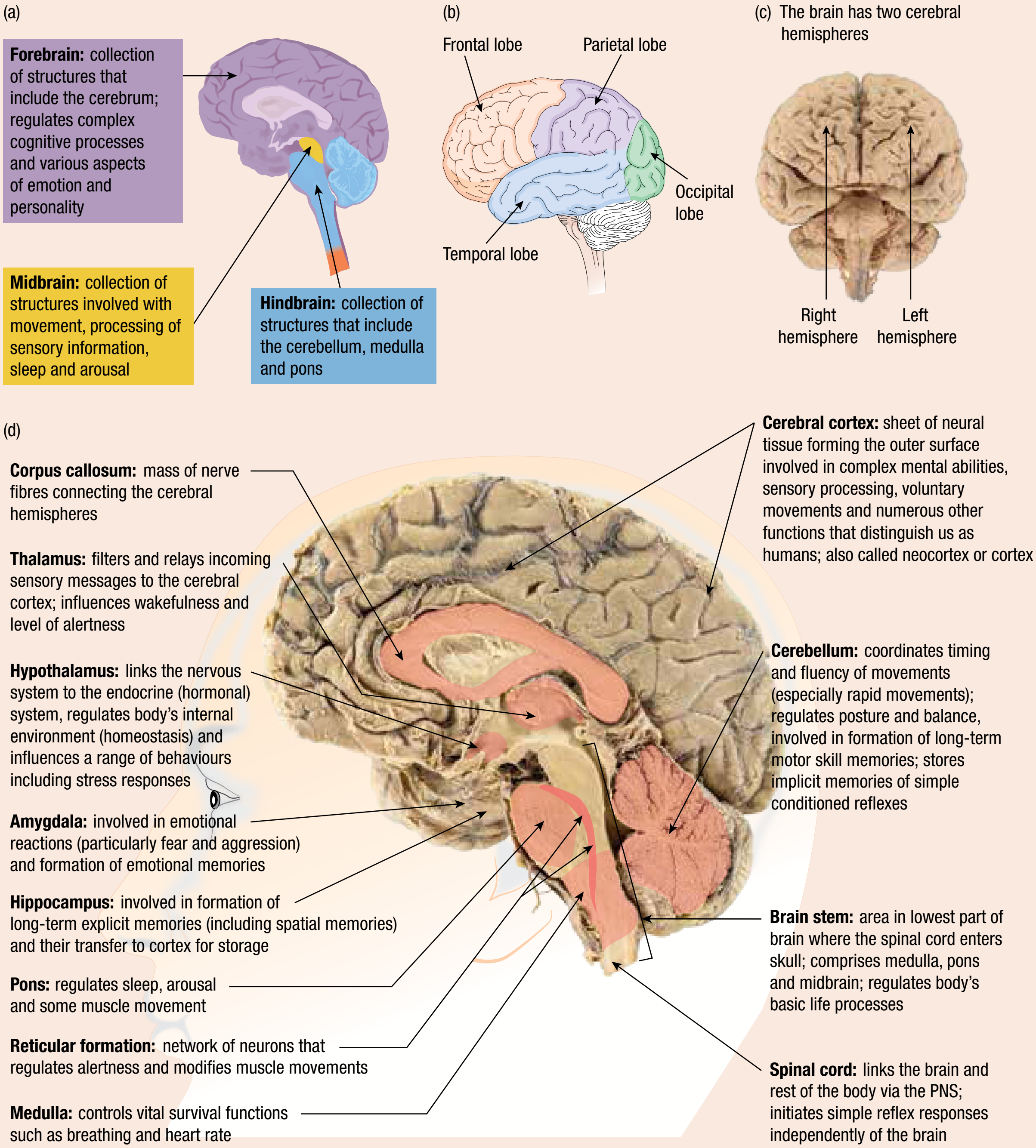
on Resources

Go to learnON to access answers to the Topic 2 test. A customisable Word version of the test can also be downloaded from the **Digital documents** tab of the Resources panel.

learnMORE | Brain areas, structures and roles

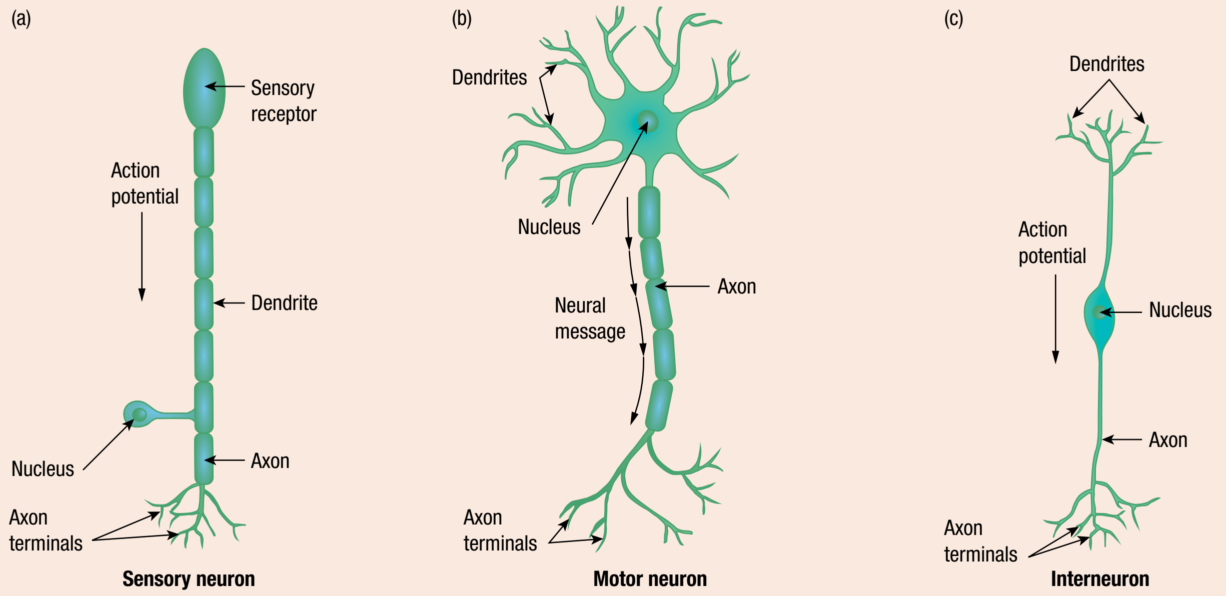
Neuropsychologists often describe the brain using three main areas (or regions) — the forebrain, midbrain and hindbrain. This is based on how the brain develops early in life. Each area is associated with identifiable mental processes and behaviour, but these function in an integrated way to enable us to think, feel and behave as we do.



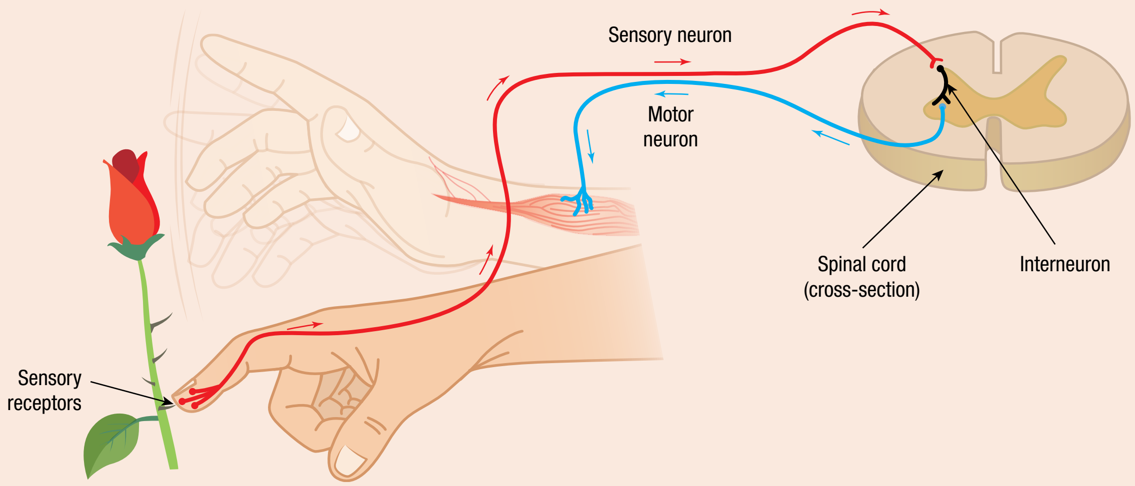
learnMORE | Three types of neurons

The neuron is the primary cell involved in the reception and transmission of information within the nervous system. Neurons can be classified in terms of their specific function and the direction that they send information. Within these three classes of neurons are hundreds of different types, each with specific message-carrying abilities.

Sensory and motor neurons are found throughout the nervous system, whereas interneurons are found only in the central nervous system (CNS). The figure below shows the interaction between the three types of neurons activated to enable a spinal reflex initiated by a painful prick to the finger.



(a) A sensory neuron receives and carries sensory information from both the external and internal environments and transmits it to the CNS. It is also called an afferent neuron or affector. As the name suggests, it is activated by sensory input. Note that it has a short axon, a long dendrite and one or more receptor cells that detect sensory information. (b) A motor neuron carries messages from the CNS to cells in skeletal muscles, organs and glands to stimulate activity. It is also called an efferent neuron, effector or motoneuron. Note that it has a longer axon than the sensory neuron and many shorter dendrites. (c) An interneuron sends messages between sensory and motor neurons within the CNS, relaying information from one to the other (because sensory and motor neurons rarely ever connect directly). It is also called a connecting or association neuron. It generally has relatively short axons and dendrites.



Interaction between the three types of neurons to enable a spinal reflex initiated by pain to the finger.

3 Stress as an example of a psychobiological process

TOPIC CONTENT

3.1 Overview

KEY KNOWLEDGE

- internal and external stressors causing psychological and physiological stress responses, including the flight-or-fight-or-freeze response in acute stress and the role of cortisol in chronic stress
- the gut–brain axis (GBA) as an area of emerging research with reference to the interaction of gut microbiota with stress and the nervous system in the control of psychological processes and behaviour
- the explanatory power of Hans Selye's General Adaptation Syndrome as a biological model of stress, including alarm reaction (shock/counter shock), resistance and exhaustion
- the explanatory power of Richard Lazarus and Susan Folkman's Transactional Model of Stress and Coping to explain stress as a psychological process (primary and secondary appraisal only)
- use of strategies (approach and avoidance) for coping with stress and improving mental wellbeing, including context-specific effectiveness and coping flexibility

Exposure to stressful situations or events is a common human experience. These can range from daily hassles that are relatively minor events, such as forgetting a locker key or missing the bus, through to ones that are longer lasting and much more challenging or even life-changing, such as the loss of a loved one or being the victim of a violent crime or catastrophic event such as a flood or bushfire. These situations and events can bring about stress; however, they do not describe or explain stress.

Stress has both psychological and physiological components and consequences. It can involve changes affecting nearly every system of the body, influencing how we think, feel and behave. It is therefore considered to be a *psychobiological* response. This is reflected in the widely used psychological definition of **stress** as a psychological or physiological response produced by internal or external stressors (APA, 2022).

Stress can affect different people in different ways, depending on the type of stressor, its severity or intensity, its duration and the individual involved. Our reaction to a stressor is commonly referred to as a *stress response* and this is often used interchangeably with the term stress.

Any stress response begins in the brain. Initial physiological reactions are often involuntary and involve a pattern of bodily changes that occur in much the same way in all individuals when we first become aware of the stressor. For example, a pounding heart beat, shortness of breath, sweating, dryness of the mouth, fidgeting and accelerated speech are common and often apparent to ourselves and others. Changes such as an increase in blood pressure, secretion of stress hormones and various others described in this topic are covert and not so easy to notice.

Most of the initial physiological changes are predictable, but we usually have no control over their onset. However, psychological responses are not involuntary and we have some degree of control over them, depending on the individual.

Psychological responses to stress are often divided into two categories — emotional and cognitive changes. These types of responses do not necessarily occur in isolation of each other, or in isolation of physiological responses, including overt, externally observable, behavioural changes.

Emotional changes when experiencing stress influence the way a person feels. When people do not have an opportunity to recover their emotional equilibrium ('balance') following exposure to an unavoidable stressor, they often report feeling anxious, tense, depressed, angry, irritable or short-tempered. In some situations, people may also report feeling a sense of hopelessness and helplessness, feeling trapped in a situation from which they feel there is no escape. These feelings are often accompanied by a negative attitude to themselves, to their work or school and to life in general.

Cognitive changes associated with stress influence a person's mental abilities, such as their perceptions of their circumstances and environment, their ability to learn and how they think. Often perceptions are distorted or exaggerated in some way. People often report that they have difficulties concentrating, making decisions and thinking clearly, and that they are more forgetful. These difficulties seem to

Figure 3.1 Exposure to stressful situations or events is a common human experience.

occur partly because of the constant intrusion of thoughts about the situation or event associated with the stressor. For example, a student experiencing stress as a result of a possible or actual relationship breakdown may continually think about the problems in the relationship and these thoughts may interfere with their school work.

Problem-solving and decision-making are other cognitive functions that can be affected by stress. For example, researchers have found that people in a stressful situation are less likely to come up with efficient or effective solutions to what would normally be relatively simple problems. Similarly, people who would typically consider all aspects of a decision may, while under stress, act impulsively and later regret their decision.

An event is usually interpreted in a way that produces stress when we believe that we may not or do not have the ability or resources to cope with its demands or consequences. If we believe we can cope, an event may be perceived as a difficult or 'unsettling' experience, but not necessarily as a stressor. For example, some people find speaking to a large group of people highly stressful, whereas others find it challenging but enjoyable rather than stressful. Similarly, some people experience a high level of stress when they are forced to make a significant change in their lives, whereas others may simply view change as an opportunity for a new experience.

While stress is often referred to as a negative experience, not all stress is bad. Some stress can be helpful, motivating us to get a task finished, or spurring us to perform well. However, if stress is ongoing or the stress response continues over a long period, it can have adverse effects on our physical and mental health. It can contribute directly to physiological and psychological disorders, thereby reducing our quality of life (APS, 2022).

In this topic we examine how biological and psychological factors contribute to stress and affect how we respond to stress. Since stress can affect our physical and mental wellbeing, strategies for coping with stress and improving wellbeing are also examined.

3.1 LEARNING ACTIVITY

Review

1. Why is stress described as a psychobiological process? Explain with reference to an example.
2. In what three ways can psychological responses be distinguished from physiological responses to stress?
3. Give an example of how prior experience may influence a psychological response to stress.
4. Suggest how an individual's personal interpretation of a stressor may impact on their stress response.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.2 Internal and external stressors

A **stressor** is any stimulus that produces stress. This means that virtually anything can be a stressor and therefore a cause of stress to any individual. It may be a condition, thought, feeling, person, object, situation, event, or a combination of these.

Stressors are often described or organised in different ways by psychologists for the purpose of constructing theories and models or for research purposes. For example, a stressor may be described as a *physical* stimulus (e.g. extreme temperature, intense light, loud noise, a heavy object) or *psychological* in nature (e.g. an argument with a friend, running late for a class, failing an exam, changing schools, being bullied). A stressor may also be described or classified as having an internal or external source.

An **internal stressor** originates within the individual; for example, a personal problem that causes concern about the potential consequences or the experience of physical pain that may be perceived as signalling an untimely illness.

An **external stressor** originates outside the individual from situations and events in the environment; for example, having too much homework, being nagged by parents, being in an overcrowded train or being threatened by someone outside a nightclub.

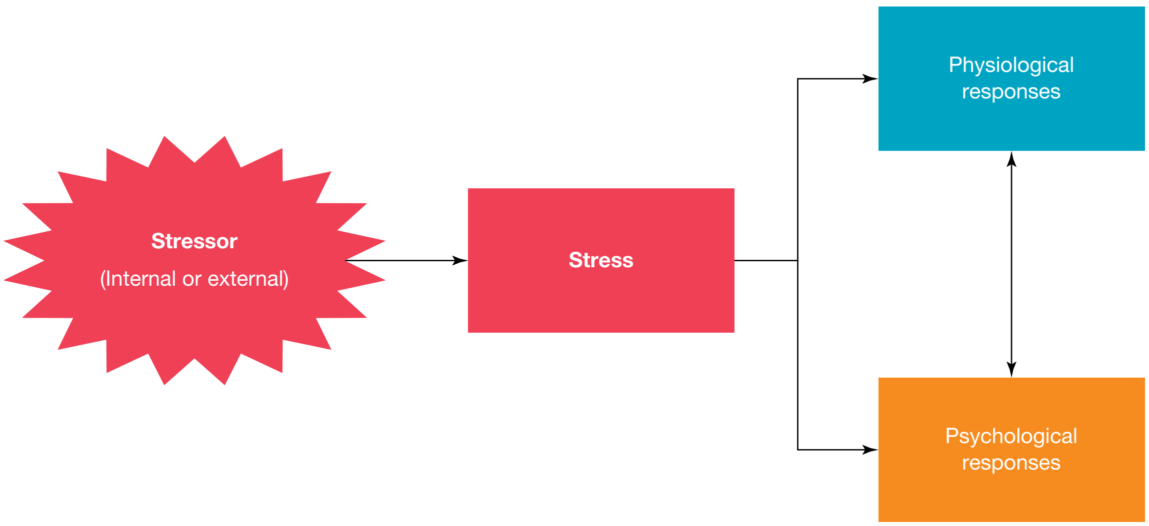


Figure 3.2 Stress is a response caused by internal and external stressors and has both physiological and psychological components and consequences.

3.2 LEARNING ACTIVITY

Review

1. Distinguish between a stressor and stress with reference to an example not used in the text.
2. Name the type of relationship between a stressor and stress.
3. a. Explain the difference between internal and external stressors with reference to one or more examples not used in the text.
   b. Give an example of an internally sourced stressor that is not psychological.
4. Explain how a physical stimulus in the environment such as noise or temperature may be a stressor.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.3 Acute and chronic stress

Stress is sometimes classified as either of two types called acute stress and chronic stress. The different types are primarily distinguished by the duration of the experience.

The stress we experience can sometimes be brief and specific to the demands of a particular situation, such as when running late for an appointment, waiting for an exam to start, taking a test, making a classroom presentation, lifting a heavy weight at the gym, or getting into an argument with a friend. This is commonly called acute stress.

Acute stress is stress that lasts for a relatively short time. The body typically bounces back well from acute stress if the stress experienced is managed by the person. Acute stress can have negative effects such as elevated blood pressure or reduced motivation to persist with a task, but it can also be beneficial. It causes our bodies to release adrenaline, which can help us to accomplish assignments and projects, and can even enhance our problem-solving ability or physical performance. However, if the acute stress experienced is severe or presents a life-threatening situation, such as being the victim of an assault, for some people, it can lead to significant mental health problems (APS, 2022).

Chronic stress is stress that continues for a prolonged period of time. It involves ongoing demands, pressures and worries that are constant and long-lasting. It can seem to go on forever, with little hope of letting up and can be debilitating and overwhelming. This can occur in circumstances such as ongoing financial difficulties, social isolation and loneliness, relationship problems, long-lasting health problems, caring for someone with complex needs, overwork, bullying, or living in an unsafe environment such as a war zone or where there is violence in the home.

When stress persists over an extended period of time it is likely to be harmful in some way to our health and wellbeing, both psychologically and physically. The stressor need not remain physically present to have its effects. Recollections of it can substitute for its presence and sustain chronic stress (APA, 2022; APS, 2022).

Stress can also be cumulative. This means that when a number of stressors occur at the same time or one after the other and the person has not had the opportunity or time to recover, the level of physiological arousal and associated bodily changes can rise and stay high (APS, 2022).

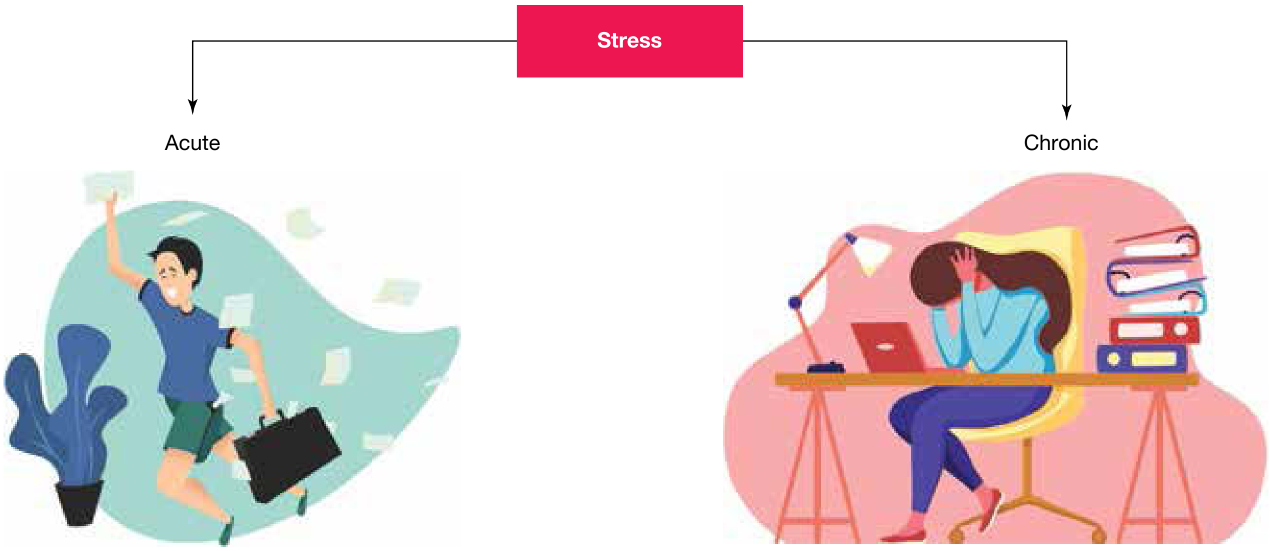


Figure 3.3 There are different types of stress, primarily defined by the duration of the experience.

3.3 LEARNING ACTIVITY

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.43 (adapted); ©VCAA

Over a few months, Marguerite experienced significant issues with her boss at work. Marguerite is usually very optimistic and positive but her problems with her boss were making her very unhappy. She could not think of any solution. Marguerite discussed the situation with her partner, who had noticed a significant change in her attitude. Her partner suggested that she join him at the gym to help manage her stress.

Which of the following identifies the internal and external stressors interacting to put Marguerite's mental health at risk?

	Internal	External
A.	physical health	family relationships
B.	genetic predisposition to anxiety	lack of solutions
C.	emotional state	interactions with her boss
D.	low self-esteem	conflict resolution skills

Question 2 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.28 (adapted); ©VCAA

Lu-Van's husband of 40 years died following a long illness. Lu-Van felt stressed, had difficulty sleeping, struggled to go shopping on her own and sometimes forgot to pay her bills, which affected her levels of anxiety and independence. Although her children would visit regularly, she felt embarrassed to tell them that she was not coping because she thought they would view this as a mental weakness.

Lu-Van is most likely experiencing _____ due to an _____ stressor.

A. acute; internal
B. chronic; external
C. acute; external
D. chronic; internal

Question 3 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.31; ©VCAA

One night, Simon came home later than the time he had agreed with his parents. As punishment, Simon's parents confiscated his mobile phone for a month. Simon experienced considerable stress during this time, because he was out of contact with his friends.

The factor responsible for this stress was

A. social.
B. cultural.
C. biological.
D. psychological.

Question 4 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.8 (adapted); ©VCAA

Vladimir is experiencing stress in response to news he has received. The stress Vladimir is experiencing is more likely to be positive if Vladimir has

A. increased arousal momentarily, decreased motivation and an elevated heart rate.
B. increased alertness momentarily, increased motivation and an elevated heart rate.
C. heightened arousal for several hours and increased motivation, and he feels overwhelmed.
D. elevated alertness for several hours and increased stress hormone levels, and he feels confident he can manage the news.

Question 5 (2 marks)

Source: VCAA 2016 Psychology, Section B, Q.10 (adapted); ©VCAA

Travis is currently undertaking his first year of university. He is feeling pressured by his family's expectation that he should score high marks. Travis also works part-time stacking frozen vegetables in the coolroom of his local supermarket to save money to go out with his new girlfriend, who he wants to impress.

Identify an external factor in the scenario above and describe how it may exacerbate Travis's physiological response to stress.

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3.4 Fight-or-flight-or-freeze response in acute stress

Two models for describing and explaining physiological stress responses are called the *fight-or-flight-or-freeze response* and the *General Adaptation Syndrome*. Both models describe patterns of involuntary, physiological changes. The changes occur in much the same way in all individuals. The fight-or-flight-or-freeze response is considered an acute stress response, whereas the General Adaptation Syndrome is a longer lasting chronic stress response that emphasises the 'wear and tear' it may cause to our body.

Any kind of immediate threat to your wellbeing is usually a stress producing experience that triggers a rapidly occurring series of physiological changes. Without our awareness or conscious control, our body immediately responds by activating the fight-or-flight-or-freeze response.

This response was originally described by American doctor Walter Cannon (1932) as involving only 'fight' or 'flight' reactions, but it is now recognised that people (and animals) may also 'freeze' when first exposed to a stressor. The pattern of changes associated with this type of acute stress response are believed to have evolved as part of a survival mechanism, enabling us to react effectively to events that threatened our wellbeing or even our lives. Whether we fight, flee or freeze depends on the situation and the proximity of the threat.

The **fight-or-flight-or-freeze response** is an involuntary response to a threatening, fearful or otherwise stressful situation, involving physiological changes produced by the sympathetic nervous system in readiness for:

- *fight* — confronting and fighting off the threat
- *flight* — escaping by running away to safety
- *freeze* — keeping absolutely still and silent to avoid detection.

The changes that occur during the fight–flight–freeze response are activated in order to prepare the body for one or more of these reactions. In terms of observable behaviour, the reactions do not occur simultaneously, which is why the response is described as '*fight-or-flight-or-freeze*'. However, all three are considered to be adaptive reactions that enable us to deal with a threat or other stressor that is present and help minimise harm.

Which of the three reactions occurs as observable behaviour depends on the situation and the individual involved. Biological processes that underlie each reaction can take place before the brain's visual information processing areas have had a chance to fully interpret what is happening. This is believed to explain why we are able to jump out of the path of an oncoming car we catch out of the corner of an eye even before we think about what we are doing.

Figure 3.4 The fight-or-flight-or-freeze response involves either of three involuntary reactions to an acute stressor, particularly when feeling threatened. Is this person experiencing fight, flight or freeze?

3.4.1 Fight or flight reactions

When our wellbeing is threatened, two immediate options are to either fight off the threat or escape from it. To prepare our body for either alternative, all energy is directed from non-essential body systems to those systems that will help us either ‘outrun’ or ‘outfight’ the threat.

Both the fight and flight reactions involve a physiological stress response that has two parts which occur one after the other. Each component involves different stress hormones that work together in preparing the body for action.

When a threat is experienced, this is detected by the amygdala which sends a signal to the hypothalamus. The hypothalamus is an almond-sized gland, located just above the brain stem. It functions like a command centre, communicating with the rest of the body via the nervous system. It also links the nervous system to the endocrine (hormonal) system and plays a vital role in monitoring and adjusting bodily processes (i.e. homeostasis).

The hypothalamus initially responds to the stressor by activating the sympathetic nervous system in less than 1/20th of a second — less than the amount of time between two beats of the heart. The sympathetic nervous system then stimulates the adrenal medulla, which is the inner part of the adrenal gland (located just above each kidney). The adrenal glands secrete hormones such as *adrenaline* (also called *epinephrine*) and *noradrenaline* (also called *norepinephrine*) into the blood stream. These stress hormones circulate in the blood, activating various organs such as the heart, lungs, liver and kidneys and boosting other physiological processes that prepare the body for action.

Next, in the second part of the stress response, the hypothalamus stimulates the nearby pituitary gland to initiate a process (called the HPA axis) for secretion of additional stress hormones. These hormones are released from the outer layer (cortex) of the adrenal glands. *Cortisol* is the most abundant of these hormones. It acts more slowly and is longer-lasting than adrenaline and noradrenaline but it also prepares the body for action and helps it stay revved up and on high alert.

The bodily changes that characterise the fight and flight reactions resulting from the sympathetic nervous system and stress hormone actions include:

- increased heart rate and blood pressure
- redistribution of blood supply from the skin and intestines to the skeletal muscles
- increased breathing rate (to increase oxygen supply)
- increased glucose (sugar) secretion by the liver (for energy)
- dilation of the pupils (so the eyes can take in as much light as possible)
- suppression of functions that are not immediately essential in order to conserve energy (such as digestion and sexual drive) and which can be delayed without damage to the organism.

These and other changes associated with fight and flight occur within seconds, thereby allowing us to react very quickly to the threat at hand. Once the threat has passed, the parasympathetic system calms and restores normal functioning. The sympathetic nervous system functions like the accelerator pedal in a car. It triggers fight or flight reactions, providing the body with a burst of energy so that it can respond to perceived dangers. The parasympathetic nervous system acts like the car's brake, slowing the body after the danger has passed.

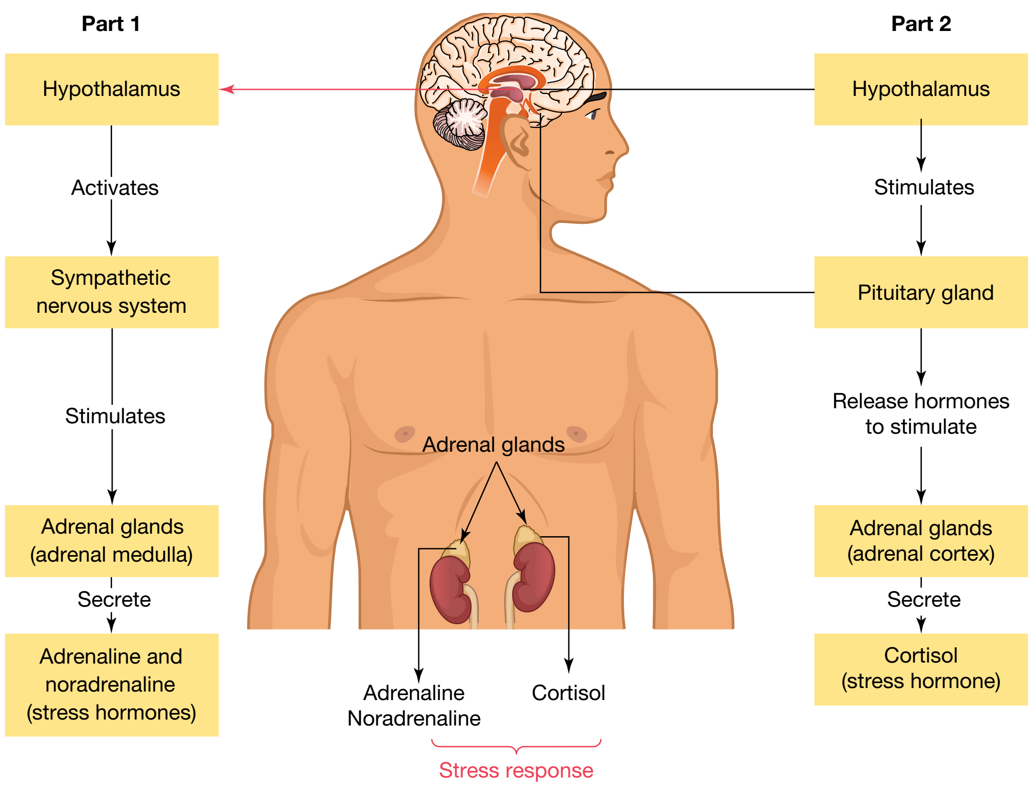


Figure 3.5 The stress response involving fight or flight reactions that are initiated in the brain. There are two parts to the response, both of which involves secretion of stress hormones and have the overall effect of arousing and energising the body to deal with an immediate threat.

on Resources

Weblink Video presentation on fight-or-flight-or-freeze 3 m 05 s

Teacher digital document Practical activity — Measurement of a fight–flight reaction

3.4.2 Freeze reaction

Sometimes, we cannot run away or are unable to fight. We may feel so overpowered or trapped that there is no option to either fight or flee. Or, the perceived threat is so intense or overwhelming that there is little or no immediate or apparent chance of successfully fighting or escaping. This is when we may go into a freeze state, remaining motionless and making no effort to run or even hide (Sharman, 2016; APA, 2022).

Body movements and vocalisations stop, the racing heart slows very significantly, blood pressure drops very quickly and tense muscles collapse and become still. Often, before immobility sets in, there is a reflexive, 'orienting response' of the head or eyes towards the direction of the threat. This is accompanied by hypervigilance — being on guard, watchful, or extremely alert.

This initial part of the freeze state has been described as a 'stop, look and listen' behavioural response that is most commonly associated with a stressor that causes fear. Before reacting with flight or fight, many mammals freeze for a few milliseconds. It has been suggested that this is done to assess the situation before making a next move. However, some psychologists believe that this is not a true freeze state because the mind can become numb during the freeze state. A genuine freeze reaction is not the result of a conscious decision (Gray, 1988; Scaer, 2001; Bracha et al., 2004; Schmidt et al., 2008; Roelofs et al., 2010; Bergland, 2014; Sharman, 2016).

The apparent frozen state of the body is called *tonic immobility* and is seen in the mouse that 'plays dead' when caught by a cat and the startled animal that 'freezes' when caught in a car's headlights at night time. However, the immobility is considered to have adaptive value, especially among animals when fearful and threatened. For example, prey that remain 'frozen' during a threat are more likely to avoid detection. The frozen state also conserves energy until a predator loses interest. When this occurs, the animal can use the excess energy for escape ('flight').

In some cases, however, freezing when fearful is not adaptive. For example, it is not an adaptive response when fear causes a job candidate to freeze during an interview, or overwhelms a student's mind during an important exam, or restricts the everyday life of the individual with a phobia who must continually engage in avoidance behaviour to avoid contact with a stimulus that triggers a panic attack or some other extreme reaction.

Nevertheless, when under attack by a person or animal, tonic immobility may also be useful when additional attacks are provoked by movement or when immobility may increase the chance of escaping, such as when a predator believes its captured prey to be dead and loosens its grip or releases it, providing the prey with an opportunity for escape (Gray, 1988, 2007).

Figure 3.6 While a deer that remains still and 'frozen' when confronted by a predator is displaying an adaptive response, a person whose mind 'freezes' because of a public speaking phobia is not.

Biological processes underlying the freeze state are not completely understood. When the freeze reaction is initiated, the energy-conserving 'rest and relaxation' actions of the parasympathetic nervous system dominate over the existing effects of sympathetic nervous system activation. Therefore, parasympathetic dominance may account for the inability to move.

The freeze reaction may be characterised as a highly aroused physiological state involving both energy conservation (parasympathetic system) and readiness for action (sympathetic system). This has been likened to the organism having one foot on the accelerator (the sympathetic system) and one foot on the brake (the parasympathetic system) at the same time. Consequently, when an animal takes the opportunity for flight after having been in a frozen state, it can very quickly escape by switching to the highly energised state of full sympathetic system arousal (Plaford, 2013; Scaer, 2014).

3.4 LEARNING ACTIVITY 1

Multiple-choice questions

1. Which sub-division of the peripheral nervous system is activated in the fight-or-flight-or-freeze response?
   - **A.** central nervous system
   - **B.** somatic nervous system
   - **C.** sympathetic nervous system
   - **D.** parasympathetic nervous system
2. Freezing in the fight-or-flight-or-freeze response is best described as a form of _____; whereas fighting is best described as a form of _____ behaviour.
   - **A.** active avoidance; passive avoidance
   - **B.** attacking; passive avoidance
   - **C.** passive avoidance; active avoidance
   - **D.** passive avoidance; attacking
3. Fighting in the fight-or-flight-or-freeze response is best described as a form of _____; whereas fleeing is best described as a form of _____ behaviour.
   - **A.** active avoidance; passive avoidance
   - **B.** attacking; passive avoidance
   - **C.** passive avoidance; active avoidance
   - **D.** passive avoidance; attacking
4. The _____ nervous system is dominant during fight and flight; whereas the _____ nervous system is dominant during freeze.
   - **A.** parasympathetic; sympathetic
   - **B.** somatic; parasympathetic
   - **C.** sympathetic; parasympathetic
   - **D.** sympathetic; somatic
5. The fight-or-flight-or-freeze response is a/an _____ response to a stimulus causing acute stress.
   - **A.** learnt
   - **B.** voluntary
   - **C.** conscious
   - **D.** unconscious

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.4 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.3; ©VCAA

Vikki wakes up to the sound of something scratching at the bedroom window and becomes so frightened that they cannot move. Vikki is likely experiencing

A. an inability to move due to parasympathetic dominance.
B. a heightened heart rate with sympathetic nervous system activation.
C. stimulation of the autonomic nervous system in preparation for running away.
D. the 'fight-flight-freeze' response, which is controlled by the somatic nervous system.

Question 2 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.17; ©VCAA

Sam and Marcus were swimming at the beach. When the shark alarm was activated, they had to exit the water quickly. Sam was able to swim much faster than he usually could to get out of the water. However, although Marcus is a skilled swimmer, he panicked and needed assistance from the lifeguard to exit the water safely.

Which of the following identifies the type of response that Sam and Marcus most likely had to the shark alarm?

	Sam	Marcus
A.	fight response	flight response
B.	flight response	fight response
C.	flight response	freeze response
D.	freeze response	freeze response

Question 3 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.18; ©VCAA

Sam and Marcus were swimming at the beach. When the shark alarm was activated, they had to exit the water quickly. Sam was able to swim much faster than he usually could to get out of the water. However, although Marcus is a skilled swimmer, he panicked and needed assistance from the lifeguard to exit the water safely.

Which of the following physiological responses may have been experienced by both Sam and Marcus when they first heard the shark alarm?

A. relaxed bladders and dilated pupils
B. stimulated digestion and relaxed bladders
C. decreased adrenaline levels and stimulated digestion
D. decreased muscle tension and increased perspiration

Question4 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.19; ©VCAA

Abraham and Ben are actors who have played many roles on television over the last two years. Three months ago, Abraham obtained a new role in a television series that guaranteed him work for the next two years. Ben, however, has been out of work for the last three months. During this time, Ben auditioned for 15 roles in different shows, but has yet to secure any work.

Each time Ben prepares for an audition, it is likely that his

A. pupils will constrict and his levels of stress hormones will increase.
B. heart rate will increase and his levels of stress hormones will decrease.
C. stomach contractions will decrease and his levels of stress hormones will increase.
D. liver will decrease the release of glucose and his levels of stress hormones will increase.

Question 5 (4 marks)

Source: VCAA 2015 Psychology, Section B, Q.12; ©VCAA

Although she is able to function in her everyday life, Annie is stressed about her driving test scheduled for today.

With reference to the physiological aspects of Annie's stress response, give two reasons why this level of stress may be helpful when Annie takes her driving test.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.4 LEARNING ACTIVITY 3

Review

1. a. Name the stress hormone that initially readies us for fight, flight or freeze.
   b. Which of the stress hormones has longer-lasting effects?
2. a. What is the fight-or-flight-or-freeze response?
   b. Does fight or flight occur before or after freeze? Explain your answer.
3. What type of stimulus and/or stressor other than a threat can initiate the response?
4. Which sub-division of the nervous system is dominant in each of the three reactions?
5. Explain whether the fight-or-flight-or-freeze response is a conscious or an unconscious response.
6. List four physiological changes commonly occurring with a:
   a. fight or flight reaction
   b. freeze reaction.
7. As you are walking home alone, late at night, you hear a crackling sound of someone or something stepping on dry leaves nearby. Your heart starts thumping as you imagine who or what is in the darkness.
   Outline and explain other physiological changes likely to occur:
   a. during the first 30 seconds or so
   b. after about 20 minutes if no threat was perceived.
8. The fight-or-flight-or-freeze response is sometimes called an 'arousal' response. Suggest an explanation for why this descriptor is used, ensuring you refer to the relevance of arousal if an organism adopts a freeze state.
9. Complete the following table on the adaptive nature of fight, flight and freeze reactions.

Reaction	Example of when adaptive	Example of when not adaptive
fight or flight		
freeze		

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.5 Role of cortisol in chronic stress

Cortisol is considered the primary stress hormone. It has a wider range of functions than other stress hormones and is involved in both the response to an acute stressor such as a threatening event as well as chronic stress.

Cortisol acts more slowly and its effects are longer lasting than the other stress hormones. This helps keep the body at an elevated level of arousal, even after the fight-or-flight-or-freeze response, thereby allowing the body to continue to deal with stress for a longer period. The level of cortisol circulating in the blood stream is commonly used as a measure of stress by researchers.

One of the immediate effects of cortisol in response to a stressor is to energise the body by increasing energy supplies such as blood sugar and enhancing metabolism. For example, cortisol acts upon the liver to make it secrete glucose into the blood stream for the muscles to use as an energy source.

Cortisol also turns off all bodily systems not immediately required to deal with a stressor. For example, it shuts down reproductive functions and inhibits the production of growth hormone. In this way, the body's energy supplies can be concentrated on dealing with stress (Kolb & Whishaw, 2015).

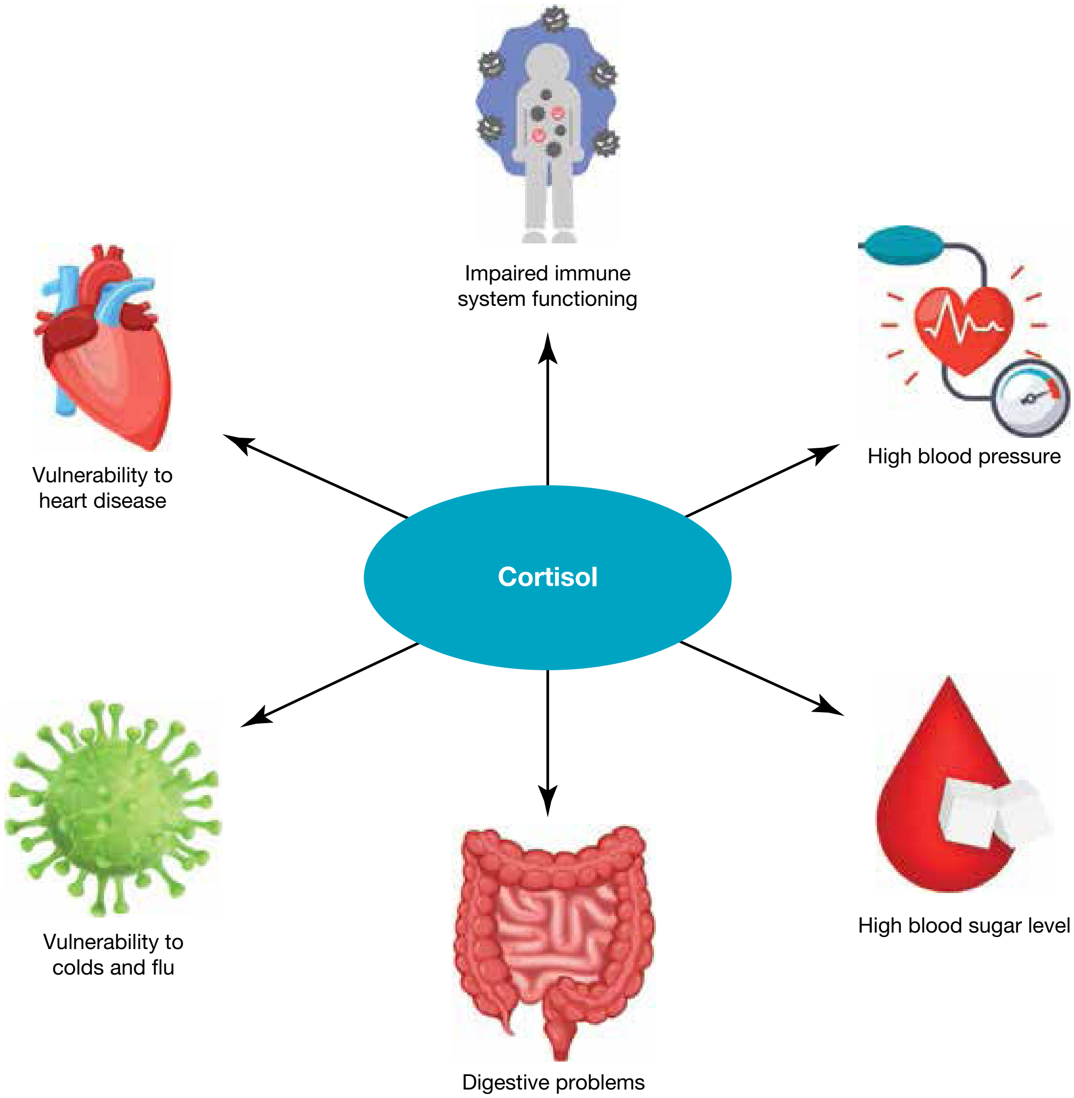


Figure 3.7 Some of the potential harmful effects associated with a prolonged high level of cortisol due to stressors

Cortisol also has an anti-inflammatory effect by blocking the activity of white blood cells that contribute to inflammation. However, it can also retard tissue repair, which slows wound healing. Suppressing the activity of the immune system is part of the overall process of targeting essential bodily resources to ensure instantaneous fight, flight and freeze reactions and keep the body in a high alert state.

A healthy stress response is characterised by a quick rise in cortisol levels, followed by a rapid decline with the termination of the stressful event. Although physiological responses to stressors are beneficial and may be adaptive in the short term, prolonged activation of our stress response can be harmful to physical and mental health. For example, with long-term stressors, cortisol remains in the blood stream at an elevated level.

One effect of the excessive amount of cortisol over a prolonged time is impaired immune system functioning and thereby increased vulnerability to disease. Normally, when foreign substances such as viruses, bacteria or allergens enter the body, the immune system launches into action to destroy the invaders.

Elevated cortisol levels also contribute to the build up of fat tissue and to weight gain. For example, cortisol increases appetite, so people tend to want to eat more to obtain extra energy. It also increases storage of unused nutrients as fat (Harvard, 2020a).

Physical health problems associated with higher and more prolonged levels of cortisol in the blood stream include colds, flu, hypertension (high blood pressure), digestive problems, obesity, atherosclerosis (hardening of the arteries), high blood sugar level (hyperglycemia) and diabetes (which is associated with hyperglycemia). The long-term risks for heart attack and stroke are also increased.

Impaired cognitive performance, learning problems, impaired memory formation and recall, and mental disorders such as depression, post-traumatic stress disorder and other anxiety disorders have also been linked to high levels of cortisol in the blood stream for a prolonged period (Cohen et al., 1992; McEwan & Stellar, 1993; McEwen, 2004; Whitworth et al., 2005; Breedlove & Watson, 2020).

on Resources

Teacher weblinks Video on how the body responds to stress 5 m 51 s

Stress effects on the body: a text-based outline prepared by the American Psychological Association on how acute and chronic stress effects different bodily systems

3.5 LEARNING ACTIVITY 1

Review

1. a. What is cortisol?
   b. Where is its source?
2. List three roles of cortisol in chronic stress.
3. Under what circumstances is the presence of cortisol potentially harmful?

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.5 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.46; ©VCAA

Eleanor got such a dreadful fright when she saw her father pretending to be a sea monster that she felt transfixed and unable to move or act.

Which of the following identifies what was initially released into Eleanor's bloodstream at the time of the incident and its function?

	Released into bloodstream	Function
A.	glutamate	Help Eleanor form a fearful memory
B.	GABA	Return Eleanor's body to homeostasis
C.	cortisol	Energise Eleanor's body to be able to deal with the sudden threat
D.	adrenaline	Activate various organs in the body for the 'fight-flight-freeze' response

Question 2 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.4; ©VCAA

A role of cortisol during prolonged stress is to

A. maintain homeostasis.
B. activate the freeze response.
C. suppress the immune system.
D. trigger the parasympathetic nervous system.

Question 3 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.33 (adapted); ©VCAA

Taiga's wife lost her job and Taiga had to start working 60 hours a week to make sure they could pay their bills. During the next two months, Taiga experienced several viral infections. He went to his doctor, who said he was suffering from stress.

Taiga's recurring viral infections were most likely due to

A. an increase in cortisol.
B. a decrease in cortisol.
C. a decrease in noradrenaline.
D. a decrease in adrenaline.

Question 4 (1 mark)

Source: VCAA 2012 Psychology 2, Section A, Q.30 (adapted); ©VCAA

When the body is required to respond to a stressor over an extended period of time, which of the following physiological responses is likely to occur?

A. Stress will decrease.
B. Cortisol may be depleted.
C. The immune system will be strengthened.
D. The body's capacity to respond to the stressor will be enhanced.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

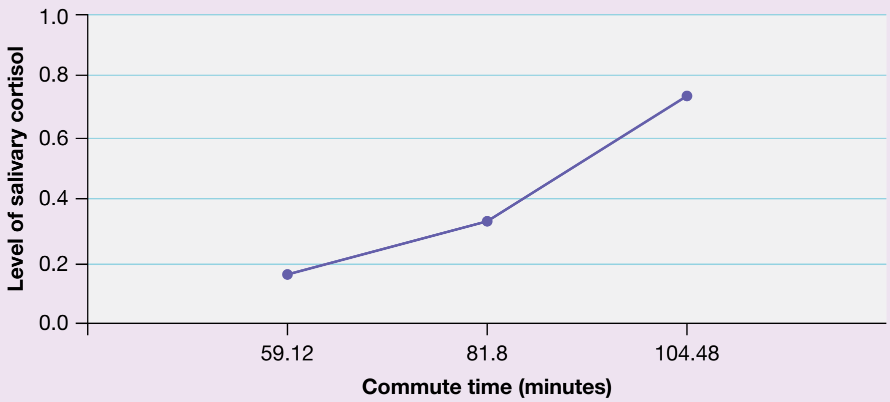
3.5 LEARNING ACTIVITY 3

Analysis and evaluation of research on passenger stress when train commuting

If you use a suburban train to get to school every morning during peak hour, you probably do not find it the most pleasurable experience of the day — delays and standing up face-to-face with someone else in a crowded carriage can make it a stressful experience, especially when on a long journey. People in such crowded environments often report physical and psychological symptoms of stress such as higher blood pressure, increased heart rate, 'light-headedness', 'feeling like fainting', nausea, difficulties concentrating, frustration, anxiety, fear and anger.

One American study investigated the relationship between train commuting and stress in 208 men and women who lived in the suburbs (New Jersey) and took the train to work in Manhattan, New York. The amount of cortisol in saliva produced by participants was used as a measure of stress. One set of results is shown in the graph below.

At the end of the journey, the researchers gave participants a proof-reading exercise to complete for which they had to identify errors in a document. Those on short journeys persisted with the task but as the journey got longer, more and more participants set it aside. Participants who did not persist with the task also reported experiencing more stress. There were no significant sex differences in the results.



Source: Based on Evans, G.W., & Wener, R.E. (2006). Rail commuting duration and passenger stress. *Health Psychology, 25*(3), 408–412.

a. How was stress operationalised by the researchers?
b. Identify the independent and dependent variables for the cortisol measurement part of the study.
c. **i.** Suggest a suitable title for the graph showing the results.
  ii. Describe the pattern of results shown in the graph.
  iii. Formulate a research hypothesis that would be supported by the results.
d. Explain whether crowded train travel to school or work would be classified as an internal or external stressor.
e. **i.** Which stress symptom was measured by the proofreading exercise?
  ii. Formulate a research hypothesis that would be supported by the results for this measure.
e. What are three questions you would ask the researchers to help you determine potential limitations or criticisms of the research design?
f. What are two conclusions that can be drawn from the results?
g. Are the results generalisable to: (a) the study's population? (b) other populations? Explain your answers.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.6 The gut–brain axis (GBA)

If you've ever felt 'butterflies in your stomach' when stressed or anxious, had a 'gut feeling' about an outcome, or made a 'gut wrenching' decision, you have probably become aware of signals between your gut and your brain. Several pathways link the brain and the enteric nervous system and information flows back and forth between the gastrointestinal tract and the brain on a continual basis. The gastrointestinal tract is often referred to as the digestive tract, intestinal tract, or simply the gut, hence the term gut–brain axis.

3.6.1 Gut–brain axis

The **gut–brain axis (GBA)** is a bidirectional ('two-way'), multi-faceted communication link between the central and enteric nervous systems. It involves direct and indirect pathways between cognitive and emotional areas in the brain with the gastrointestinal tract. For example, when we feel stressed or anxious, we may end up with an upset stomach due to the signals our brain has sent to our gut. Similarly, disruption in the gut or its activities may affect our mood, emotional arousal, motivation, behaviour and even higher-order cognitive functions such as decision-making and problem-solving (Cryan et al., 2019; Nguyen, 2021; Laue et al., 2022).

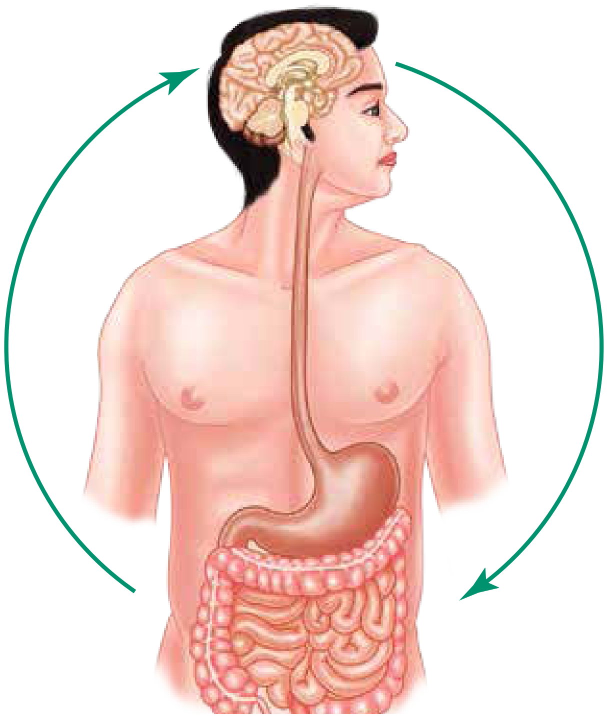


Figure 3.8 The gut–brain axis is a bidirectional communication link between the central and enteric nervous systems.

The gut microbiota and the brain also communicate with each other within the gut–brain axis, so the microbiota may also affect mental processes and behaviour. For example, in addition to their direct actions on the gut itself and the enteric nervous system, the gut microbiota can influence the production of serotonin and other neurotransmitters within the gut, and therefore their supply and various roles throughout the body. Chemical agents produced by the gut microbiota also enter the blood stream and communicate with the brain and other distant organs such as the heart and liver.

The wide-ranging effects of gut microbiota have led more and more researchers to include gut microbiota into the gut–brain axis and refer to the *gut–brain–microbiota axis*. Together, the gut–brain–microbiota axis is a complex interconnected circuit with multiple pathways. The term recognises that the gut, brain and gut microbiota all play crucial roles in the axis. Furthermore, this means that when an issue arises at any point within its communication pathways, it can affect the entire axis (Sidhu & van der Poorten, 2017; Cryan et al., 2019).

The gut–brain axis extends to include communication routes with the autonomic nervous system, endocrine system, immune system, stress response system (HPA axis) and other bodily systems, so functions associated with these may also be influenced by gut–brain and microbiota activities. For example, disruptions in the gut–brain axis or an imbalance in gut bacteria can affect endocrine and immune system functioning, as well as our physiological responses to stress (Appleton, 2018; Cryan et al., 2019).

3.6.2 Gut microbiota

Each individual has a personal composition of gut microbiota comprising all the microorganisms (such as bacteria, viruses and fungi) present in their digestive tract. The term *enterotype* is used to refer to the unique combination of gut microbiota we each possess. The collective term for a population of microbiota in a defined environment is *microbiome*. A microbiome is not fixed as its composition can be affected by both internal and external factors, including diet, infection, disease and lifestyle choices. The diversity of gut microbiota also diminishes with age.

There is no standard definition of an optimal or healthy gut microbiome since it is different for each individual. However, important characteristics include high levels of microbiota richness (i.e. the number of different species), diversity (i.e. how different they are), and stability, resilience and resistance to significant change over time (e.g. the ability to resist disturbance by an antibiotic medication or poor diet) and to recover a stable state. The term *gut dysbiosis* is used to refer to an unbalanced gut microbiome, either in number or type of microbiota.

Microbiomes and disturbances to the balance of microbiota have been associated with changes in the production of neurotransmitters in the gut (e.g. gut bacteria help produce dopamine, GABA and over 80% of the body's serotonin), the production and activity of neurotransmitters in the nervous system, immune system impairments, digestive disorders, numerous inflammatory diseases and infections, stress reactivity, heart disease, mood, cognitive functioning, neurological conditions such as autism and Parkinson's disease, and various mental health disorders such as anxiety disorders, schizophrenia and depression.

Most of these findings have been based on research with germ-free laboratory animals (especially young mice) to study the effects of antibiotics, probiotics (substances with live 'good' bacteria) and faecal transplants. In particular, their effects on gut bacteria and how changes to the microbiome may influence brain activity, the nervous system, circulating hormones, psychological processes, behaviour, and so on.

Researchers have also undertaken studies with people. For example, human infants given antibiotics throughout their first 6 months of life due to a medical condition have been investigated to understand the connection between the gut and brain. There have also been faecal transplants of gut microbiota from people with major depression to colonise microbiota-depleted rats. These rats subsequently tended to show behavioural changes associated with depression (Kelly et al., 2016; Carabotti et al., 2019; Cryan et al., 2019; Nikolova et al., 2021; Xu et al., 2022).

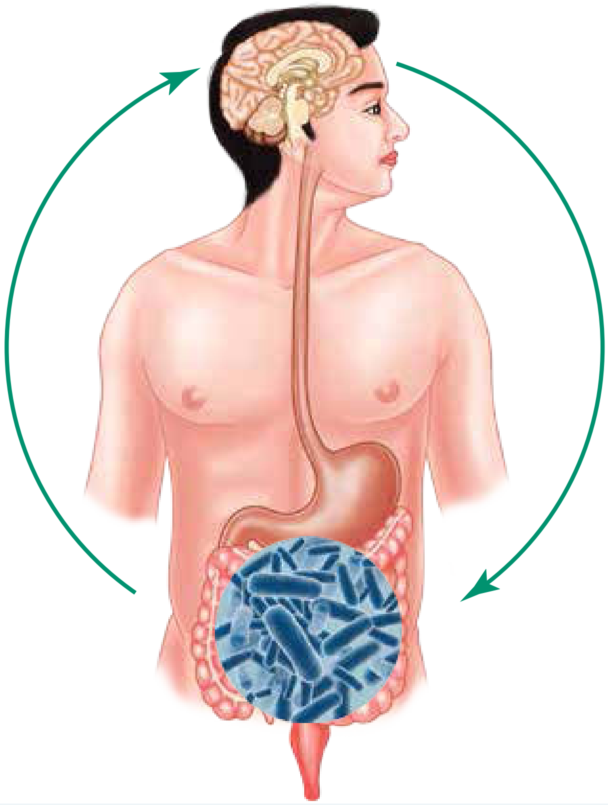


Figure 3.9 The wide-ranging effects of gut microbiota have led more and more researchers to include gut microbiota into the gut–brain axis and refer to the *gut–brain–microbiota axis*.

on Resources

Weblinks Video explaining the gut-brain axis 9 m 35 s
Video overview of the microbiome and links with health and wellbeing 4 m 29 s

3.6.3 Links with stress

There is mounting evidence that there are bidirectional links between the gut microbiota and stress. Stress can disturb the balance of gut microbiota and the microbiota can influence susceptibility to stress, physiological stress responses, stress-induced changes in psychological processes and behaviour, stress resilience, and recovery from stress-induced changes.

Many studies have found that stress impacts on gut microbiota composition in a number of different animals, including rodents, pigs, horses and monkeys.

For example, stressors such as immersion in water or exposure to heat, loud noise, overcrowding or maternal separation have all been shown to change the composition of the gut microbiota and the stress response of the animal host (Cryan et al., 2019).

This also occurs among people. For example, researchers have found that infants born to mothers who are highly stressed during pregnancy (i.e. high reported stress and high cortisol concentrations) tended to have abnormal compositions of gut microbiota. More specifically, the infants tended to have higher levels of harmful bacteria and lower levels of beneficial bacteria. In addition, the infants had significantly higher levels of stress-related gastrointestinal symptoms (Maartje et al., 2015).

Furthermore, researchers have found that manipulating the gut microbiota using probiotics containing 'good' strains of bacteria and various other microbiota-improving methods, such as faecal microbiota transplantations and specific diets, can promote healthy gut–brain–microbiota interactions, thereby reducing the physiological stress responses and negative effects of stress, including stress-related behaviour and HPA axis activation (Loughman et al., 2016; Liang et al., 2018; Cryan et al., 2019).

The brain and gut communicate constantly through a network of neural, hormonal and immunological messages. The network and the cross-talk signals within it can be disturbed when we experience stress.

In addition, stress may affect different physiological functions of the gastrointestinal tract, including changes in blood flow, gastric secretions and gut motility (movement of food through the tract); increase in visceral perception (heightened sensitivity to gastrointestinal actions and processes) and intestinal permeability (greater leakage through the gut lining); and negative effects on gut microbiota. These types of changes contribute to the development of various gastrointestinal disorders that are strongly associated with stress (Konturek et al., 2011; Cryan et al., 2019; Molina-Torres et al., 2019).

Moreover, the gut microbiota are considered a part of the gut–brain axis, so it should not be surprising that a significant disturbance in the microbial balance due to stress can in turn trigger reactions that feedback to

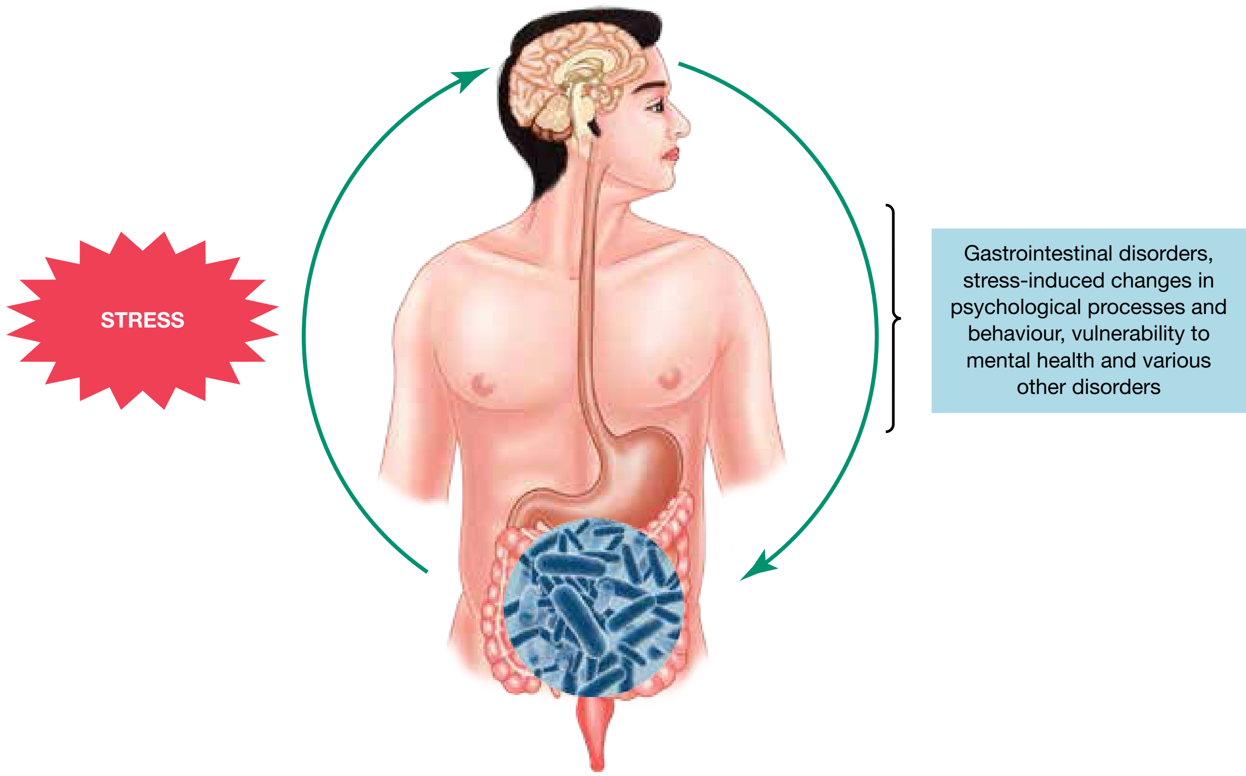


Figure 3.10 Stress can disturb the gut–brain axis, gut microbiota composition and gut–brain–microbiome interaction, thereby influencing development of gastrointestinal disorders.

the brain as well as making the host more vulnerable to stress-related changes and stress management issues. The research evidence suggests that a healthy, balanced gut microbiota helps the host to cope with stress, whereas an abnormal microbiota reduces the resistance and increases the susceptibility to stress-related disorders (Liang et al., 2018).

The gut–brain axis and its interaction with gut microbiota, stress and the nervous system in the control of psychological processes and behaviour is an area of emerging research. This has been accompanied by the emergence of *psychobiotics* — microbiota-targeted interventions such as beneficial bacteria (e.g. probiotics) or support for such bacteria (e.g. prebiotics) that influence gut–brain axis communication (Sarkar et al., 2016). Most of the research in both these fronts has been with animals and there is a relative lack of research evidence with both healthy and unhealthy people, especially experimental research and long-term studies. Despite the accumulating evidence, caution is needed in over-interpreting or over-stating the research evidence. There is still much to learn.

3.6 LEARNING ACTIVITY

Multiple-choice questions

1. The primary role of the gut–brain axis is to
   A. provide a habitat for gut microbiota.
   B. adjust the composition of the gut microbiota.
   C. manage stress-induced changes in the gut and brain.
   D. provide communication pathways between the brain and digestive tract.
2. The term _____ is commonly used to refer to the entire population of gut microbiota.
   A. microbiome
   B. gut microbiome
   C. enterotype
   D. gut dysbiosis
3. Which of the following statements about gut microbiota is correct?
   A. Gut microbiota are dead microorganisms.
   B. The combination of gut microbiota in any individual is fixed.
   C. Each individual has a unique combination of gut microbiota.
   D. Gut microbiota can influence gut activity but not brain activity.
4. Disruption to the gut–brain axis has been linked to which of the following types of disorders?
   A. neurological
   B. mental health
   C. gastrointestinal
   D. All of the above are correct.
5. Which of the following statements about the gut–brain axis and stress is not correct?
   A. Stress can disturb the balance of gut microbiota.
   B. Gut microbiota can influence stress responses.
   C. The gut microbiome tends to be relatively unaffected by stress.
   D. There are bidirectional links between the gut microbiota and stress.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.7 Selye's General Adaptation Syndrome (GAS) as a biological model of stress

While Cannon was investigating fight–flight reactions in the 1930s, Hans Selye was conducting research on both immediate and long-term effects of stress. Most of Selye's research was done with rats that were exposed to a variety of stressors such as painful tail-pulling, prolonged exposure to heat or cold, mild electric shocks, bacterial infections, strenuous exercise and forced restraint.

Selye observed that the pattern of physiological changes in response to each of these different kinds of stressors was generally the same — adrenal glands were enlarged, gastrointestinal ulcers developed, weight loss occurred and vital glands in the immune system had shown shrinkage (such as the lymph glands that play a vital role in filtering out harmful substances).

On the basis of these observations, Selye concluded that stress is a condition that is non-specific, and which can be brought on by either internal or external stressors. In addition, stress is the body's physiological response to both physical and psychological demands and that it 'represents the body's generalised effort to adapt itself to new conditions' (Selye, 1936; 1950).

According to Selye, any emergency, illness, injury, or an imposing demand at school or work, initiates sympathetic nervous system responses such as increases in heart and breathing rates, slowing of digestive functioning, and so on. These are *non-specific* reactions to stress that occur regardless of the type of stressor. In addition to non-specific reactions, a number of *specific* reactions that are appropriate to particular stressors can occur. These specific reactions may include running away from a vicious dog, fighting off an attacker, activation of the immune system to destroy bacteria and viruses, and becoming tense or frustrated at someone who is annoying. Specific and non-specific responses to stressors are natural reactions to the challenges of varying complexity that we encounter in everyday life.

On the basis of his observations of animals, and to a lesser extent people, Selye developed the General Adaptation Syndrome. The **General Adaptation Syndrome (GAS)** is a three-stage physiological response to stress that occurs regardless of the stressor that is encountered. This means that the GAS is non-specific and will occur whatever the source of the stressor.

Figure 3.11 Based on extensive research with rats, Austrian-born endocrinologist Hans Selye (1907–1982) developed the three-stage General Adaptation Syndrome (GAS), which describes the physiological consequences of severe stress. His popular book, *The Stress of Life* (1956), helped make stress a household word. Selye spent a lifetime researching the GAS and wrote over 30 books and more than 1500 articles on stress and its health-related problems.

3.7.1 Stages of the GAS

As shown in Figure 3.12 below, the GAS comprises a brief alarm reaction stage (with shock and counter shock), a prolonged stage of resistance and a final stage of exhaustion.

Stage 1: Alarm reaction

The first stage of the GAS involves an initial response called **alarm reaction** which occurs when the person (or animal) first becomes aware of the stressor. This stage comprises two phases or sub-stages.

At first, the body goes into a temporary state of **shock**, and its ability to deal with the stressor falls below its normal level. Physiologically, the body reacts as if it were injured. This is marked by a decrease in body temperature, blood pressure, and muscle tone and loss of fluid from body tissues. Then, the body rebounds from this level with a reaction that Selye called counter shock.

During **counter shock**, the sympathetic nervous system is activated and the body's resistance to the stressor increases. The organism's response is a fight or flight reaction. It becomes highly aroused and alert as it prepares to deal with the stressor. Adrenaline, noradrenaline, cortisol and other stress hormones are released into the blood stream and the organism's heart and respiratory system respond by accelerating. Among other actions, these hormones supply the muscles with more energy (glucose and oxygen), allowing the organism to 'fight or flee', as needed.

This initial stage of the GAS is a general defensive reaction to the stressor, and results in a state of tension and alertness, and a readiness to respond to the stressor.

Stage 2: Resistance

According to Selye, if the source of the stressor is not dealt with immediately, and the state of stress continues, energy is still required and the body will continue responding in order to cope with and adapt to the stressor. The body will then enter a stage of resistance to the stressor.

During the **resistance** stage, the body's resistance to the particular stressor rises above normal. The intense arousal of the alarm reaction stage diminishes through activity of the parasympathetic system, but physiological arousal remains at a level above normal (even though heart and respiration rates may have slowed down). Since the body is being taxed to generate resistance, all unnecessary physiological processes are shut down. For example, digestion, growth and sex drive stall, menstruation stops, and the production of testosterone and sperm decrease.

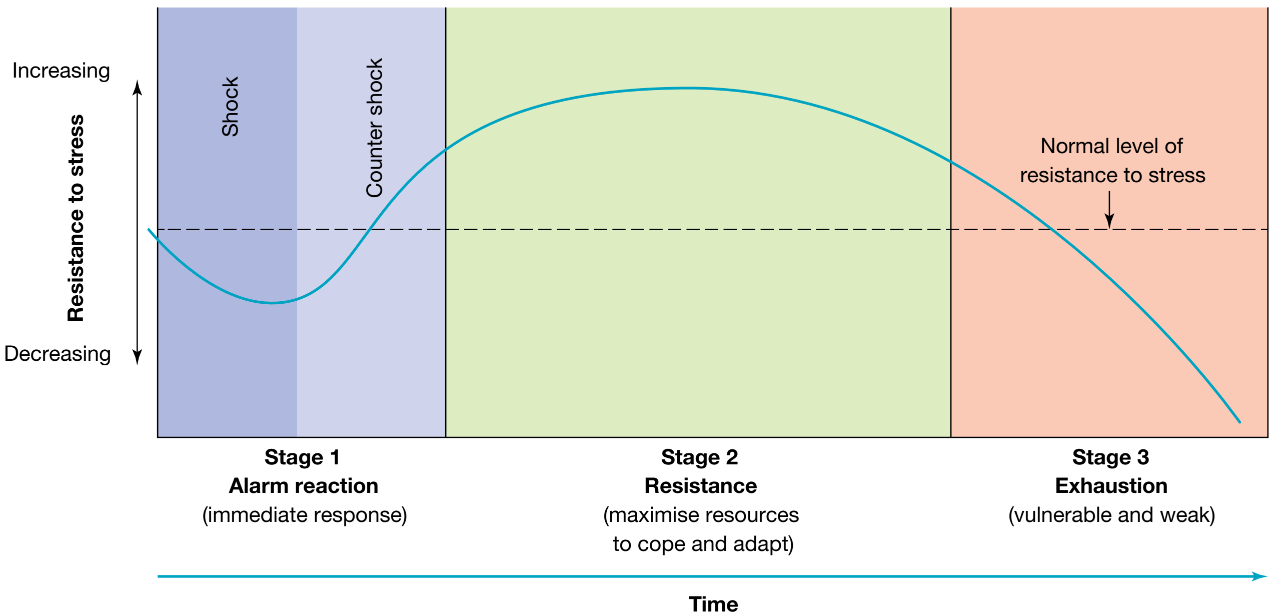


Figure 3.12 A graphical representation of Selye's General Adaptation Syndrome (GAS) which describes how people (and animals) react to any stressor. The GAS consists of three stages that occur in a sequence: alarm reaction (shock/counter shock), resistance and exhaustion.

However, steroid hormones such as cortisol which support resistance continue to be released into the blood stream to further energise the body and act as an anti-inflammatory agent and provide fast-acting pain relief for inflammation that may have occurred.

Because cortisol also suppresses immune system activity, its continuing presence at an abnormally high level interferes with the body's ability to fight disease and to protect itself against further damage. This means that even though the ability to adapt to and deal with the effects of the initial stressor increases during this stage, resistance to other stressors, such as illness or disease, may decline.

For example, during an exam week, a VCE student may be able to cope well enough to study for all their exams despite a decrease in sleep, exercise, recreation and healthy food (i.e. their body responds to the initial stressor). However, soon after the exams, the student may come down with an illness such as the flu. While the body's focus has been on dealing with the original stressor, it has failed to respond effectively to the flu virus, a new stressor that has entered the body.

Everybody goes through the alarm reaction and resistance stages many, many times in their lives. If the effort to deal with the initial stressor during the resistance stage is successful, the body will have adapted to the stressor and eventually returns to its normal 'balanced' (homeostatic) state of functioning.

Stage 3: Exhaustion

According to Selye, if the stressor is not dealt with successfully during the resistance stage, and stress is not relieved, the body may reach a stage of exhaustion.

During the **exhaustion** stage, some of the alarm reaction changes may reappear, but the body cannot sustain its resistance and the effects of the stressor can no longer be dealt with. Because the organism has been trying to deal with the stressor for a prolonged time, its resources such as stress hormones have been depleted, its resistance to disease is very weak, and it becomes more vulnerable to physical and mental disorders.

Figure 3.13 In the exhaustion stage, resistance to disease or disorder is very weak or ineffectual.

The exhaustion stage is evidenced by such changes as fatigue, sleep disturbances, severe loss of concentration, vulnerability to anxiety attacks, irritability, depressed mood, jumpiness and crying spells. High blood pressure can develop into hypertension and heart disease and gastrointestinal problems may also occur. Changes to body organs may be permanent. In extreme cases, if the stress continues further, the organism may even die.

Overall, the exhaustion stage brings about signs of physical wear and tear, especially in organs that have been consistently trying to deal with the stressor throughout the resistance stage. These are primarily attributable to the immune-suppression and other effects of higher and more prolonged levels of cortisol in the blood stream. According to Selye (1974), cortisol and other similar stress hormones are responsible for most of the physiological effects of stress, especially in the stages of resistance and exhaustion.

3.7.2 Strengths and limitations of the GAS

Selye's three-stage GAS model of physiological responses to stress extended Walter Cannon's findings on the fight–flight response and further developed awareness and understanding of the links between stress and disease. He was among the first researchers to suggest that stress could weaken the body's ability to resist infection and increase the likelihood of developing a physical disorder. This idea is now widely accepted within psychology (and medicine).

For instance, there is extensive research evidence that stress is associated with the initiation and progression of a wide variety of diseases, from cardiac, kidney and gastrointestinal diseases to AIDS and cancer. However, in the 1930s, the proposal that stress could actually cause disease, or at least weaken the body's resistance to disease, was a radical idea. Back then, the dominant view was that most diseases could only be caused by exposure to germs, viruses and other sources of infection.

Selye's GAS model also identifies biological processes associated with the body's stress response. For instance, many of his findings on the role in the GAS of the endocrine system and its various hormones have been confirmed by contemporary researchers and continue to be influential. This also applies to Selye's proposals that the GAS will occur in response to any type of stressor and that our bodies have only a limited amount of resources in coping with prolonged stress. These ideas are now included in most contemporary theories on stress and stress responses.

Selye's GAS has also been influential through its description and explanation of the potentially detrimental effects of the three-stage adaptation process following exposure to a persistent stressor. The idea that our bodies can eventually run out of resources and become increasingly vulnerable to disease as the stress persists had not been fully understood by previous researchers.

There are, however, a number of limitations of Selye's GAS. The GAS is a 'one size fits all' model. It assumes that *everyone* has the same general, predictable and automatic physiological responses to any kind of stressor, not unlike a sensor light that turns on outside regardless of the type of motion that is detected. Consequently, the GAS does not fully take account of or explain individual differences in physiological responses to a stressor.

The GAS also tends to understate the roles of bodily systems other than the endocrine system in the stress response and overlooks our psychological response to different types of stressors. It does not take into account cognitive aspects of the stress response, specifically the role of the brain in interpreting a situation or event as stressful. For

Figure 3.14 Hypertension (abnormally high blood pressure) is one of many physiological reactions associated with chronic stress, but not all people who experience chronic stress will develop hypertension. Selye's GAS tends to overlook such individual differences in the stress response.

example, two people may appraise, or 'weigh up', the same situation and judge it differently as either stressful or not stressful. This means that what might be considered a stressful situation and cause a stress response in one person may not in another. Furthermore, if both individuals appraise the situation as stressful, they may experience qualitatively different stress responses.

Similarly, not all people experience the same physiological reactions to chronic stress. For example, some experience hypertension, gastrointestinal problems, skin rashes or heart disease, whereas others may develop physical aches or pains, gain or lose weight, or become generally 'run down' without a specific disorder. This suggests that, despite the same bodily arousal systems and processes being involved in the GAS in all people, the precise way that prolonged activation can lead to disease could involve other biological and/or psychological processes.

Selye's description of the GAS as a non-specific stress response may also be limited. For instance, there is research evidence that different types of stressors can trigger their own distinctive physiological reactions (Cohen et al., 1986).

Finally, Selye's GAS has been criticised for being primarily based on the results of research with animals and may therefore be of limited relevance to the human stress response. His reliance on laboratory research with rats may explain why the GAS overemphasises biological factors and does not fully take into account individual differences and psychological factors in the stress response, particularly the role of cognitive processes.

learnon

learnMORE | Some disorders and diseases associated with chronic stress

Access learnON for an outline of disorders and diseases associated with long-term stress.

3.7 LEARNING ACTIVITY 1

Review

1. What is the General Adaptation Syndrome (GAS)?
2. Why did Selye use the term adaptation when describing this syndrome?
3. Explain the meaning of the phrase 'the GAS is non-specific'.
4. Make a copy of the GAS graph in Figure 3.12 and use it to summarise each stage of the GAS, including shock and counter shock during alarm reaction, and specific physiological changes associated with each stage, including the presence of cortisol and other adrenal gland hormones.
5. a. When Daniel hears his teacher tell the class to clear their tables so they can complete 'an important topic test', he suddenly realises he forgot about it and his heart begins pounding rapidly. Which stage of the GAS is Daniel most likely experiencing?
   b. One week remained before Chloe's exams. She stayed up late every night studying, and although she was feeling tired, she seemed to be managing her workload. Two nights before her first exam, Chloe witnessed her dog being hit by a car, which upset her very much. On the morning of her exam, she woke up with a headache, a sore throat, aches and pains in her joints and she kept sneezing.
      i. Name and describe the GAS stage Chloe is most likely in, with reference to Chloe's situation and experiences.
      ii. According to the GAS, under what circumstances would Chloe be vulnerable to a physical disease?
6. a. Identify two strengths and two limitations of the GAS.
   b. Include the two strengths and limitations in your GAS summary prepared for question 4.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.7 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.10; ©VCAA

Which one of the following is the most accurate description of the role of cortisol in the stress response, according to Selye's General Adaptation Syndrome?

A. stops the immune system from functioning
B. increases glucose in the bloodstream and reduces inflammation
C. reactivates functions that are non-essential in a fight-flight response
D. provides the initial alert about a perceived threat, through the release of adrenaline

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.9; ©VCAA

Jamie is experiencing a constant state of stress and has also caught a cold. Which of the following most accurately identifies the stage of Selye's General Adaptation Syndrome that Jamie is in and the reason that supports this stage?

	Stage	Reason
A.	shock	Jamie's immune system is immobilised so his body can fight the stressor.
B.	resistance	Continued cortisol release weakens Jamie's immune system, resulting in his body being unable to fight the cold.
C.	exhaustion	Jamie's body's resources are depleted, resulting in vulnerability to a range of serious physical disorders.
D.	resistance	Increased adrenaline in Jamie's bloodstream results in his body becoming susceptible to illnesses.

Question 3 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.5; ©VCAA

A psychologist wanted to investigate people's responses to being pricked by a needle. Details of the investigation were provided to a group of 10 participants prior to the investigation. The investigation involved blindfolding participants and pricking each participant's finger over several trials.

Before the first trial, all of the participants were shown the needle that was to be used in the investigation. One of the participants, Nerissa, felt stressed when she saw the needle and her blood pressure dropped.

According to Selye's General Adaptation Syndrome, Nerissa was most likely experiencing

A. shock, which activated her parasympathetic nervous system.
B. resistance, which activated her sympathetic nervous system.
C. exhaustion, which activated her fight–flight response.
D. countershock, which activated her freeze response.

Question 4 (1 mark)

Source: VCAA 2018 Psychology 2, Section A, Q.30 (adapted); ©VCAA

When the body is required to respond to a stressor over an extended period of time, which of the following physiological responses is likely to occur?

A. Adrenaline will be secreted from the hypothalamus.
B. Stress hormones will be secreted.
C. The immune system will be strengthened.
D. The body's capacity to respond to the stressor will be enhanced.

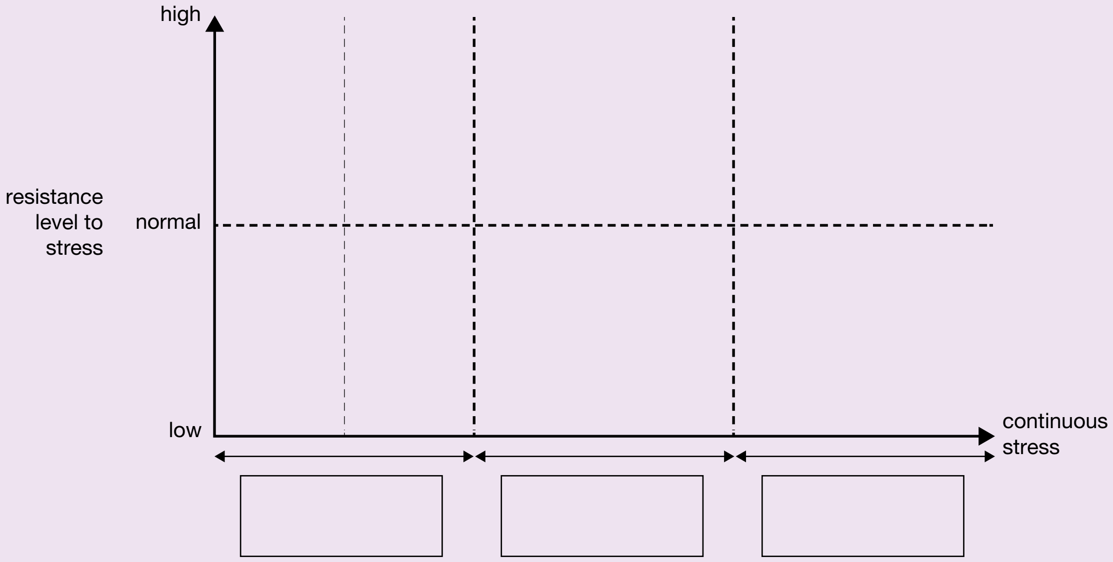
Question 5 (8 marks)

Source: VCAA 2021 Psychology, Section B, Q.1; ©VCAA

Bob works for a highly competitive and demanding advertising company with a stressful work environment. When he first started this job, he was surprised at the additional tasks he was required to complete on a daily basis. After many months, Bob started experiencing headaches and frequently caught colds.

a. i. On the diagram below, draw a graphical representation of Selye's General Adaptation Syndrome to show how an individual typically reacts to a stressor. 1 mark

ii. In the boxes provided on the diagram below, label the three stages that occur according to Selye's General Adaptation Syndrome. 1 mark



b. Identify what stage of Selye's General Adaptation Syndrome Bob was in when he started frequently catching colds. Justify your response. 3 marks

c. After working in this highly stressful environment for many years, Bob was diagnosed with a heart condition that required surgery.
Explain which stage of Selye's General Adaptation Syndrome Bob was experiencing when he was diagnosed with a heart condition. 3 marks

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.8 Stress as a psychological process

Researchers have identified many and varied psychological factors that cause or influence how we respond to stressors. These include our prior experience with stressors and stress responses, attitudes, motivation, level of self-esteem, general outlook on life (e.g. optimism versus pessimism), personality characteristics, coping skills, and our perception of how much control we have over a stressful event or situation. Such factors are not independent of each other and combine in different ways within each individual to have more or less impact on their response to a stressor.

American psychologists Richard Lazarus and Susan Folkman (1984) developed a model which explains stress as a psychological process and individual differences in how people respond to a stressor. Their model focuses on two key psychological factors that determine the extent to which an event (or situation) is experienced as stressful:

- the meaning of the event to the individual
- the individual's judgment of their ability to cope with it.

3.8.1 Lazarus and Folkman's Transactional Model of Stress and Coping

The Lazarus and Folkman **Transactional Model of Stress and Coping** proposes that stress involves an encounter ('transaction') between an individual and their external environment, and that a stress response depends upon the individual's evaluation ('appraisal') of the relevance of the stressor to his or her wellbeing and their ability to cope with it.

According to Lazarus and Folkman (1984), stress is not a result of the individual alone or the environment alone. The environment can influence the individual, but the individual can also influence the environment. Furthermore, an individual's appraisal of the situation and of their resources for dealing with that situation determine whether or not they experience stress and the nature of their stress response. When there is an imbalance between a person's appraisal of the demands of the situation and their estimation of their ability to meet those demands, then they will experience stress.


Figure 3.15 American psychologists Richard Lazarus (1922–2002) and Susan Folkman (1938–) developed the Transactional Model of Stress and Coping in the early 1980s.

For example, imagine two drivers stuck in a traffic jam on a major road caused by a car accident blocking one of the exits. Both are on their way to a business meeting at work.

One driver believes that the lack of movement is untimely, but that 'it's no big deal' and there's no point in getting upset because it will not make the cars ahead start moving again. So she decides to phone her assistant and explain that she will be late. She then uses the unexpected 'spare time' to catch up with her sister over the phone.

The other driver reacts very differently. She thumps the steering wheel and swears out loud. She then thinks about ringing her assistant but her phone battery is dead. She thumps the steering wheel again, thinking that the traffic jam is awful and will ruin her whole day. As the traffic jam continues, she sits and fumes, tapping on the steering wheel with her finger. She checks her watch regularly and becomes increasingly agitated with the passing of each minute. Her heart is pounding and, despite it being a cold day, she has to wind down the window because she feels very hot.

In this example, a specific situation is a stressor for one individual and not the other. The first driver is barely affected by the situation, whereas the second driver experiences significant distress, worsened by the fact that she feels trapped and cannot do anything to improve her circumstances.

According to the transactional model, both drivers are involved in an encounter with the environment that has produced a potential stressor — they are stuck in a traffic jam that will make them late for a business meeting. However, each individual responds differently to the same event because of how they appraise it. The first driver appraised the event as 'no big deal', managed the situation as best she could, then viewed it as an opportunity to speak with her sister. The second driver was overwhelmed and appraised the event as 'awful' and as exceeding her ability and available resources to do anything about.

According to Lazarus and Folkman, stress is largely 'in the eye of the beholder' and therefore a product of each individual's appraisal of a stressor. Furthermore, the event with which the individual has a 'transaction' will lead to stress only if they appraise that event as unpleasant, uncomfortable or perhaps as 'the worst thing that could happen to me,' as did the second driver.

Appraisal is not necessarily a conscious process. However, it is always subjective and therefore a highly personal process. It also depends on our estimation of our ability to cope with the stressor. It is for these reasons that two individuals may assess the same potential or actual stressor differently.

Figure 3.16 According to the Lazarus and Folkman transactional model, stress is 'in the eye of the beholder' and events become stressors only when individuals interpret them as unpleasant, uncomfortable or perhaps 'the worst thing that could happen to me'. This means that stress is a product of our individual appraisals of stressors.

Resources

Teacher weblink Video of a Folkman 2009 presentation on stress and coping 44 m

Primary and secondary appraisals

The Transactional Model of Stress and Coping distinguishes between two different types of cognitive appraisal of an event. These are called primary appraisal and secondary appraisal, and they occur in a two-step sequence in response to a potential stressor.

In a **primary appraisal**, we evaluate, or 'judge', the significance of the event and whether anything is at stake in this encounter. For example, we may ask questions such as 'Is this something I have to deal with?', 'Am I in trouble?', 'Is there any benefit?' and 'Does this matter to me?'

The outcome of a primary appraisal is a decision about whether the event is *irrelevant, benign–positive* or *stressful*. If we decide that the situation is stressful, then we engage in additional appraisals that involve deciding if a situation is harmful, threatening and/or challenging. More specifically, these appraisals involve:

- *harm/loss* — an assessment of how much damage has already occurred (e.g. 'I have lost my job')
- *threat* — an assessment of harm/loss that may not have yet occurred but could occur in the future (e.g. 'I mightn't be able to afford the rent'), and
- *challenge* — an assessment of the potential for personal gain or growth from the situation (e.g. 'I'll get any other job I can and will learn to budget and save money').

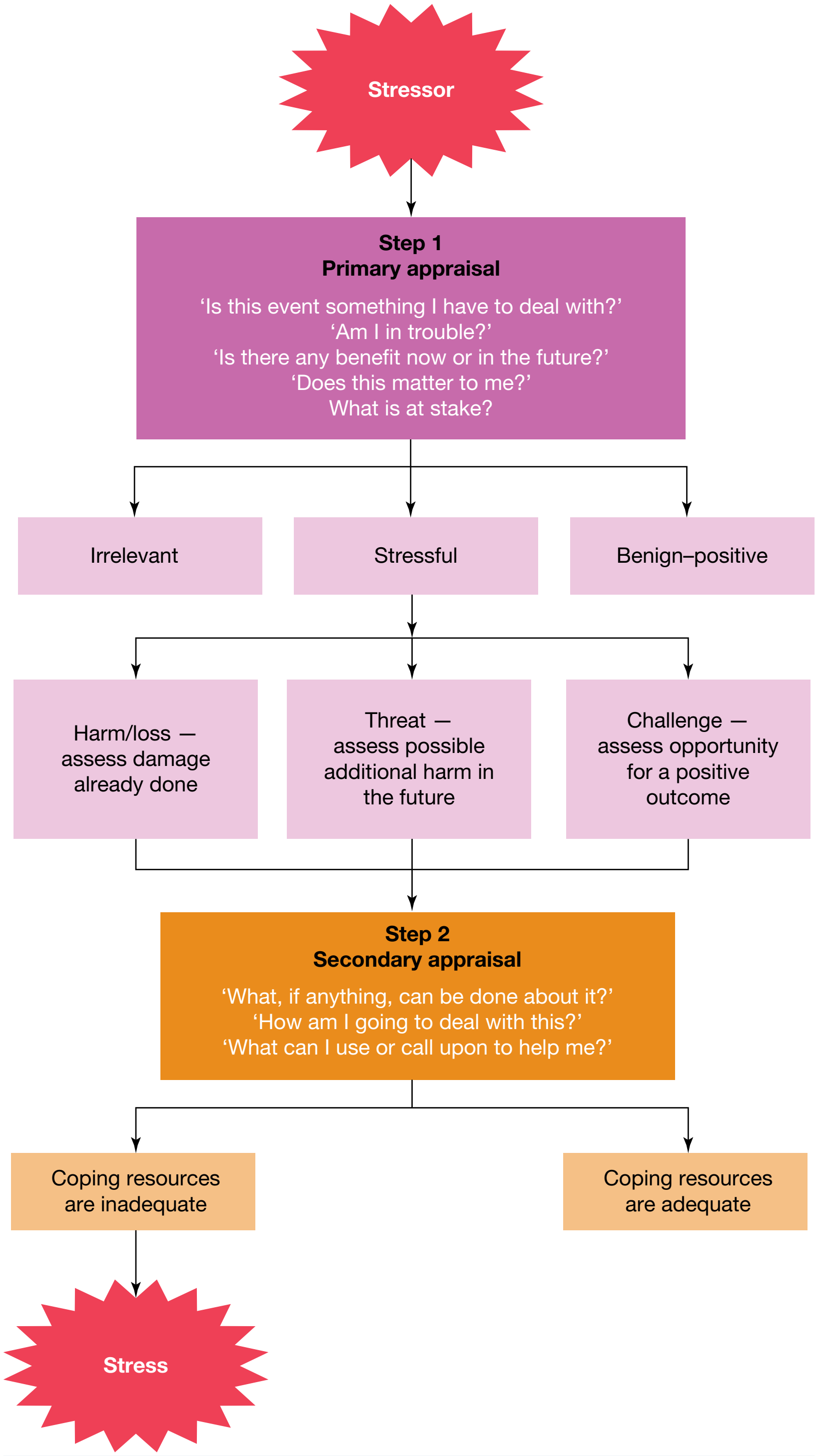


Figure 3.17 A representation of Lazarus and Folkman's two-step Transactional Model of Stress and Coping

In a **secondary appraisal**, we evaluate our ability to control or overcome the situation in which we find ourselves. This includes an evaluation of our coping options and resources for dealing with the event. The coping options and resources available may be *internal* (e.g. strength and determination) or *external* (e.g. money and support from family or friends).

If the coping demands of the situation are perceived as being far greater than the resources that are available, then we are likely to experience a stress response. The discrepancy that is perceived may also trigger a search for additional or new resources that can be used to cope with the stress.

Note also that our primary and secondary appraisals can merge to influence our overall judgment of the specific transaction with the potential stressor. For example, we may judge that an event contains the possibility of harm or loss, so it is threatening and challenging, and therefore significant for our wellbeing and will tax our coping resources for some time (Folkman et al., 1986).

3.8.2 Strengths and limitations of the Lazarus and Folkman model

Lazarus and Folkman's Transactional Model of Stress and Coping has a number of strengths. Unlike the fight-or-flight-or-freeze response and the GAS, which focus on involuntary physiological changes occurring in response to stressors and which mostly overlook cognitive processes and individual differences when reacting to a stressor, the transactional model focuses on psychological influences on how we react to a stressor. It also emphasises the personal nature and individuality of the human stress response.

Development of the model with reference to observations of people may also be considered a strength, as compared with the use of animals in developing the GAS.

The transactional model views stress as involving an interaction with the environment in which the individual has an active rather than passive role. The role involves personal appraisals of a situation or an event that may be a stressor, thereby emphasising each individual's role in interpreting what that situation means to them from their perspective rather than from someone else's. This allows for much more variability in the human stress response and helps explain why different individuals respond in different ways to the same types of stressors.

In sum, strengths of the model are:

- focuses on psychological determinants of the stress response over which we have control
- emphasises the personal nature and individuality of the stress response
- views stress as an interaction with the environment in which the individual has an active role
- respects personal appraisals of a situation, thereby interpreting the situation from an individual's perspective
- explains why individuals respond in different ways to the same types of stressors
- allows for the fact that stressors and the circumstances under which they occur can change over time
- allows us to change our thinking about a stressor and our response
- proposes different methods for managing psychological responses to stressors.

A major limitation of the transactional model is that it is difficult to test through experimental research. This is mainly because of the subjective nature, variability and complexity of individual responses to stressful experiences. Furthermore, primary and secondary appraisals can interact with one another and are often undertaken simultaneously. This also makes their study problematic as they are difficult to isolate for experimental research purposes as separate variables (Lazarus & Folkman, 1984).

Some psychologists also doubt that we actually need to appraise something as causing stress in order to have a stress response. For example, we can experience a stress response without ever having thought about a specific event or situation, let alone made the assessments and judgments described by the transactional model. Individuals may not always be conscious of or be able to specifically name or identify all the factors that are causing them to experience a stress response. For example, someone might feel a little 'on edge' and experience stomach aches and other reactions associated with stress a few weeks before an important exam, which is well before they have begun to consciously think about preparing for it.

This also suggests another limitation of the transactional model, especially when compared with the GAS — that it overlooks physiological responses to stressors.

In sum, limitations of the transactional model include:

- difficult to test through experimental research because of the subjective nature of individual responses to stressors
- individuals may not always be conscious of all the factors causing them to experience a stress response
- we can experience a stress response without ever having thought about a situation or event (i.e. appraisal is not essential)
- overlooks physiological responses to a stressor
- the linear approach of the model does not allow for individual variation in progression through the stages
- primary and secondary appraisals can interact with one another and are often undertaken simultaneously
- primary and secondary appraisals are difficult to isolate for study as separate variables.

Figure 3.18 Lazarus and Folkman's Transactional Model of Stress and Coping can explain why some learner drivers find driving stressful, whereas most experienced drivers do not. The learner has limited ability to meet the demands of handling a car in traffic, which means that the demands of the environment are greater than their perceived ability to cope. For experienced drivers, the perceived demands of the environment are fewer than their perceived ability to cope.

3.8 LEARNING ACTIVITY 1

Review

1. Explain the meaning of 'transaction' in relation to the Lazarus and Folkman model, ensuring you refer to the individual and their environment.
2. Briefly explain why the model is sometimes described as a two-step model.
3. a. What is the role of appraisal in the model?
   b. Name and describe the two major types of appraisal.
4. Name and describe the three types of appraisals that follow an appraisal of a stimulus as stressful.
5. Why does how you think about stress matter? Explain in relation to the Lazarus and Folkman model.

6. Xanthe and Olivia must each present a 10-minute oral report in class for one of their SACs. The girls are best friends, enrolled in the same VCE subjects and also work casually three evenings a week, on the same shifts at the same fast food outlet. They have five days in which to prepare their reports. They have different topics of about the same difficulty.
   Xanthe is distressed about having to prepare and present her report. She gets very anxious whenever she thinks about it. She is concerned about the amount of preparation work required within the time available. She also doesn't like making oral presentations because she thinks she looks and sounds 'weird' when doing so.
   Olivia is not hassled or distressed. Instead, she is looking forward to getting the presentation done and out of the way.

   Explain Xanthe's and Olivia's different reactions to the SAC task with reference to the Lazarus and Folkman transactional model. You may use a diagram to support your explanation.

7. *Source: VCAA 2015 Psychology, Section B, Q.4; ©VCAA*
   Identify **two** strengths and **two** limitations of Lazarus and Folkman's Transactional Model of Stress and Coping.

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3.8 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.5; ©VCAA

Dakota decided to purchase a second surfboard in preparation for an upcoming competition. When it arrived, she noticed that it was damaged and she was informed that a replacement would not be available until after the competition.

In terms of Lazarus and Folkman's Transactional Model of Stress and Coping, a possible secondary appraisal for Dakota might be

A. feeling disappointed because her new surfboard cannot be used.
B. that she could cope with the delay by using her existing surfboard.
C. feelings of loss at not being able to compete because her new surfboard is broken.
D. that this is an opportunity to seek another supplier from whom she can purchase an alternative surfboard.

Question 2 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.19; ©VCAA

Tracy received the news that her audition for the lead role in the school play was successful. According to Lazarus and Folkman's Transactional Model of Stress and Coping, which one of the following may best describe Tracy's initial reaction to the news?

A. She recalls that learning lines has always been easy.
B. She views it as an opportunity to begin her acting career.
C. She decides to learn the rest of the lines in the play's script with a friend.
D. She decides that she does not have the resources to cope due to the stress of the news.

Question 3 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.7; ©VCAA

One limitation of Lazarus and Folkman's Transactional Model of Stress and Coping is that the model

A. fails to explain the outcome if coping resources are inadequate.
B. does not account for the different interpretations of events by individuals.
C. does not recognise that the individual and the environment both play a role in the stress response.
D. is unable to be researched experimentally because primary and secondary appraisals often occur simultaneously.

Question 4 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.6; ©VCAA

Masako was anxious about and excited to be competing in the last baseball game before the finals. If her team won, it would progress to the finals. Masako was new to the sport and doubted her abilities but had practised a lot and carefully listened to her coach's tips. She had also decided that this game would help increase her skills. When it came time for Masako to bat, she was concentrating so closely on the ball that she blocked out the crowd cheering her on.

According to Lazarus and Folkman's Transactional Model of Stress and Coping, an example of Masako undertaking primary appraisal would be if she thought

A. of the crowd cheering her on.
B. of the tips given to her by her coach.
C. of the situation as good practice for the finals.
D. that she had practised enough to hit the ball a long way.

Question 5 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.31; ©VCAA

Andrew was accepted to study psychology at a university in Germany. Although he was excited, he was also stressed about where he would stay. He considers two options: ask if he could stay with his aunt who lives close to the university or move into student accommodation at the university if his aunt rejects his request. However, when he visited the university's student accommodation website, he saw that the cost of accommodation was very high, which made him even more stressed.

According to Lazarus and Folkman's Transactional Model of Stress and Coping, Andrew thinking about moving into student accommodation is an example of

A. secondary appraisal, where he considers his aunt's possible rejection as a threat.
B. primary appraisal, where he considers his aunt's possible rejection as a challenge.
C. primary appraisal, where he considers his options should his plan of living with his aunt be rejected.
D. secondary appraisal, where he considers his options should his plan of living with his aunt be rejected.

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3.9 Strategies for coping with stress

Everyone experiences stress that arises from daily hassles and other life events. These events often occur when we least expect them and can create stressful consequences that may persist for longer than we prefer. This is particularly the case with stressors arising from events over which we have little or no control and are not easily resolved. How we choose to cope with a stressor can have a significant impact on its immediate and long-term effects on our physical and mental health.

Coping describes all the different things we do to manage and reduce the stress experienced as a result of problems, issues or difficult situations that arise in life. According to Lazarus and Folkman (1984), **coping** is a process involving 'cognitive and behavioural efforts to manage specific internal and/or external stressors that are appraised as taxing or exceeding the resources of the person' in a stressful situation. This means that coping is an attempt to manage the demands of a stressor in some effective way.

In our attempts to cope with a stressor, we use one or more coping strategies. A **coping strategy** is a specific method, behavioural or psychological, that people use to manage or reduce the stress produced by a stressor. It may be an action, a series of actions, or a thought process (APA, 2022).

There are many different types of coping strategies but there is not a single 'right' way to cope. Nor is there any particular strategy that suits everyone. Some strategies will 'work better' and therefore be more effective than others, depending on a range of factors, such as the nature of the stressor (e.g. acute or chronic, hassle or catastrophe), the individual (e.g. their appraisals, coping flexibility, personality, access to support) and the stressful event itself.

Although there is a wide variety of coping strategies that may be used, some strategies are less beneficial than others. Those with the least benefit reduce stress temporarily but can have an adverse impact on physical or mental health. For example, drugs and alcohol can provide immediate, temporary relief from stress symptoms. However, they also interfere with a good outcome and have potentially harmful consequences.

Similarly, ineffective coping strategies for stress due to mounting bills include ignoring them, denying responsibility, gambling, yelling, swearing and becoming physically agitated. A more effective strategy would involve a plan of action that will eventually diminish the financial problems and alleviate the stress. A strategy is not necessarily ineffective if it provides only temporary relief from stress because the short-term relief may be a benefit in itself.

The various coping strategies can be organised into different categories, each with a distinctive approach. Two commonly used categories are called approach and avoidance coping. Generally, *approach* strategies attempt to deal directly with a stressor and *avoidance* strategies deal with it indirectly. In this section, we examine the use of specific approach and avoidance strategies. We start by considering the nature of the stressful situation requiring coping.

Figure 3.19 Many people report that prayer and meditation are effective coping strategies for dealing with certain stressful events.

3.9.1 Context-specific effectiveness

People with good coping skills tend to be more stress-free and happier and more positive overall than those who haven't yet figured out what coping strategies work best for them. They understand that a coping strategy that works well in one situation does not necessarily work well or may even be counterproductive in another. They are also flexible with their coping and adjust their style or strategy to help ensure it is suitable for dealing with the stressful situation in which they find themselves.

Researchers have found that there are situational determinants of coping effectiveness. This means that a specific coping strategy can be more or less effective in different situations. In order for a strategy to be effective, it must take account of all the characteristics of the stressful situation. These may relate to the physical environment, the stressor and the individual involved. Consequently, it is important that there be an appropriate 'match' between the coping strategy to be adopted, the situationally specific demands of the stressor and relevant personal characteristics of the individual involved (Folkman & Lazarus, 1985; Roth & Cohen, 1986).

A coping strategy is considered to have **context-specific effectiveness** when there is a match or 'good fit' between the coping strategy that is used and the stressful situation. For example, when experiencing stress about upcoming exams, a coping strategy that focuses on taking positive action, such as planning, time management and study would be suitable for many students in that situation, whereas coping strategies such as 'mental distancing' (not thinking about the exams at all) or 'wishful thinking' (hoping for good grades) while engaging in minimal study are likely to be detrimental. However, 'mental distancing' or 'wishful thinking' would be more effective if needing to minimise stress about the exam results while waiting for their release. In this context, when little or nothing can be done but wait until the results are available, these coping strategies would be more effective in reducing stress (Folkman & Lazarus, 1985; Lazarus, 1993).

A stressful context also includes the person confronted by the stressor. Consequently, the coping strategy most likely to be effective will also take account of the personal characteristics of the individual involved; for example, their personality, knowledge, skills, interests, preferences, access to social support from family, friends or community, and any other attributes that are especially relevant to the stressful situation.

For example, exercise is commonly recommended as an effective coping strategy when experiencing stress as it has psychological as well as physical benefits. However, it may not be a suitable option for someone who hates all types of exercise. Similarly, if someone has a medical condition that could be compromised by exercise, then this coping strategy is more likely to be detrimental than effective. In either case, a suitable coping strategy could involve a relaxation technique such as slow breathing or meditation, assuming the individual is willing to learn and use the technique.

Figure 3.20 Exercise is commonly recommended as an effective coping strategy when experiencing stress because it has psychological as well as physical benefits. However, it may not be a suitable option for someone who hates all types of exercise.

3.9.2 Coping flexibility

Most people have a number of coping strategies that they may draw upon for use in times of stress. However, mere access to coping strategies does not necessarily produce the desired results.

Given the wide variety of stressors encountered in life, we also need to select and use a coping strategy that is appropriate for a specific stressful situation. We must also be willing and able to recognise when a coping strategy is not working and modify a strategy or implement a new one if necessary. This type of flexibility with coping strategies is associated with more effective coping, greater wellbeing and positive outcomes. In contrast, persistent use of the same type of coping strategy for different stressful situations can hinder positive outcomes (Lazarus, 1993; Cheng et al., 2014).

Psychologists use the term **coping flexibility** to refer to the ability to effectively modify or adjust one's coping strategies according to the demands of different stressful situations. It includes the abilities to:

- recognise whether the use of a flexible coping strategy is appropriate for a specific situation
- select a coping strategy that suits the situational circumstances
- recognise when the coping strategy being used is ineffective
- discontinue an ineffective coping strategy
- produce and implement an alternative coping strategy when required.

Coping flexibility is considered to be an adaptive personality attribute that enables us to adjust our thoughts, feelings or behaviour according to changing situational circumstances. Adaptability in our approach to coping helps ensure we are more able to meet the specific challenges of a variety of stressful situations, most of which occur within the context of an ever-changing environment (Cheng, 2001; Kato, 2015).

There are individual differences in coping flexibility. Some individuals have a higher level of coping flexibility than others.

Individuals with *high coping flexibility* readily adjust their coping strategies if a particular strategy they are using is proving to be ineffective. They also tend to use different types of coping strategies across a variety of stressful situations, and there tends to be a good fit between the coping strategies they deploy and the characteristics of the specific situational demands.

In contrast, individuals with *low coping flexibility* consistently use the same type of coping strategies across different stressful situations, and persist in their use of the coping strategies they deploy, even in the face of ineffectiveness. Essentially, these individuals are not very adaptable and always approach coping in much the same way, almost habitually (Cheng & Cheung, 2005; Kato, 2012).

Consider the example of coping flexibility by Ally who has just separated from her husband and is consequently very distressed. Ally typically finds going to church relaxing, uplifting and inspiring, so she selects this as her coping strategy and increases her church attendance to three times per week. However, after attending church on five occasions, Ally is still very distressed. She evaluates her situation and realises that attending church has not reduced her stress enough so she needs to adapt and consider alternative strategies. Ally therefore arranges to cut back on church attendance and use the time to meet with compassionate friends. She will go to a movie with one friend and to a yoga class with another. Ally has been self-monitoring her coping progress and after going out with her friends realises that these strategies, in conjunction with church attendance, are proving to be effective, so she starts to think more positively about herself and her situation.

As can be reasonably expected, individuals with high coping flexibility tend to cope more effectively with stress and are more likely to achieve positive outcomes from the coping strategies they deploy than are individuals with low coping flexibility. Coping flexibility with a good strategy–situation fit is related to adaptive outcomes, such as mental wellbeing, physical wellbeing, social adjustment and reduced stress symptoms (Cheng & Cheung, 2005).

The concept of coping flexibility originates in the Lazarus and Folkman's Transactional Model of Stress and Coping. The model describes coping as a process that is responsive to situational changes rather than one that remains relatively stable across situations. More specifically, individuals take into account the contextual characteristics of the stressful situation and appraise whether the outcome is controllable. This type of appraisal guides their choice and use of coping strategies to meet specific situational demands (Cheng et al., 2014).

Figure 3.21 People who have high coping flexibility readily change or adjust their coping strategy if a particular strategy they are using is ineffective.

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Access learnON to complete the Coping Flexibility Scale.

3.9.3 Approach and avoidance coping strategies

Strategies people use to cope with difficult or stressful circumstances in their lives have been organised into different categories. One classification system distinguishes between approach and avoidance strategies.

In this system, the terms 'approach' and 'avoidance' are used to refer to the orientation or focus of an individual's activity either toward or away from the stressor. The aim of both approach and avoidance strategies is to reduce stress levels and increase the ability to cope, but the method in which this is achieved differs (Billings & Moos, 1981; Roth & Cohen, 1986).

Approach coping strategies involve efforts to confront a stressor and deal directly with it and its effects. Activity is focused *towards* the stressor, its causes and a solution that will address the underlying problem, issue or concern and minimise or eliminate its impact.

For example, an approach strategy for a stressor involving loss of a job through retrenchment is to search for a new job. Similarly, stress due to an upcoming exam might involve an approach effort that targets working harder and spending more time studying while maintaining a healthy lifestyle.

Stress due to a chronic pain condition might involve trying to seek more information about the condition, working out the triggers for flare-ups and identifying alternative treatment options.

Avoidance coping strategies involve efforts that evade a stressor and deal indirectly with it and its effects. Activity is focused *away* from the stressor and there is no attempt to actively confront the stressor and its causes.

For example, an avoidance strategy for a job loss stressor may be to not tell anyone and not think about it. For stress due to an upcoming exam a strategy might involve 'preparing for the worst' or indirectly reducing the tension by such behaviour as eating more or playing video games. An avoidance strategy for stress due to pain might involve trying to ignore the pain through distraction or attempting to avoid increasing the pain.

Table 3.1 includes additional examples of approach and avoidance strategies. Note that avoidance-oriented coping includes strategies that involve behavioural or emotional *disengagement* (e.g. 'I stop trying', 'I pretend it isn't real'), whereas approach-oriented coping includes strategies that involve *engagement* with the stressor (e.g. 'I try to find out more information', 'I consider several alternatives for handling it').

Table 3.1 Examples of approach and avoidance strategies

Approach strategies	Avoidance strategies
• 'I try to find out more information.' • 'I consider several alternatives for handling it.' • 'I try to think about it in a more positive way.' • 'I try to step back from the situation and be more objective about it and what I might be able to do.' • 'I ask a professional person for advice and follow it.' • 'I take steps to eliminate the cause.' • 'I make a plan of action and I follow it.' • 'I draw on my past experiences in similar situations.' • 'I will try to find a way of controlling the situation.' • 'I accept the reality of the situation and deal with it.'	• 'I stop trying.' • 'I pretend it isn't real or doesn't exist.' • 'I accept the death and know that I must make the funeral arrangements, but I try to not think about it.' • 'I change the subject.' • 'I use alcohol or drugs to feel better.' • 'I yell a lot at other people even though I don't mean to.' • 'I try to distract myself with other activities.' • 'I avoid people and situations that remind me of it.' • 'I sleep more than usual.' • 'I go on an eating binge.'

3.9.4 Comparing effectiveness of approach and avoidance strategies

Approach coping strategies are generally considered to be more adaptive and effective than avoidance strategies. For example, research studies have found that people who rely more on approach strategies to cope with a stressor tend to experience fewer psychological symptoms and are more able to function effectively compared to people who rely more on avoidance strategies.

In addition, excessive reliance on avoidance strategies tends to be associated with a number of negative consequences, such as an increase in vulnerability to mental health problems and stress-related physical problems, such as hypertension and cardiovascular disease. Long-term use of avoidance strategies can also contribute to other problems. For example, one study of adolescents found that those who relied on avoidance coping strategies were more likely to engage in socially inappropriate or illegal behaviours, including substance use (Cooper et al., 2003; Mund & Mitte, 2011).

Although avoidance coping strategies tend to be maladaptive, this does not mean that all avoidance coping strategies are maladaptive or ineffective, or always maladaptive or ineffective. For example, when coping with a number of stressors at the one time, selectively avoiding to deal with unchangeable aspects of a stressor by 'switching off' may be considered an adaptive strategy. This allows for the conservation of energy to focus on other stressors that can be changed. Disengagement, for example, might be appropriate in a situation where nothing can be done (such as awaiting the outcome of an important medical test), but might be detrimental when action is needed (such as seeking medical attention for a serious health problem).

In addition, avoidance strategies can be more effective in coping with stress in the *short term*. For example, many students find preparing for exams very stressful. In this situation, using avoidance strategies such as listening to music, playing a video game or going to a movie can all decrease stress. Similarly, ignoring a relationship problem for a couple of days while focusing on an important priority at work can also provide 'time out' from one stressor while minimising potential stress from another source, such as the workplace. However, these avoidance strategies are only helpful in the short term and their *long-term* use can prevent people from responding to stressors in constructive ways.

A delay in dealing with a stressor can also have negative consequences. For example, not thinking about an exam until the night before can provide stress-free time, but waiting until the last moment to study can make that study period more stressful than it might have been and may also have negative consequences for future achievement if spending less time studying does not allow for proper exam preparation.

Figure 3.22 If experiencing stress over job loss, (a) an approach strategy would involve effort to confront the stressor and deal directly with it and its effects, whereas (b) an avoidance coping strategy would involve effort that evades the stressor and deals indirectly with it and its effects.

Many stressors and stressful situations are actually quite complex, so both approach and avoidance strategies may be used for coping. For example, in some situations, we may first use an avoidance strategy, which allows us to deal with the intense emotions that have been triggered by an especially overwhelming stressor. Then, later on, when we are feeling somewhat better, we can evaluate our situation and use an approach strategy to look for ways of managing the stressor or solutions. Of course, in other situations, the strategies may be used in the opposite order.

FIGURE 3.23 Use of avoidance strategies can be effective in the short term by reducing distress, anxiety and preventing stressors from becoming overwhelming. However, long-term use of avoidance strategies may increase the risk of experiencing negative physical and/or mental effects of the stressor and ultimately delay, prevent or interfere with its resolution.

on Resources

Weblink *Psychology Today* article on recognising avoidance coping

3.9 LEARNING ACTIVITY 1

Review

1. Explain the meaning of coping in relation to a stress response.
2. a. Explain the meaning of context-specific effectiveness in relation to coping strategies.
   b. Which elements of a stressful situation are relevant to context-specific effectiveness?
   c. Give an example of a stressful situation in which context-specific effectiveness is
      i. demonstrated
      ii. not demonstrated.

3. a. Explain the meaning of coping flexibility with reference to an example involving:
   i. high coping flexibility
   ii. low coping flexibility.
   b. What is a potential benefit of coping flexibility?
4. Describe the relationship between context-specific effectiveness and coping flexibility.
5. a. Complete the following table to summarise approach and avoidance coping strategies. Include two of your own examples for each strategy.

Coping strategy	Description	Key features	Examples
approach			
avoidance			

   b. Explain why approach strategies are considered to be more adaptive than avoidance strategies, especially when considered from a long-term perspective.
   c. Give an example of when an avoidance strategy may be considered adaptive.
   d. Are approach and avoidance strategies mutually exclusive and therefore unable to be used together? Explain with reference to an example.
   e. Explain whether each of the following stress coping strategies involves approach, avoidance or both.
   i. meditating
   ii. praying for guidance or strength
   iii. procrastination
   iv. waiting until an appropriate opportunity presents itself before taking action
   v. seeking social support from a friend
   vi. seeking advice from a friend
   vii. exercise.
   f. Consider the cartoon depicting a coping strategy.

   i. Explain whether the cartoon depicts use of approach or avoidance.
   ii. What is an advantage and a disadvantage of using this type of strategy in both the short and long term?

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3.9 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.6; ©VCAA

Dakota decided to purchase a second surfboard in preparation for an upcoming competition. When it arrived, she noticed that it was damaged and she was informed that a replacement would not be available until after the competition.

Which one of the following could be an effective approach coping strategy that Dakota could use while preparing for the surfing competition?

A. Research other shops to find an appropriate replacement surfboard.
B. Discuss and complain about the situation with her family and friends.
C. Exercise by going for a long run to take her mind off the competition.
D. Play hours of video games that use different surfing scenarios to pass the time.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.44 (adapted); ©VCAA

Over a few months, Marguerite experienced significant issues with her boss at work. Marguerite is usually very optimistic and positive but her problems with her boss were making her very unhappy. She could not think of any solution. Marguerite discussed the situation with her partner, who had noticed a significant change in her attitude. Her partner suggested that she join him at the gym to help manage her stress.

An appropriate coping strategy that Marguerite could use, that has context-specific effectiveness, would be to

A. exercise to help her cope.
B. set a meeting time to speak to her boss directly about the issue.
C. change the subject when her partner begins to discuss the issue.
D. apply a coping strategy that she used successfully to deal with a difficult teacher in the past.

Question 3 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.23; ©VCAA

Rose participated in a television game show about general knowledge. While waiting to go onstage she felt very stressed. At one point she felt so anxious that she left the studio. However, she then decided to return to the studio and study the notes she had prepared earlier.

The coping strategies that Rose used prior to going onstage can be considered to be

A. approach strategies only.
B. avoidance strategies only.
C. exercise and approach strategies.
D. avoidance and approach strategies.

Question 4 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.45; ©VCAA

Oscar and Flynn started attending the same kindergarten at the same time. They had previously attended the same childcare centre together.

Initially, when starting kindergarten, Flynn displayed symptoms of separation anxiety when dropped off in the morning, including crying and clinging to his mother. His heart rate also increased and a rash appeared on his forehead. Once his mother left, however, he quickly settled and enjoyed the activities provided by his kindergarten teacher. After one month of attending kindergarten, Flynn no longer cried or clung to his mother when dropped off and he would quickly settle.

In contrast, when starting kindergarten, Oscar was very excited. He eagerly ran up to the front door of the kindergarten with great enthusiasm. He hesitantly waved goodbye to his mother, but took his kindergarten teacher's hand and settled quickly into the activities provided.

When Flynn is upset, he goes to his teacher and asks for a cuddle. What is Flynn's strategy an example of?

A. meditation
B. biofeedback
C. physical exercise
D. emotion-focused coping

Question 5 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.59; ©VCAA

Susan was delayed on her way to the airport to catch a flight to Sydney for an important business meeting. While she was sitting in a long line of cars, she became worried that she would miss her flight. Her heart started pounding and she could feel herself becoming quite anxious.

Susan decided that she would telephone the branch of her office in Sydney to see if it was possible to delay the meeting.

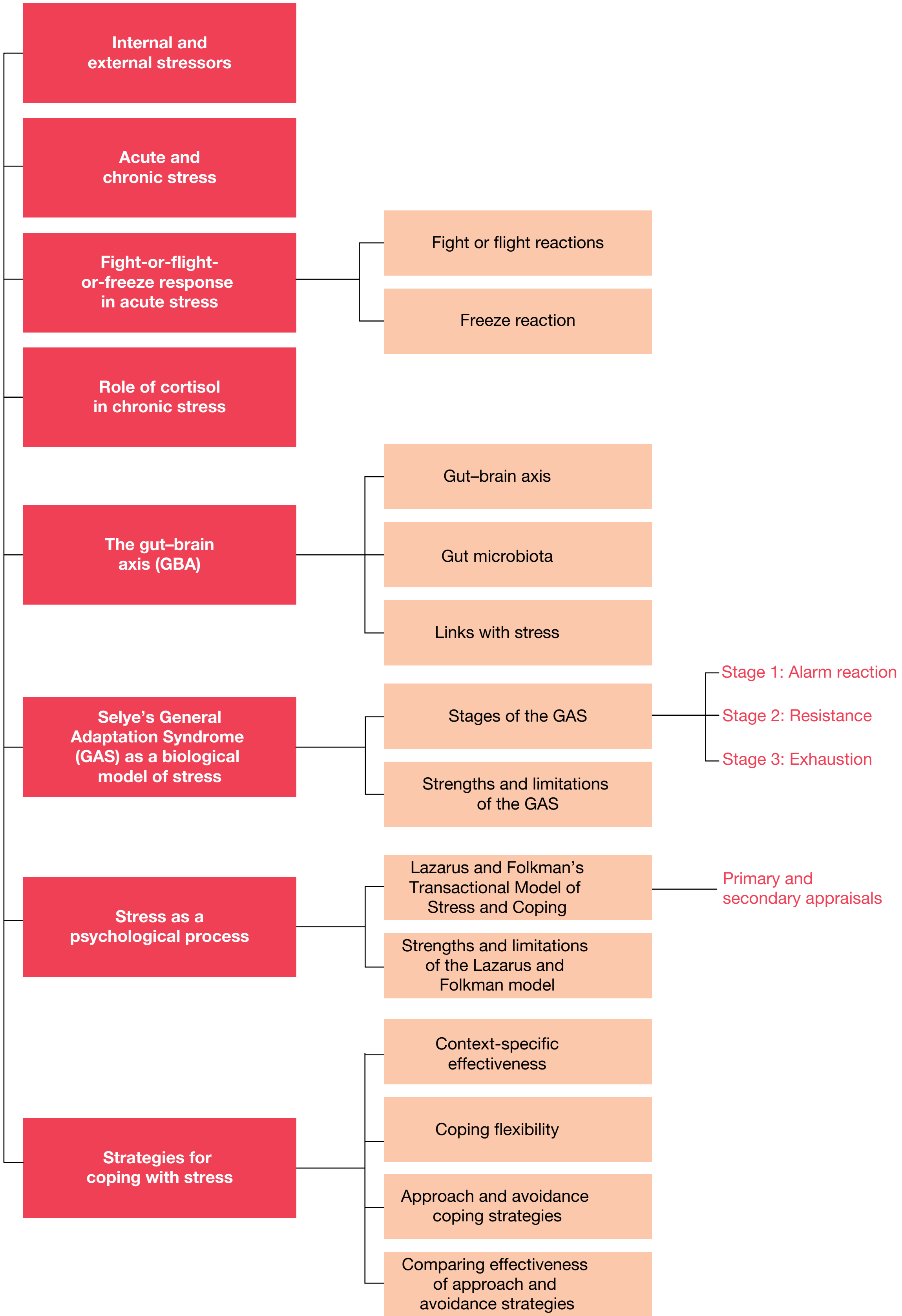
In Lazarus and Folkman's Transactional Model of Stress and Coping, Susan's attempt to delay the meeting was an example of

A. reappraisal.
B. primary appraisal.
C. problem-focused coping.
D. emotion-focused coping.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

3.10 Review

Topic summary



Key terms

acute stress p. 221
adrenaline p. 221
alarm reaction stage p. 239
approach coping strategy p. 255
avoidance coping strategy p. 255
chronic stress p. 221
context-specific effectiveness (for coping) p. 253
coping p. 252
coping flexibility p. 254
coping strategy p. 252
cortisol p. 224
counter shock (in alarm reaction) p. 239
exhaustion stage p. 240
external stressor p. 220
fight-or-flight-or-freeze response p. 223
General Adaptation Syndrome (GAS) p. 238
gut–brain axis (GBA) p. 234
gut microbiota p. 234
internal stressor p. 220
noradrenaline p. 239
primary appraisal p. 247
resistance stage p. 239
secondary appraisal p. 248
shock (in alarm reaction) p. 239
stress p. 218
stress hormone p. 218
stressor p. 218
stress response p. 218
Transactional Model of Stress and Coping p. 245

Note: The **References** for the entire title can be accessed in learnON and are also available as a downloadable PDF.

on Resources

Digital documents: Key terms glossary — Topic 3 (doc-37985)
Topic summary — Topic 3 (doc-37986)
Key diagrams PowerPoint — Topic 3 (doc-37988)

Exam question booklet Exam question booklet — (eqb-0127)

3.10 Topic 3 test

Section A: 25 marks **Section B:** 40 marks **Total:** 65 marks

Access learnON to answer the following test questions online and receive **immediate feedback**.

Section A — Multiple-choice questions

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

The fight-or-flight-or-freeze response is a/an _____ response to a threat or emergency causing acute stress.

A. learnt
B. voluntary
C. conscious
D. unconscious

Question 2

The fight reaction in the fight-or-flight-or-freeze response is best described as a form of _____; whereas the freeze reaction is best described as a form of _____ behaviour.

A. active avoidance; hypervigilant
B. active avoidance; passive avoidance
C. attacking; passive avoidance
D. attacking; active avoidance

Question 3

The stress hormone _____ which is secreted from the _____ initially readies the body for fight, flight or freeze.

A. cortisol; adrenal glands
B. adrenaline; adrenal glands
C. noradrenaline; hypothalamus
D. adrenaline; pituitary gland

Question4

A benefit of the fight-or-flight-or-freeze response is that

A. it enables an organism to successfully adapt to all types of situations.
B. the body is quickly energised to react to a threat or emergency.
C. it prevents organisms from being harmed by stressors that are threatening.
D. the organism has three choices for responding to a threat or emergency.

Question 5

Which of the following potential stressors would be classified as having an internal source?

A. travelling in an overcrowded peak hour train
B. being refused entry to an important exam for being late
C. achieving a lower grade than expected for a SAC
D. being bullied by another student

Question 6

Which of the following is a part of the physiological stress response?

A. HPA axis
B. appraisal of a stressor
C. appraisal of coping resources
D. approach and avoidance strategies

Question 7

Which of the following is an example of an approach coping strategy?

A. 'I exercise more.'
B. 'I eat.'
C. 'I sleep more.'
D. 'I get busy with other things to keep my mind off it.'

Question 8

Coping refers to the

A. product of stress.
B. typical biological reaction to stress.
C. typical psychological reaction to stress.
D. process of dealing with stress.

Question 9

The opposite of a fight-or-flight response to a stressor is

A. a freeze reaction.
B. an arousal state.
C. sympathetic nervous system activation.
D. a gut–brain communication failure.

Question 10

The most immediate effect of adrenaline and noradrenaline secretion is

A. arousal.
B. immobility.
C. relaxation.
D. energy conservation.

Question 11

An elevated level of cortisol in the blood stream for a prolonged period due to a chronic stressor may

A. maintain the parasympathetic nervous system in an active state.
B. deplete the body of all its hormones.
C. contribute to a breakdown in the functioning of the immune system.
D. deplete the body's resources and lead to long-term illness or disease.

Question 12

Acute and chronic stress are best distinguished by the _____ of the stressor.

A. duration
B. severity
C. source
D. type

Question 13

The type of relationship between a stressor and stress is best described as

A. causal.
B. positive.
C. correlational.
D. psychological.

Question 14

Acute stress is typically a _____ state of arousal, whereas chronic stress is a _____ state of arousal.

A. long-term; short-term
B. non-harmful; harmful
C. minor; major
D. temporary; continuous

Question 15

After overcoming the initial blow of finding that her mobile phone was stolen, Sam sees the year level coordinator and becomes actively involved in seeking witnesses to the incident. At this point, Sam is most likely in the _____ stage of the General Adaptation Syndrome.

A. shock
B. counter shock
C. resistance
D. exhaustion

Question 16

The gut–brain axis

A. provides communication links between the brain and digestive tract.
B. coordinates stress-induced changes in the gut and brain.
C. continually adjusts the gut microbiota balance.
D. is a natural habitat for gut microbiota.

Question 17

The term _____ is commonly used to describe the entire population of gut microbiota in an organism.

A. enterotype
B. microbiome
C. gut microbiome
D. gut dysbiosis

Question 18

Which statement about gut microbiota is correct?

A. Gut microbiota are gut microorganisms that have died.
B. Gut microbiota can influence gut activity but not brain activity.
C. Gut microbiota in any individual is stable throughout the life span.
D. Each individual has a unique combination of gut microbiota.

Question 19

Which term refers to the entire population of microbiota in and on a living organism's body?

A. microbiome
B. enterotype
C. gut dysbiosis
D. gut microbiome

Question 20

Which of the following statements about the gut–brain axis and stress is not correct?

A. Stress can disturb the balance of gut microbiota.
B. Gut microbiota can influence stress responses.
C. There are bidirectional links between the gut microbiota and stress.
D. The gut microbiome tends to be relatively unaffected by stress.

Question 21

The stage of Selye's General Adaptation Syndrome in which an organism initially responds to a stressor is called

A. resistance.
B. exhaustion.
C. counter shock.
D. alarm reaction.

Question 22

Which of the following is an example of secondary appraisal according to the Lazarus and Folkman Transactional Model of Stress and Coping?

A. making a judgment about whether a situation is actually stressful
B. minimising harm or loss that may occur
C. estimating the value of coping options and resources that may be accessed
D. minimising harm or loss that has occurred

Question 23

According to the Lazarus and Folkman Transactional Model of Stress and Coping, stress is

A. a product of appraisal.
B. a product of arousal.
C. a biological response to a stressor.
D. an environmental response to a stressor.

Question 24

Which of the following is an example of primary appraisal according to the Lazarus and Folkman Transactional Model of Stress and Coping?

A. determining the extent to which additional resources are needed to cope
B. evaluating the potential impact of the stressor
C. judging the usefulness of coping resources that are available
D. any exchange between the individual and the environment

Question 25

In the Lazarus and Folkman model, appraisal is best described as a/an _____ process.

A. biological
B. cognitive
C. emotional
D. environmental

Section B — Short answer questions

Question 1 (2 marks)

Define the meaning of stress.

Question 2 (3 marks)

a. Describe the role of appraisal in the Lazarus and Folkman Transactional Model of Stress and Coping. 1 mark
b. What is a strength and a limitation of the transactional model? 2 marks

Question 3 (4 marks)

Your friend tells you about a scary movie about killer cockroaches she watched last night. In one scene, a cockroach came around the corner and confronted a young woman who was waiting for a late night bus. She saw the ferocious-looking ‘monster’, but did nothing. She did not run. Nor did she scream. She just stood there ‘scared stiff’ with a look of horror on her face until the cockroach approached and ate her. Your friend screamed as she thought the woman was stupid because she should have run or at least done something. Your friend has seen this failure to respond in some other horror movies and is confused. She knows you are studying psychology and wonders if you can offer an explanation.

a. What term would psychologists use to describe the woman’s response? 1 mark
b. Would they describe it as a voluntary or involuntary response? 1 mark
c. What is a psychobiological explanation of the response? 2 marks

Question 4 (7 marks)

A research study measuring the effectiveness of a stress management course used cortisol level as their dependent variable.

a. Explain whether cortisol level is a valid dependent variable for this study. 2 marks
b. If the stress management course was effective, what would happen to the participants’ cortisol levels? 1 mark
c. What are two potential benefits and two potential harmful effects of cortisol when stressed? 4 marks

Question 5 (4 marks)

a. Jack usually takes the stairs at work because he gets anxious in a crowded elevator. One morning, when late for work, he notices the elevator is empty and decides to take it. The elevator jams and he is told over the emergency phone that it will take 'quite a while' to repair. He focuses on remaining as calm as possible and decides to use the spare time to review the report in the document he is carrying.
Explain whether Jack is using approach and/or avoidance to cope with the stress of being stuck in an elevator. 2 marks

b. Ramij suffers migraines and always takes her medication as soon as she notices a migraine coming on.
Explain whether Ramij is using an approach or avoidance coping strategy. 2 marks

Question 6 (5 marks)

a. Explain the meaning of coping flexibility. 2 marks

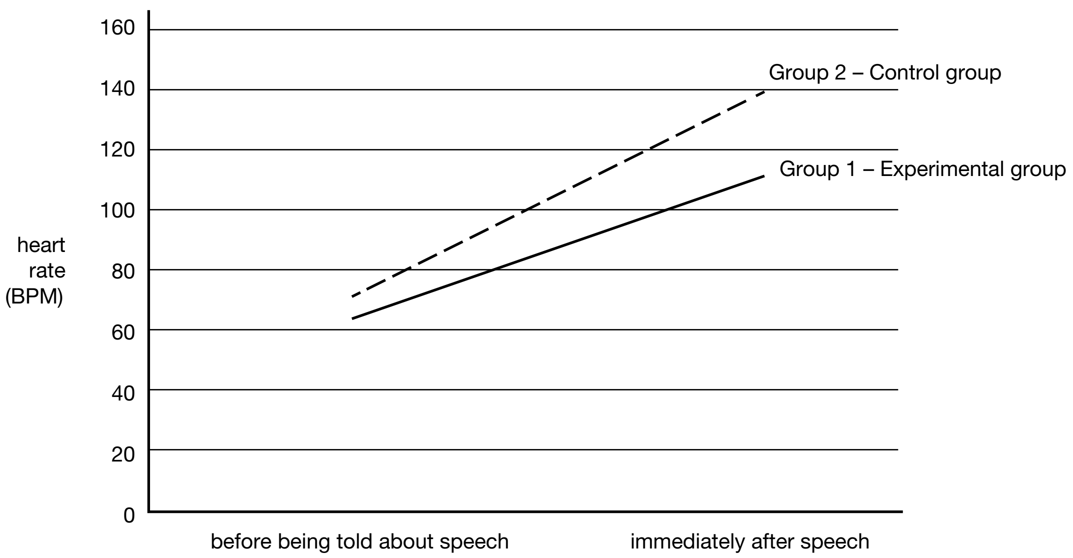
b. Explain how coping flexibility can influence context-specific effectiveness of coping. 3 marks

Question 7 (15 marks)

Source: VCAA 2020 Psychology, Section B, Q.2; ©VCAA

For his Psychology practical investigation, Peter decided to examine whether information about the positive effects of stress could affect stress levels during public speaking. His participants were 20 newly appointed volunteer leaders at a local organisation. Peter randomly assigned participants to one of two groups. Participants in the experimental group were told they would be recorded giving a five-minute speech one week later and were shown a brief presentation outlining how stress can improve performance. They were told not to discuss this presentation with participants in the other group. Participants in the control group were only told they would be giving a five-minute speech one week later and that their speech would be recorded. The heart rate of participants in both groups was measured prior to them being told about the five-minute speech, in order to provide a baseline, and one week later, immediately after giving the five-minute speech. Means for the two measurements for each group were calculated. The results are shown in the graph below.

Mean baseline heart rate compared to mean post-speech heart rate



a. Write a possible research hypothesis for Peter's experiment. 3 marks

b. In terms of the nervous system, why would heart rate be used as a measure in this experiment? 3 marks

c. Using Lazarus and Folkman's Transactional Model of Stress and Coping, identify the most likely secondary appraisal made by participants in the experimental group and by participants in the control group. Justify your response with reference to the graph and the independent variable. 6 marks

- **Group 1 – Experimental group**
  Secondary appraisal
  Justification
- **Group 2 – Control group**
  Secondary appraisal
  Justification

d. At the conclusion of his practical investigation, Peter realises that, entirely by chance, seven participants allocated to the experimental group were members of the region's high-performing basketball team whereas the control group contained only one participant who was an athlete. Explain the problem created by this uneven allocation of athletes between groups, identifying the type of variable involved. 3 marks

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on Resources

Go to learnON to access answers to the Topic 3 test. A customisable Word version of the test can also be downloaded from the **Digital documents** tab of the Resources panel.

learnMORE | Some disorders and diseases associated with chronic stress

Disorder/disease	Description
Hypertension (abnormally high blood pressure)	Blood pressure measures how strongly blood presses against the walls of arteries (i.e. large blood vessels) as it is pumped around the body by the heart. If this pressure is too high it puts a strain on the arteries and the heart, which increases the likelihood of heart attack, stroke or kidney disease.
Immunodeficiency disorders	Immunodeficiency disorders occur when the body's immune response is reduced or absent. The immune system helps protect the body from harmful substances such as bacteria, viruses, toxins and cancer cells. If the body is unable to protect itself against harmful substances it will experience persistent, recurrent infections and/or experience a delay or incomplete recovery from illness.
Atherosclerosis ('hardening of the arteries')	Atherosclerosis occurs when fat, cholesterol and other substances build up in the walls of arteries and form hard structures called 'plaques'. These plaques make it harder for blood to flow through the arteries. Restricted blood flow can damage organs and stop them from functioning properly. If a plaque ruptures, it can lead to a blood clot that blocks the blood supply to the heart, triggering a heart attack, or to the brain, triggering a stroke (i.e. a serious medical condition that occurs when the blood supply to the brain is disturbed or interrupted).
Cardiovascular disease	Cardiovascular disease is a category of diseases that involve the heart or blood vessels (arteries and veins); for example, coronary heart disease, which occurs when the main arteries that supply the heart (the coronary arteries) become clogged with plaques. The causes of cardiovascular disease are diverse but atherosclerosis and/or hypertension are the most common.
Cerebrovascular disease	Cerebrovascular diseases are conditions that develop as a result of problems with the blood vessels inside the brain; for example, a stroke, or transient ischaemic attack (i.e. a temporary fall in the blood supply to the brain, resulting in a lack of oxygen to the brain).
Diabetes	Diabetes is a long-term condition involving too much glucose in the blood. This is caused by the pancreas not producing any or enough insulin to help glucose enter the body's cells (or the insulin that is produced does not work properly).

learnMORE | Coping Flexibility Scale

The *Coping Flexibility Scale (CFS)* was developed by Japanese psychologist Tsukasa Kato. The scale is based on the operationalisation of coping flexibility as 'the ability to discontinue an ineffective coping strategy and produce and implement an alternative coping strategy'. The following is a reproduction of the scale.

INSTRUCTIONS

When we feel stressed, we try to cope using various actions and thoughts. The following items describe stress-coping situations. Please indicate how these situations apply to you by choosing one of the following for each situation:

0 = Not applicable; 1 = Somewhat applicable; 2 = Applicable; 3 = Very applicable

1. When a stressful situation has not improved, I try to think of other ways to cope with it.
2. I only use certain ways to cope with stress.
3. When stressed, I use several ways to cope and make the situation better.
4. When I haven't coped with a stressful situation well, I use other ways to cope with that situation.
5. If a stressful situation has not improved, I use other ways to cope with that situation.
6. I am aware of how successful or unsuccessful my attempts to cope with stress have been.
7. I fail to notice when I have been unable to cope with stress.
8. If I feel that I have failed to cope with stress, I change the way in which I deal with stress.
9. After coping with stress, I think about how well my ways of coping with stress worked or did not work.
10. If I have failed to cope with stress, I think of other ways to cope.

To obtain your scores, first reverse the answer values for items 2 and 7. That is, for these two items, 0 = 3, 1 = 2, 2 = 1 and 3 = 0.

Next, sum the answer values for items 2, 6, 7, 8 and 9 to obtain your Evaluation Coping score. Then sum the answer values for items 1, 3, 4, 5, and 10 to obtain your Adaptive Coping score. Evaluation coping refers to your tendency to abandon ineffective strategies. Adaptive coping refers to your tendency to consider and create alternative coping strategies.

Kato (2012) found a mean of 10.10 (sd = 3.12) for Evaluation Coping and a mean of 7.29 (sd = 3.20) for Adaptive Coping in a sample of Japanese college students.

Source: Kato, T. (2012). Development of the Coping Flexibility Scale: Evidence for the coping flexibility hypothesis. *Journal of Counseling Psychology, 59*, 262–273.

4 Approaches to understand learning

TOPIC CONTENT

4.1 Overview

KEY KNOWLEDGE

- behaviourist approaches to learning, as illustrated by classical conditioning as a three-phase process (before conditioning, during conditioning and after conditioning) that results in the involuntary association between a neutral stimulus and unconditioned stimulus to produce a conditioned response, and operant conditioning as a three-phase process (antecedent, behaviour and consequence) involving reinforcement (positive and negative) and punishment (positive and negative)
- social-cognitive approaches to learning, as illustrated by observational learning as a process involving attention, retention, reproduction, motivation and reinforcement
- approaches to learning that situate the learner within a system, as illustrated by Aboriginal and Torres Strait Islander ways of knowing where learning is viewed as being embedded in relationships where the learner is part of a multimodal system of knowledge patterned on Country

Source: ©VCAA *VCE Psychology Study Design: 2023–2027*. p.35.

Can you think of something you do that you did not learn? It's a difficult task because learning is involved in nearly all our behaviours. Except for a range of physiological responses that are involuntary and normally occur automatically without conscious awareness, such as blinking, breathing, digesting food and secreting hormones, most of what you do each day depends to a large degree on learning. For example, behaviours such as, checking social media, texting a friend and undertaking the VCE all depend on learning in a significant way.

Your attitudes, values, beliefs, opinions, interests and decisions also involve learning. Knowing how to read a timetable, the quickest way home from school and how to subtract 1 from 2 all involve learning. Many of our emotions are also learned or influenced significantly by learning. And as you learnt in topic 2, if we could not learn, there would be nothing to remember.

Learning is such an integral part of daily living that without the ability to learn from an early age, people would be unable to live independently and would need constant care in order to survive. However, there are also unlearned behaviours, often involving very simple responses, that are also important in everyday life.

Learning is commonly defined as a relatively permanent change in behaviour that occurs as a result of experience. Learning new behaviour or anything else is an ongoing process that continues throughout the life span, enabling us to adapt and cope in an ever-changing world.

Learning can occur *intentionally*, such as when someone takes piano lessons, or *unintentionally*, such as while watching or hearing someone else playing the piano. Similarly, learning can be *active*, such as reciting multiplication tables, or *passive*, such as when hearing about Australia's performance in the Olympic Games.

The concept of *change* is an important part of the definition of learning, because something must be different about an organism after learning has taken place. The change in behaviour may be immediate (e.g. changing a tennis serve immediately after a coach suggests a way to improve it), or it may be delayed and actually occur some time after learning has taken place (e.g changing a tennis serve the next time you play tennis after watching an instructional video). Furthermore, the change may be possible but not evident because of a lack of opportunity (e.g. by watching a tennis pro serving on TV you know how to improve your serve but you never again play tennis). Consequently, learning refers to the potential to behave in a particular way, as well as behaviour that is observed to take place.

Learned behaviour is also defined as relatively *permanent* because it cannot be something that is present one moment and gone the next, or 'here today and gone tomorrow'. It must be stored in long-term memory and have a continuing or lasting effect for a time, but it does not necessarily have to produce a permanent (lifelong) change. Thus, information you recalled when correctly answering a question in a test is said to have been learned even if you can't recall that information now.

Learning is regarded as *relatively* permanent because most, if not all, learned behaviours can be modified.

For example, someone who has learned to fear spiders to the extent that the sight of any spider in any context is distressing can subsequently learn to respond differently to them, possibly to not fear them.

Temporary changes in behaviour that are caused by illness, prescription and illegal drugs, injury, fatigue and alcohol are not classified as learning. Such changes in behaviour tend to be brief compared with those that result from learning. For example, the effects on behaviour of a sleepless night will typically wear off after a night or two of rest. Similarly, the effects of medication will usually disappear after a certain period.

Approaches to learning

Psychologists have developed many different models and theories to describe and explain human learning. Most of these are based on studies involving observations of the learning experiences of animals in laboratory experiments. Through such studies, psychologists have identified many principles of learning that apply across a wide range of species, including humans.

When considered collectively, the models and theories indicate that there are many ways in which we learn and that different types of learning share common elements. They also suggest that how we learn can vary from situation to situation and from individual to individual. We may also shift between different types of learning depending on personal factors, what we are learning and the context in which the learning is occurring.

One of the most basic types of learning involves linking stimuli (or 'events') that occur close together through a process called *conditioning*. For example, learning to associate thunder with impending bad weather, a smile with friendly behaviour, sugar with a sweet taste, mould with food that should be avoided, and working at a supermarket with getting paid.

All of these involve learning through conditioning by associating events that have occurred together on a number of occasions. In some cases, only a single experience is sufficient for the learning to occur. Importantly, these associations influence our behaviour as certain kinds of experiences with stimuli make particular actions (or 'responses') more or less likely.

The term 'conditioning' is often used interchangeably with 'learning', but conditioning is more to do with the learning process; that is, *how* the learning occurs. As well as being considered as an element of other types of learning, conditioning is generally viewed as a type of learning in its own right. Similarly, the terms *conditioned response* and *learned response*

Figure 4.1 Learning involves a relatively permanent change in behaviour that occurs as a result of experience.

may be used interchangeably when a response is learnt through conditioning.

The two main types of conditioning which have been the focus of most research in psychology are classical conditioning and operant conditioning.

Classical conditioning is a relatively simple form of associative learning. In *classical conditioning* we learn that two events go together after we experience them occurring together on a number of occasions; for example, a dial tone and an incoming phone call, and walking in the rain and getting wet.

In *operant conditioning* we learn by forming a three-way association between a specific stimulus, a response and the consequence of the response. Therefore, in response to an upcoming VCE exam (the stimulus), we are likely to repeat behaviour (studying) associated with a satisfying consequence (a good grade). Conversely, the upcoming exam (the stimulus) will also make us more likely to avoid behaviour (partying) associated with an unsatisfying consequence (a bad grade).

Other types of learning that are similar to and different from classical and operant conditioning in varying degrees have also been described and explained. For instance, we can learn by watching and/or listening to others. This is called *observational learning* and reflects the widely held belief that learning involves cognitive processes that often occur in a social context, as well as associations between behaviour and consequences. Unlike classical and operant conditioning, the observational learning model is primarily based on studies with people, particularly children.

Another approach to learning prescribed for study in VCE Psychology 'situates the learner within a system'. This is illustrated by Aboriginal and Torres Strait Islander peoples' ways of knowing and learning that are tied to their relationships with people and Country.

Classical conditioning

Learning through association

Operant conditioning

Learning is influenced by consequences

Observational learning

Learning through watching

Aboriginal and Torres Strait Islander peoples

Learning through relationships with people and country

Figure 4.2 Four ways of learning

4.1 LEARNING ACTIVITY

Review

1. a. Define the meaning of learning.
   b. List five characteristics of learned behaviour.
2. Give an example of a response you may have learned through conditioning, but not an example used in the text.
3. Although learning accounts for most of the behaviour observed in people and animals, not all behaviour has to be learned. For example, reflexes are one type of human behaviour that are not dependent on learning.
   a. Differentiate between learned behaviour and reflexive behaviour with reference to the role of experience and an example.
   b. What is another type of behaviour that is not dependent on learning? Explain with reference to an example.
   c. Explain whether reflexive behaviour and the behaviour described for b. above can be influenced by learning.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

4.2 Behaviourist approaches to learning

Throughout the history of psychology there have been various perspectives on its subject matter, each with different theories and approaches to the study of behaviour or mental processes. These perspectives have traditionally been called ‘schools of thought’ or ‘schools of psychology’. One of these approaches was labelled *behaviourism*. It emerged as a major influence in psychology in the early twentieth century, particularly through its theories on learning and how it occurs.

Behaviourist approaches to learning emphasise the study of observable behaviour alone to understand and explain learning, without regard to underlying mental processes and states such as thoughts, feelings, motives and consciousness.

According to strict behaviourists, mental processes are not directly observable, far too subjective and overly reliant on self-reports and qualitative data. In contrast, observable behaviour can be objectively measured and confirmed by other researchers.

Behaviourist approaches also emphasise the roles of conditioning and environmental stimuli in learning. Learning basically occurs through interaction with the environment, which is the source of rewards and punishments. Almost everything a person (or animal) does is influenced by experience with rewards and punishments in everyday life.

We tend to repeat behaviours that we find rewarding in some way and avoid or not repeat behaviours we associate with punishment. In this sense, our actions are shaped and controlled by the environment because this is the source of rewards and punishments.

Classical conditioning and operant conditioning are the two predominant behaviourist approaches to explaining how learning occurs.

Figure 4.3 John B. Watson (1878-1958), the founder of behaviourism. He believed that any person could be ‘trained’ to do anything regardless of their ‘talents, penchants, tendencies, abilities, vocations, and race’. It simply required the right type of conditioning. In 1920, Watson published a report on one of the most controversial experiments in psychology in which he and his student demonstrated the conditioning of a fear response in ‘Little Albert’, a 9-month-old infant. The famous experiment is described in topic 9.

4.2 LEARNING ACTIVITY

Multiple-choice questions

1. The phrase 'approach to learning' may be used interchangeably with
   A. view of learning.
   B. theory of learning.
   C. school of thought on learning.
   D. All of the above are correct.
2. The behaviourist approach to learning is also referred to as
   A. behaviourism.
   B. observable behaviour.
   C. learning within a system.
   D. a way of knowing.
   E. All of the above are correct.
3. The behaviourist approach to learning emerged in the early _____ century.
   A. 18^{th}
   B. 19^{th}
   C. 20^{th}
   D. 21^{st}
4. Behaviourist approaches emphasise learning through
   A. observable behaviour.
   B. cognitive processes.
   C. ways of knowing.
   D. associating different stimuli.
5. According to the behaviourist approach, which of the following has the most important influence on learning?
   A. observable behaviour
   B. cognitive processes
   C. interaction with the environment
   D. All of the above are correct

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

4.3 Classical conditioning as a three-phase process

What do the following three people have in common: Annie, a former cigarette smoker who always has the urge to light up a cigarette whenever she has coffee; Samir, who will no longer travel anywhere by plane after his previous two interstate flights were caught in a violent thunderstorm; and Jack, who broke up with his girlfriend a year ago but still feels sad whenever he catches sight of her? The answer is classical conditioning. Annie, Samir and Jack have all changed their behaviour by learning through classical conditioning, sometimes called *respondent conditioning*.

Classical conditioning was first described by Russian physiologist Ivan Pavlov in 1899 while he was conducting research into the digestive system of dogs. Pavlov was particularly interested in the role of salivary secretions in the digestion of food and was awarded the Nobel Prize in Physiology or Medicine in 1904 for his work in this field. He used apparatus like that shown in Figure 4.4 to measure the amount of saliva produced when a dog ate. The flow of saliva occurred naturally whenever food (meat powder)

Figure 4.4 This sketch shows the simple apparatus used by Pavlov to collect the dog's saliva in his initial experiments.

was placed in the dog's mouth, as salivation is an involuntary reflex response.

To minimise the influence of potential confounding variables, the dog was restrained in a harness that held it in the desired position (as shown in Figure 4.6 below). Food (meat powder) was placed directly on the dog's tongue or in its bowl. A tube was surgically attached to the dog's cheek near one of the salivary glands. As shown in Figure 4.4 on the previous page, this drained saliva straight out into a type of test tube that enabled precise measurements of the amount of saliva secreted.

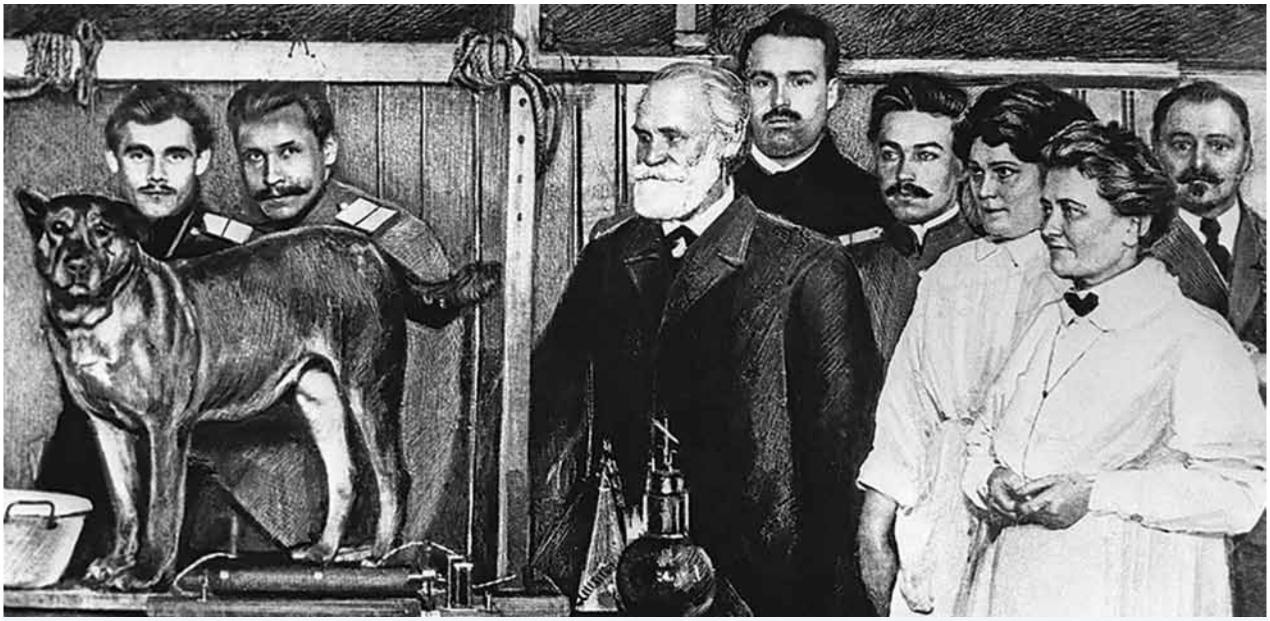

Figure 4.5 Ivan Pavlov (1849–1936) and some of his research colleagues

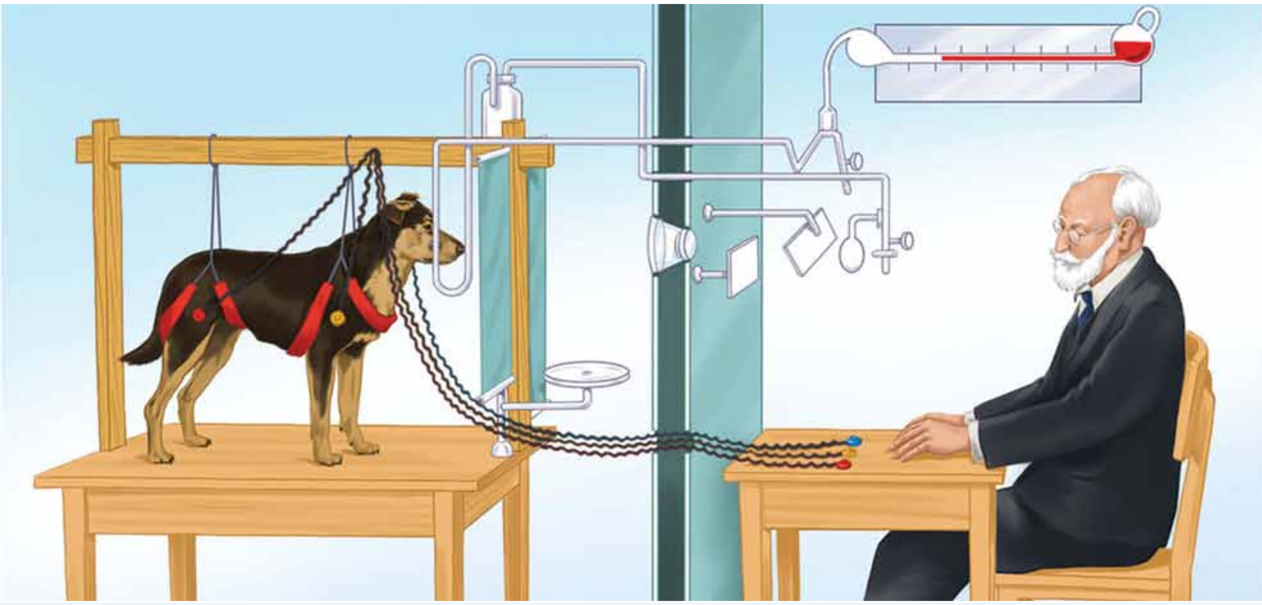

Figure 4.6 This sketch of Pavlov's apparatus is reproduced from one that appeared in his published lectures and shows a more elaborate saliva-measuring device than that used in his earlier experiments (as shown in Figure 4.4)

Resources

Weblink Video on Pavlov's experiments 3 m 54 s

In later experiments, more sophisticated measuring devices were used, some of which measured the rate (speed) of the saliva flow as well as the quantity produced. The dog was observed using a series of mirrors, as shown in Figure 4.6 on the previous page, so that it could not see or be distracted by the observer.

In the course of his research, Pavlov observed that the dogs salivated not only at the sight of the food and when food entered their mouths, but also at the sight or sound of the laboratory assistant who had been preparing their food. For example, the dogs salivated when they heard the rattling sound of the spoon against the container as the food was being prepared.

These unintentional observations intrigued Pavlov and he decided to conduct further experiments under controlled conditions in order to systematically investigate the dogs' behaviour.

Pavlov's subsequent experiments provided clear evidence of a type of learning that occurred through association of two different stimuli. In relation to learning, a **stimulus** is any object or event that elicits (produces) a response from an organism. A **response** is a reaction by an organism to a stimulus.

In Pavlov's experiment, the stimulus of *food* initially produced the response of *salivation*. Eventually, however, the sight or sound of the laboratory assistant became the stimulus that produced the salivation response.

The salivation response is controlled by the autonomic nervous system so it occurs involuntarily. It is a reflex response over which the dog has no control. Salivation had become associated with, and conditioned to, a new stimulus — the sight or sound of the laboratory assistant. This new stimulus was originally a 'neutral' stimulus because it did not produce any specific response other than attention when the laboratory assistant was seen or heard before he was associated with food.

The process through which the dog learned to associate the sight or sound of the laboratory assistant with food is basically the process of classical conditioning.

Classical conditioning (CC) refers to a type of learning that occurs through the repeated association of two (or more) different stimuli. Learning is only said to have occurred when a particular stimulus consistently produces a response that it did not previously produce.

Learning results from the involuntary linking of this stimulus, over a number of trials, with a stimulus that normally produces the response automatically. In classical conditioning, a response that is automatically produced by one stimulus becomes associated, or linked, with another stimulus that would not normally produce this response.

In later experiments, Pavlov varied the stimulus that had been conditioned to test whether it would still produce the same response (salivation). He found that the salivation response could be brought on after repeated associations of the meat powder with a range of different stimuli such as a bell, the musical tone of a tuning fork, a light, a tug on the hind leg or even the sight of a circle.

4.3.1 The three-phase model of classical conditioning

Classical conditioning is often described as a learning process that occurs in a series of three phases or stages — before conditioning, during conditioning and after conditioning.

Five key terms are used to explain the entire process and are applied whenever describing or analysing any simple response or more complex behaviour acquired through classical conditioning. These are known as the unconditioned stimulus, the unconditioned response, the neutral stimulus that becomes a conditioned stimulus, and the conditioned response.

The **unconditioned stimulus (UCS)** is any stimulus that consistently produces a particular, naturally occurring, automatic response. In Pavlov's experiments, the UCS was the food. Another example of a UCS is the placement of a nipple in a newborn infant's mouth. With no learning whatsoever, and assuming it is 'maturationally ready', the infant will automatically commence sucking. This is a naturally occurring, automatic sucking reflex response.

The **unconditioned response (UCR)** is the response that occurs automatically when the UCS is presented. A UCR is a reflexive involuntary response that is predictably caused by a UCS. In Pavlov's experiments, the UCR was the salivation by the dogs to the presence of food. In the example of the newborn infant, the infant's sucking is the UCR to the mother's nipple being placed in its mouth.

The **neutral stimulus (NS)** is any stimulus that does not normally produce a predictable response. In particular, this stimulus is 'neutral' to the UCR. For example, dogs do not normally salivate in response to the ringing of a bell. Pavlov's dogs had to be conditioned to do so through repeated pairing of the bell ring with meat powder, a food stimulus that does produce the particular response.

Through repeated association with the meat powder (UCS), the originally neutral stimulus (the bell ring) becomes a conditioned stimulus that triggers a very similar or identical response to that caused by the UCS. Therefore, the **conditioned stimulus (CS)** is the stimulus that is 'neutral' at the start of the conditioning process but eventually elicits a very similar response to that caused by the UCS — a response that has become a conditioned response.

The **conditioned response (CR)** is the learned response that is produced by the CS. The CR occurs after the NS has been associated with the UCS and has become a CS. The behaviour involved in a CR is

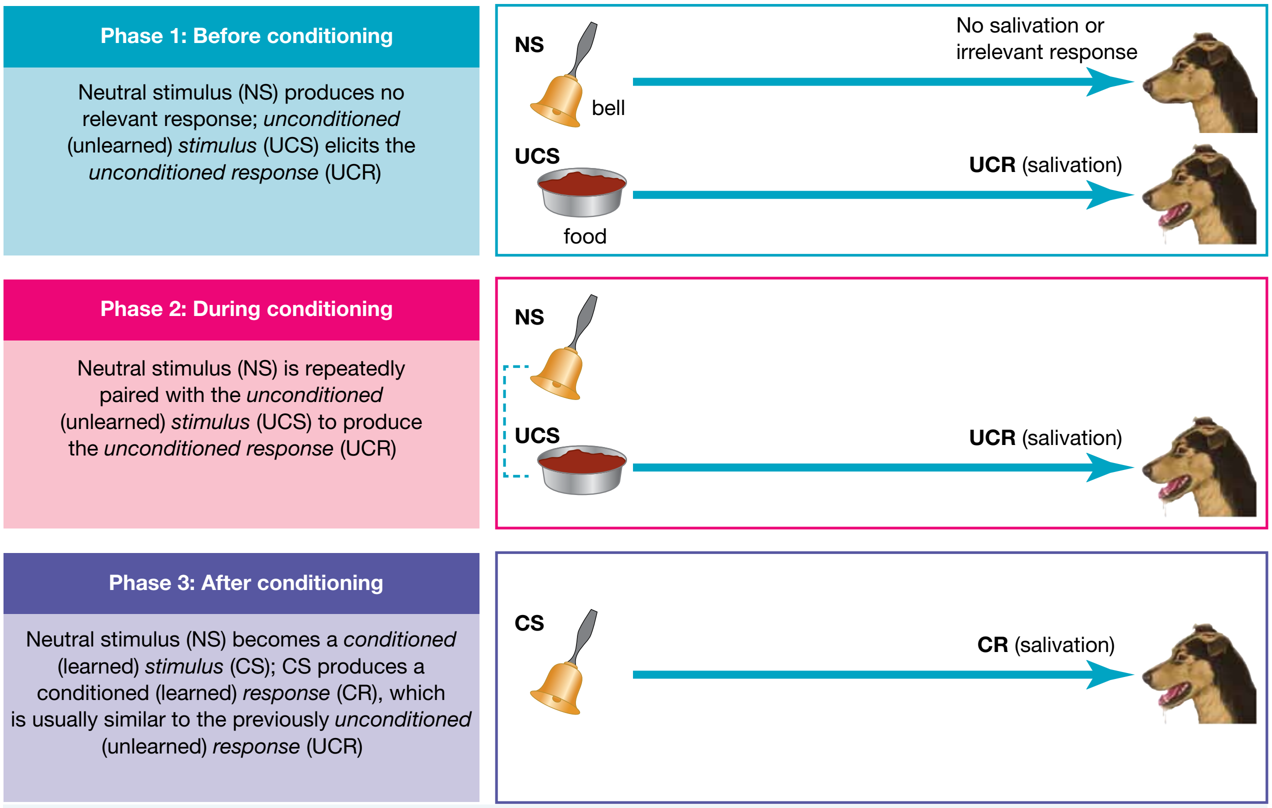

Figure 4.7 The three-phase process of classical conditioning in Pavlov's experiments. Classical conditioning is learning through involuntary paired associations between a neutral stimulus and an unconditioned stimulus to produce a conditioned response. Dogs do not normally salivate in response to the ringing of a bell. Pavlov's dogs had to be conditioned to do so through repeated pairing of the NS (the bell ring) with the UCS (the meat powder), a stimulus that does produce the particular response.

very similar to that of the UCR, but it is triggered by the CS alone.

Pavlov's dogs displayed a CR (salivation) only when they began to salivate to a CS. When a dog responded to a CS such as the sound of a bell, classical conditioning had taken place because salivation would not be a usual response to the sound of a bell. Similarly, we would not expect the newborn infant to begin sucking merely at the sight or smell of the mother's breast unless an association between these stimuli and the feeding process had been made.

The acquisition of the conditioned response is evident in the anticipatory behaviour of the learner. For example, Pavlov's dogs could anticipate the arrival of the meat powder (UCS) by the sound of the bell (CS). Similarly, the newborn infant soon learns to anticipate the arrival of the milk well before the nipple enters their mouth. In bottle-fed babies, this may be even more evident, as they anticipate food at the sight of the bottle, even before it has been filled with milk.

During classical conditioning, each paired presentation of the NS with the UCS is referred to as a *trial*. The term *acquisition* is used to describe the overall process during which an organism learns to associate two events — the NS and the UCS — until the NS alone has become a CS that produces the CR. During acquisition, the presentations of the NS and the UCS occur close together in time and always in the same sequence. The duration of the acquisition stage is usually measured by the number of trials it takes for the CR to be acquired (learned). This may vary considerably. As shown in Figure 4.8 below, the rate of learning is often very fast early in the acquisition period.

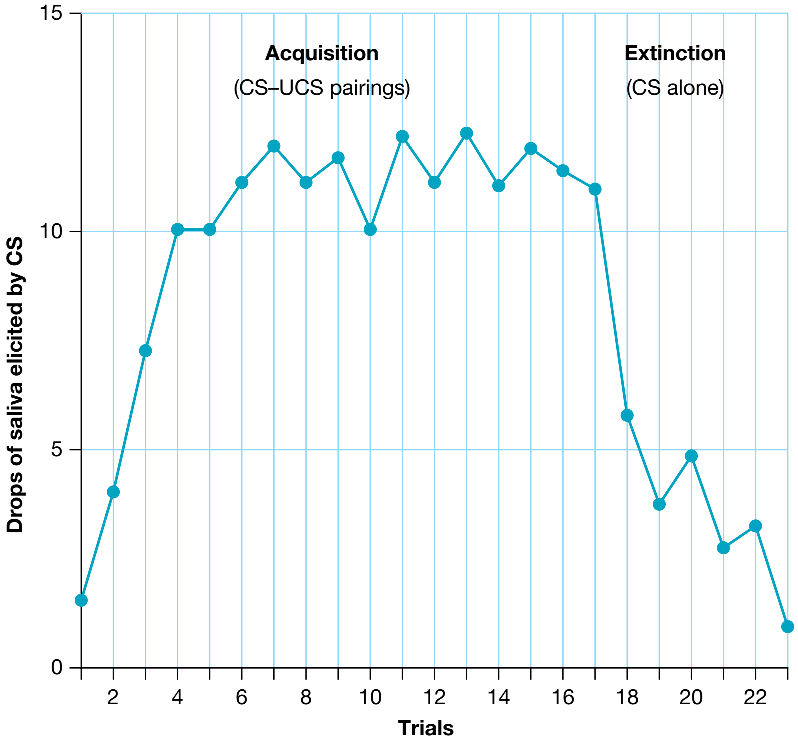

Figure 4.8 The results reported by Pavlov (1927) for one of his experiments. Note the amount of saliva produced by a dog in response to the CS and the UCS during the first 15 trials in the acquisition phase. The strength of the CR rapidly increases then levels off near its maximum. In trials 16 to 22 when the UCS is removed and the CS is presented alone, the CR declines irregularly until extinguished and no longer occurs.

Table 4.1 In models that explain learning through conditioning, the term 'conditioned' simply means 'learned', as described in this summary.

Key term	Learned or not learned
unconditioned stimulus	stimulus that is *not learned*
neutral stimulus	stimulus that is *not learned*
conditioned stimulus	stimulus that is *learned*
unconditioned response	response that is *not learned*
conditioned response	response that is *learned*

4.3.2 Factors that influence classical conditioning

A number of key factors influence learning by classical conditioning. These include the nature of the response, the association or linking of stimuli, and the timing of the stimulus presentation.

Nature of the response

For classical conditioning to occur, the UCR must initially be an automatic or involuntary response, such as a reflex response. In Pavlov's experiments, salivation (UCR) that resulted from the smell or taste of food (UCS) was a reflexive response over which a dog had no control. The behaviour shown in the UCR occurs without the need for prior learning, and the behaviour sometimes serves a protective or survival function.

Pavlov used the term *conditioned reflex* to describe what has since come to be known as a conditioned response. Essentially, classically conditioned responses *are* conditioned reflexes that are acquired through associative learning; that is, they are 'conditional' upon an organism's experience.

Conditioned responses are reflexive in the sense that they are automatic, involuntary and involve little conscious thought or awareness on the part of the organism. For example, when driving a car behind another vehicle, we learn to rely on its brake lights as a signal that the vehicle is slowing down. It does not take long as a driver for us to put our foot on the brake as soon as we see the brake lights illuminated on the vehicle in front. It becomes such an automatic response that we rarely give it much thought.

Figure 4.9 The parrot immediately flew to the fence on sighting the white paper food bags. It has formed an association between the sight of the white bag (CS) and the presentation of food (UCS). This suggests the development of anticipatory behaviour through repeated pairing of the two stimuli.

However, forming and responding to the connection between the brake lights of a car illuminating and that car slowing down (or stopping) is not necessarily without any thought. We may learn to *expect* that a car with illuminated brake lights is slowing down and may stop (or even stop suddenly) in certain situations.

As described previously, conditioned responses are evident in anticipatory behaviour. For example, the behaviour of touching the brake whenever we see the brake lights of the vehicle in front involves anticipatory behaviour in the same way that Pavlov's dog salivated at the sound of the bell or the laboratory technician in anticipation of food (but not at the sound or sight of Pavlov).

Consequently, learning through classical conditioning may be involuntary and relatively simple, but conditioned reflexes or responses acquired through classical conditioning may not necessarily be 'thoughtless' and are therefore not as 'mechanistic' as Pavlov believed them to be.

Association of stimuli

Another important factor influencing classical conditioning is the association of two different stimuli. If the individual does not associate the two stimuli, conditioning will not occur. The reason two stimuli (that may normally have no connection at all) become linked is said to be due to contiguity.

Contiguity refers to the formation of a connection or an association between two events when the events occur close together in time and/or space. The two events become linked so that it is difficult to think of one event without thinking of the other. In Pavlov's experiments, it is said that contiguity is evident because in time, a dog associates or links the CS (the bell) with the UCS (presentation of meat powder).

Timing of the NS and UCS pairing

Pavlov examined how much time should elapse between the presentation of the NS (e.g. the bell) and the UCS (the meat powder) in order to maximise the speed with which they would be associated so that the CS alone would elicit the conditioned response.

Pavlov found that the NS should be presented *before* the UCS and that there should be a very short time between their presentations. Ideally, the NS should occur *not more than half a second* before the UCS in order for the association to be most effectively made. According to Pavlov's research, longer time intervals were less effective for the dogs in establishing the links.

Figure 4.10 In many scary movies, the soundtrack music becomes intense just before something horrible happens. When we hear the music we became tense, anxious or even fearful. This technique has led us to form the association after having watched several scary movies. The intense music is the conditioned stimulus (CS) that triggers the conditioned response (CR) of tension, anxiety or fear.

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4.3 LEARNING ACTIVITY 1

Review

1. Define classical conditioning with reference to the neutral stimulus, unconditioned stimulus, conditioned stimulus and conditioned response.
2. What is a possible explanation for why Pavlov actually used the term 'conditioned reflex' rather than conditioned response?
3. Briefly describe how classical conditioning occurs, with reference to the three phases, but avoiding use of 'technical' terms.
4. a. Define and explain the role of each of the different kinds of stimuli and responses in classical conditioning: UCS, NS, CS, CR, UCR.
   b. Describe the relationship between the neutral stimulus and conditioned stimulus in classical conditioning.
   c. Explain the importance of each of the following in classical conditioning:
      i. nature of the response that is conditioned
      ii. frequency stimulus presentation during conditioning
      iii. timing of stimulus presentation during conditioning.
5. When can it be said that a response has been learned and the final phase is evident?
6. In what way(s) did restraining the dogs in his experiments help to control potential confounding variables?

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4.3 LEARNING ACTIVITY 2

Identifying elements of classical conditioning

Identify the NS, CS, UCS, CR and UCR in each of the following scenarios.

a. During Christmas Eve in 1974, Cyclone Tracey — one of the most destructive cyclones in Australia's history — struck Darwin. Sixty-six people died and many more were injured. Many people sought shelter in the smallest room of their house because it was structurally the strongest. Many families therefore huddled together in bathrooms as the cyclone destroyed the area. After the cyclone, some children feared going to the bathroom — a fear that persisted for several years. These children had learned to associate going to the bathroom with the noise and destruction of a cyclone.
b. On 11 September 2001, terrorists crashed two passenger planes into the twin towers of the World Trade Center in New York. The attacks killed some 3000 people and injured over 6000 others. The noise, destruction and loss of life witnessed on that day has led many New Yorkers to become anxious whenever they see or hear low-flying aircraft.
c. A participant is seated in an experimental chamber. A buzzer is sounded and the participant is given a mild electric shock to the left hand through a metal plate on the armrest of the chair. After several trials, the buzzer is sounded without the electric shock being given, but the participant still moves their hand.

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4.3 LEARNING ACTIVITY 3

Analysing classical conditioning scenarios

1. Insert the missing terms in the following scenario.

   In attempting to classically condition an eye-blink response to the sound of a pencil tap, Sophia was the experimenter and Isabelle was the participant. During conditioning, Sophia noticed that Isabelle's conditioned response (the eye-blink to the pencil tap alone) was becoming stronger as the number of pairings of the _____ and _____ increased.

2. Identify the components that are the CS, UCS, UCR and CR in the following scenario.

Doctors treating cancer patients with chemotherapy found that their immune systems had been classically conditioned. Initially, only the chemotherapy treatment affected the patient's immune system, but after many treatments, cues related to the hospital environment where the treatment was administered produced reduced immune system functioning.

   a. The UCS in this example is the _____, and the _____ is the UCR.
   b. After repeated treatments, the _____ related to the hospital environment became associated with chemotherapy treatment.
   c. Now the CS produced a response of _____, which is the CR.

3. Using the terminology of classical conditioning, explain the acquisition of the conditioned response referred to in each of the following scenarios.

   a. A person under treatment for a gambling addiction often feels an urge to play the pokies whenever he again encounters cues such as driving past a gaming venue where he experienced a huge 'buzz' after hitting a jackpot, and hearing about someone else's big win on the machines.
   b. After swimming in the lake near his home one day, Glen emerged from the water covered with slimy blood-sucking leeches all over his back and legs. He was revolted as he removed the leeches. The next time he swam there, a leech attached itself to his cheek. Now, every time he passes the lake, Glen shudders in disgust.
   c. When Mardi and her sisters were toddlers, their mother frequently used their nap time to vacuum. Now, when Mardi and her sisters hear vacuum cleaners, they feel sleepy.
   d. Every time three-year-old Sienna heard the doorbell ring, she raced to open the front door. On Halloween night, Sienna answered the doorbell and encountered a scary monster that intentionally startled her. Sienna screamed in fear and ran away. Her parents calmed her down but it happened again later that evening. Now Sienna whimpers and hides whenever the doorbell rings.
   e. A flashing light suddenly appearing on the control panel of an aeroplane triggers a burst of adrenaline in a pilot.

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4.3 LEARNING ACTIVITY 4

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.13; ©VCAA

Bernard was about to sit on a bench at the beach when he noticed that he felt happy and had been unconsciously smiling. He realised that this feeling was probably associated with his girlfriend, whom he often brings to this bench to watch the sunset.

During the process of conditioning Bernard's response, the

A. unconditioned stimulus is the bench.
B. unconditioned stimulus is his girlfriend.
C. association is between the sunset and his girlfriend.
D. association is between his feelings and his girlfriend.

Question 2 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.15; ©VCAA

Sally takes the bus to school every day. She salivates each time the bus driver gives her and the other children a lolly. Sally now salivates when she sees the bus approach her bus stop.

In terms of classical conditioning, the conditioned response in this scenario is

A. Sally salivating when she sees the bus approach her bus stop.
B. Sally waiting for the bus to take her to school.
C. Sally seeing the bus driver in his seat.
D. the bus driver giving out lollies.

Question 3 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.20; ©VCAA

Millie the dog is always fed her dinner in the garage. Now Millie salivates every time her owner, Priya, opens the garage door.

With reference to Millie's learned behaviour, Priya opening the garage door is the

A. conditioned response.
B. conditioned stimulus.
C. unconditioned response.
D. unconditioned stimulus.

Question 4 (3 marks)

Source: VCAA 2015 Psychology, Section A, Q.23 (adapted); ©VCAA

Vicki wanted to teach her dog, Misha, to sit on command. When first teaching Misha, Vicki would say 'sit' and then would give Misha a pat and a dog biscuit every time Misha sat on command. After a number of training sessions, Vicki noticed that Misha began to salivate whenever she said 'sit'.

That Misha begins to salivate whenever Vicki says 'sit' is

A. a conditioned response.
B. a conditioned stimulus.
C. an unconditioned response.
D. an unconditioned reflex.

Question 5 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.33; ©VCAA

Bobbi, a one-year-old child, is playing with red balloons when suddenly one bursts, making a loud noise. Bobbi is startled by the loud noise. She continues playing with the balloons and another one pops. Again, Bobbi demonstrates the startle reflex in response to the balloon bursting. After five balloons popping and Bobbi being startled at each pop, Bobbi now startles whenever she sees a balloon.

In terms of classical conditioning of Bobbi's fear of a red balloon, the unconditioned stimulus and the conditioned stimulus were, respectively, the

A. red balloon, loud noise.
B. loud noise, red balloon.
C. startle reflex, red balloon.
D. red balloon, startle reflex.

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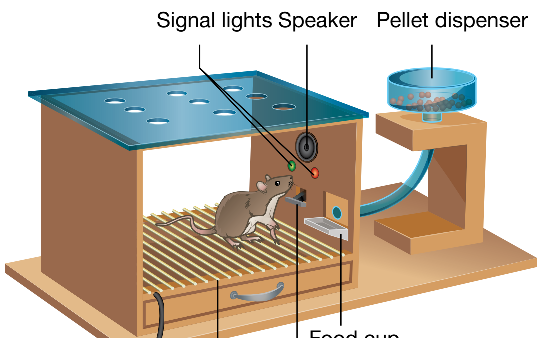
4.4 Operant conditioning as a three-phase process

Classical conditioning is one of two types of associative learning. The other type is operant conditioning (also known as *instrumental conditioning*). Unlike classical conditioning which involves associating stimuli, operant conditioning involves associating stimuli with responses (behaviours) which are in turn influenced by consequences.

The term operant conditioning was first used in the 1930s by American psychologist Burrhus Frederic Skinner. **Operant conditioning (OC)** is a learning process whereby the consequences of behaviour determine the likelihood that it will be performed again in the future.

More specifically, operant conditioning theory proposes that an organism will tend to perform or repeat a behaviour (an operant) that has desirable consequences (such as receiving a treat) and likewise beahviour that will enable it to avoid undesirable consequences (such as being given detention). Furthermore, an organism will tend *not* to perform or repeat a behaviour that has undesirable consequences (such as disapproval or a fine).



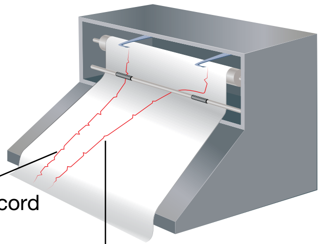


Figure 4.11 B. F. Skinner (1904–1990) conducting an experiment on operant conditioning. For his pioneering experiments on operant conditioning, Skinner created an apparatus that eventually came to be known as a 'Skinner box'. This is a small operant conditioning chamber in which an experimental animal learns to make a particular response for which the consequences can be controlled by the researcher. It is equipped with a lever that delivers food (or water) into a dish when pressed. Some boxes are also equipped with lights and buzzers, and some have grid floors for delivering a mild electric shock. The lever was usually wired to a cumulative recorder, an instrument with constantly moving chart paper on which a pen makes a special mark each time a desired response (usually lever-pressing) was made. The recorder, now replaced by a computer, indicates how often each response is made (frequency) and the rate of response (speed). Most of Skinner's early experiments using the Skinner box were done with rats, while his later experiments were conducted with pigeons. Rats were usually conditioned to press the lever, and pigeons were conditioned to peck at a disk.

An **operant** is any response (or set of responses) that acts ('operates') on the environment to produce some kind of consequence. Essentially, it is behaviour that has an impact on the environment in some way. In turn, the environment provides an event that makes the behaviour more or less likely to recur.

Positive consequences strengthen the behaviour and make it more likely to recur and adverse consequences weaken the behaviour and make it less likely to recur. Since the consequence occurs in the environment, the environment determines whether or not the operant occurs (Skinner, 1953).

Unlike the classical conditioning process which involves involuntary, reflexive responses that are automatically elicited by a stimulus, operant conditioning involves *voluntary* responses. An operant is voluntary action that people and animals initiate and often perform on a daily basis. Smiling, drinking water, listening to music, Googling for information and liking on TikTok are common human operants. Although operants first appear spontaneously and can be controlled by the organism, they are greatly influenced by their consequences.

Resources

Weblink Video on operant conditioning with pigeons, including old footage of Skinner. 3 m 57 s

4.4.1 The three-phase model of operant conditioning

Skinner believed that virtually all behaviour can be analysed and explained by the relationship between the behaviour, its antecedents (what happens just before it) and its consequences (what happens just after it). The three-way relationship between these elements and the order in which they occur is called the three-phase model of operant conditioning.

The **three-phase model of operant conditioning** has three parts that occur in a specific sequence:

1. antecedent (A), a stimulus that occurs before the behaviour
2. the behaviour (B) that occurs due to the antecedent
3. the consequence (C) to the behaviour.

This is usually expressed as antecedent (A) → behaviour (B) → consequence (C) and is therefore sometimes called the *A-B-C model of operant conditioning*. Basically, a specific antecedent prompts relevant behaviour that is followed by a specific consequence.

Anything in the organism's environment can be an antecedent. These stimuli are already in place before any behaviour occurs. Some are essentially neutral in the sense that they do not have any effect on behaviour at all, at least as far as the relevant operant conditioning behaviour is concerned. Other antecedents may signal that behaving in a particular way is likely to have a specific consequence. They are like cues ('prompts') in the environment that tell us what to do and set us up to behave in a particular way. When an antecedent does influence the likelihood of specific behaviour occurring, it is technically called an *antecedent stimulus*.

The antecedent stimulus must be present for the relevant behaviour to occur. The **antecedent** (A) is the stimulus (object or event) that precedes a specific behaviour, signals the probable consequence for the behaviour and therefore influences the occurrence of the behaviour. For example, your mobile phone ring tone when you are expecting a call from a friend is the antecedent stimulus that sets up the specific behavioural response of tapping 'Accept' on the screen for the desirable consequence of chatting with your friend.

Through its association with a consequence, the antecedent stimulus signals whether certain behaviour will lead to a particular consequence (but does not actually elicit a response as in classical conditioning). In this way, the antecedent stimulus enables the organism to predict the likely outcome of their behaviour. In the mobile phone example, your ring tone indicates that the behaviour of tapping 'Accept' is very likely to be followed by the desired chat with your friend.

Consider another example of a car stopped at a red traffic light at a busy intersection. When the traffic light turns green, the car is driven through

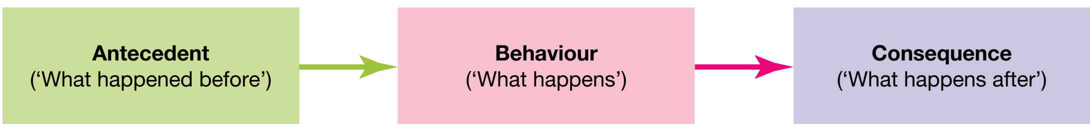


Figure 4.12 The three-phase model of operant conditioning

the intersection. In this situation, the green traffic light is the antecedent stimulus that prompts the behaviour of gently pressing on the accelerator for the known, likely and desirable consequence of safely travelling across the intersection.

The antecedent stimulus is sometimes referred to as the *antecedent condition* to emphasise that it occurs *before* the relevant behaviour. It may also be called a *discriminative stimulus* because it helps us distinguish between the consequences we have associated with different behaviours in different situations; for example, to tell the difference between the likely consequences of driving through a red or green traffic light at a busy intersection.

We learn from experience to associate certain environmental cues with particular behaviours (operant responses). In this way, according to Skinner (1974), our behaviour is determined and controlled by stimuli that are present in the environment and our prior experience with the consequences of responding in particular ways to different stimuli.

In the A-B-C model, **behaviour** is the voluntary action that occurs in the presence of the antecedent stimulus. It may be one specific action (e.g. tapping 'Accept' on your mobile's screen) or a pattern of actions (e.g. checking the number of the incoming call, tapping 'Accept' and speaking). In all cases, it involves activity that has an effect on the environment in the form of a consequence that follows it.

The **consequence** is the environmental event that occurs immediately after the behaviour and has an effect on the occurrence of the behaviour. Skinner argued that any behaviour which is followed by a consequence will change in strength (become more, or less, established) and frequency (occur more, or less, often) depending on the nature of that consequence (reward or punishment).

Behaviour that is followed by a reward strengthens the behaviour and makes it more likely to occur again, whereas behaviour followed by punishment weakens the behaviour and makes it less likely to occur again. For example, if you wear a particular T-shirt and get lots of compliments (rewards), you are likely to wear it more often. If people give you strange looks or make uncomplimentary comments, you will probably wear it less often.

The nature of the consequence can often depend on the individual. For example, consider bungee jumping, for which a person dives off a very high tower (or place) with their feet connected to an elastic cord. The antecedent stimulus is the sight of the bungee tower and the behaviour is diving off the

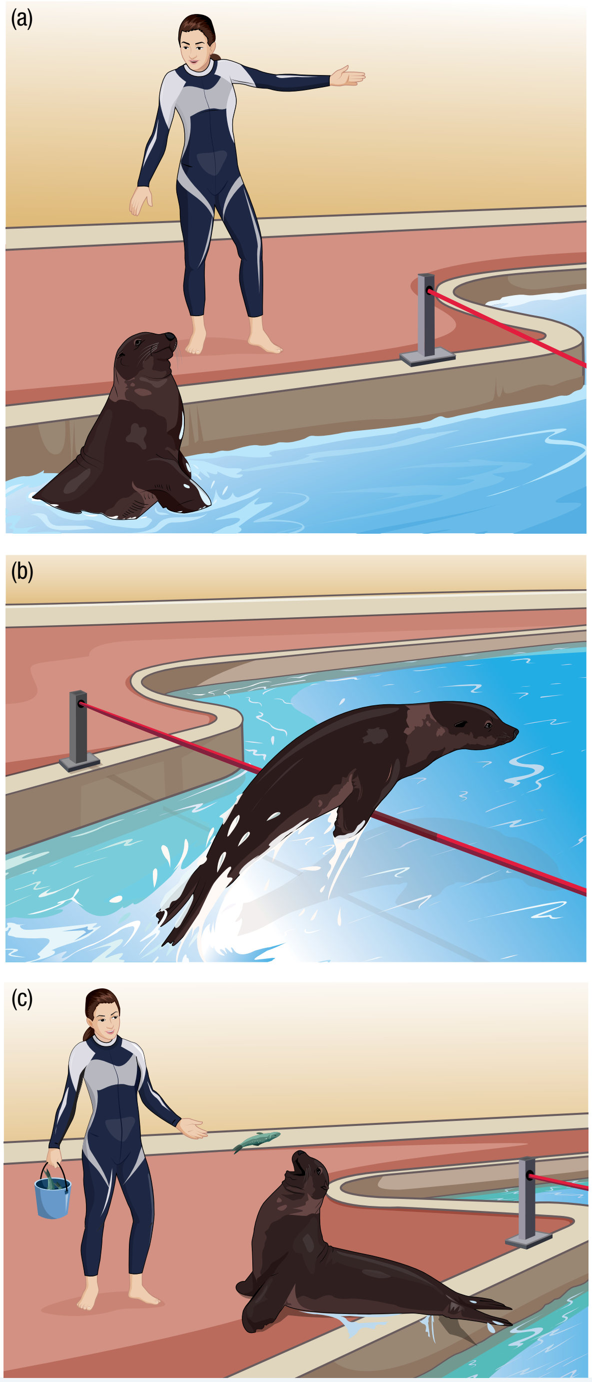


Figure 4.13 (a) Antecedent: the trainer presents a stimulus — a hand signal. (b) Behaviour: the sea lion immediately responds with the correct behaviour — leaping over a rope. (c) Consequence: the outcome is a tasty treat immediately after the behaviour, which strengthens the behaviour and makes it more likely to be repeated in the future when the stimulus is presented.

tower. The consequence, however, will be a reward in the form of a thrill for some people and punishing in the form of terror for others.

In more formal terms, the three-phase model of operant conditioning means that the probability of particular behaviour occurring in response (B) to an antecedent stimulus (A) is a function of ('depends on') the consequence (C) that has followed (B) in the past. For example, when waiting for a friend's phone call, tapping 'Accept' on your mobile phone's screen and speaking (B) when you hear your mobile's ring tone (A) leads to the consequence (C) of connecting with someone with whom you may wish to chat.

Table 4.2 Behavioural analysis using the three-phase model of operant conditioning

	Antecedent (A)	Behaviour (B)	Consequence (C)	Effect on future behaviour
Definition	The environmental stimulus that precedes the relevant behaviour and indicates the consequence	Voluntary activity that has an effect on the environment	The environmental event that follows the behaviour	Reinforcement (positive or negative) increases the likelihood of the behaviour being repeated. Punishment decreases the likelihood of the behaviour being repeated.
Examples	The word 'Men' on a toilet door	Enter if a male	Empty a full bladder	Positive reinforcement — more likely to enter again when bladder is full
	Petrol gauge almost on empty	Fill car with petrol	Avoid running out of petrol	Negative reinforcement — more likely to fill car when petrol gauge on empty
	Drink vending machine	Put in $2	Get no drink and lose money	Punishment (negative) — less likely to use that vending machine again
	In a small group in the schoolyard	Tell a 'bad' joke	Ridiculed by others	Punishment (positive) — less likely to tell 'bad' jokes to the group

4.4 LEARNING ACTIVITY 1

Review

1. a. What is operant conditioning?
   b. In what way is it a form of associative learning?
2. Explain what an operant is with reference to an example not used in the text.
3. a. In what way do classical and operant conditioning differ in terms of the organism's control over the behaviour that may be elicited by a stimulus?
   b. Explain how classical conditioning occurs with reference to an antecedent stimulus.
4. a. Explain what the three-phase model of operant conditioning is with reference to the relationship between each phase.
   b. What is the main difference between an antecedent and a consequence in relation to timing?
5. Charlotte experienced the 'runner's high' (due to endorphin release) when she ran a mini-marathon and as a result has started running 10 kilometres three times a week. Explain Charlotte's changed behaviour using the language of the three-phase model of operant conditioning.
6. Consider toddler Alex who is being toilet-trained by her parents using operant conditioning. Her parents wait until after Alex has had a drink and her bladder is full, then put her on a potty seat and wait for nature to take its course. When Alex urinates in the potty, her parents provide verbal praise ('What a good girl you are, Alex!') or even some stickers that she loves. She is also punished when she has a wetting accident by verbal disapproval ('Mummy is very disappointed in you, Alex'). Gradually, Alex learns enough bladder control to recognise when urination is imminent, and to withhold the response long enough for a quick trip to the potty seat — thus obtaining a reward and avoiding punishment. Eventually, the behaviour becomes automatic enough that Alex continues to use the potty seat.

   Explain Alex's successful toilet training using the language of the three-phase model of operant conditioning. Ensure you refer to each component with reference to the relevant aspect(s) of Alex's toilet training.

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4.4 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.18 (adapted); ©VCAA

Elijah paid careful attention to his friend making a funny video of her pet cat so that he could also make a funny video of his own cat, Kato. When Elijah posted a funny video of his cat Kato on social media, he received hundreds of likes in the first hour, which made him happy.

In terms of operant conditioning, the number of likes

A. is an antecedent.
B. is a punishment.
C. is an antecedent.
D. causes a voluntary change in Elijah's behaviour.

Question 2 (1 mark)

Source: VCAA 2008 Psychology 2, Section A, Q.38 (adapted); ©VCAA

Skinner demonstrated that organisms tend to repeat responses that are followed by favourable consequences.

Skinner termed these favourable consequences

A. unconditioned stimuli.
B. rewards.
C. reinforcements.
D. operants.

Question 3 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.49; ©VCAA

In operant conditioning, the nature of the response and the division of the nervous system that is most active are, respectively

A. voluntary, the somatic nervous system.
B. involuntary, the somatic nervous system.
C. voluntary, the autonomic nervous system.
D. involuntary, the autonomic nervous system.

Question 4 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.2; ©VCAA

In the three-phase model of operant conditioning, the antecedent condition is also known as the

A. reward.
B. reinforcer.
C. behavioural outcome.
D. discriminative stimulus.

Question 5 (1 mark)

Source: VCAA 2012 Psychology 2, Section A, Q.9 (adapted); ©VCAA

Four-year-old Mary always kicked and screamed when her mother dressed her. One morning, Mary's mother gave her a lollipop and was then relieved to be able to finish dressing Mary in peace and quiet.

In terms of the three-phase model of operant conditioning, if the antecedent stimulus in this scenario is considered to be the mother dressing Mary, then the response would be

A. Mary eating the lollipop.
B. Mary kicking and screaming.
C. Mary quietly dressing herself.
D. Mary stopping the kicking and screaming.

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4.4.2 Reinforcement

When you are training your dog to 'shake hands' and you give it a treat, pat it on the head or say 'good dog' when it behaves the way you want it to, you are using reinforcement. Similarly, using an umbrella to prevent yourself from getting wet when it rains is a kind of reinforcement. So, reinforcement may involve receiving a pleasant stimulus (the dog receiving a treat) or 'escaping' an unpleasant stimulus (avoiding getting wet by using an umbrella). In either case, the consequence or outcome is one that is desired by the organism performing the behaviour.

Reinforcement is a process in which a stimulus strengthens or increases the frequency or likelihood of a response that it follows. This may involve using a positive stimulus or removing a negative stimulus to subsequently strengthen or increase the frequency or likelihood of a response that it follows. An essential feature of reinforcement is that it is only used *after* the desired or correct response is made.

Reinforcement is achieved with reinforcers. A **reinforcer** is any stimulus that strengthens or increases the frequency or likelihood of a response that it follows.

Note that the term reinforcement may be used in relation to the process of administering a reinforcer, in relation to the consequence of a reinforcer, and sometimes in relation to the stimulus and therefore interchangeably with the term reinforcer.

In addition, the term 'reinforcer' is often used interchangeably with the term 'reward'. Although they are not technically the same, many psychologists accept that they are similar enough to be used interchangeably. One difference is that a reward suggests a consequence that is positive, such as satisfaction or pleasure.

A stimulus is a reinforcer if it *strengthens* the preceding behaviour. In addition, a stimulus can be rewarding because it is pleasurable, but it cannot be said to be a reinforcer unless it increases the frequency of a response or the likelihood of a response occurring. For example, a person might enjoy eating chocolate and find it pleasurable, but chocolate cannot be considered to be a reinforcer unless it promotes or strengthens a particular response.

Positive reinforcement

Many of Skinner's early experiments on operant conditioning were conducted with hungry rats in an apparatus that has come to be known as a 'Skinner box' (as shown in Figure 4.11 on page 278).

In some experiments, the rats were conditioned to press a lever to obtain a food pellet. This was used as a positive reinforcer for making the correct response — pressing the lever would achieve a satisfying consequence, especially when hungry. Similarly, a high score for a SAC is a positive reinforcer for a student who works hard, as is the thanking of a friend for doing you a favour. These examples also illustrate why the term *reward* is often used to describe a positive reinforcer.

A **positive reinforcer** is a stimulus that strengthens or increases the frequency or likelihood of a desired response by providing a satisfying consequence. The process of **positive reinforcement** involves giving or applying a positive reinforcer after the desired response has been made.

Figure 4.14 A positive reinforcer strengthens or increases the frequency or likelihood of a desired response by providing a satisfying consequence. The reinforcer does not have to be a physical object. For example, teacher praise for correctly answering a classroom question can be a reinforcer.

Negative reinforcement

On a rainy day, if you want to avoid the unpleasant experience of having wet clothes, you could use an umbrella. If the umbrella successfully kept you dry, the next time it rained you would probably use it again. The increased likelihood of using an umbrella makes this behaviour one that has been negatively reinforced. The increase in its likelihood is based on the avoidance of something unpleasant (wearing wet clothes).

A **negative reinforcer** is any unpleasant or aversive stimulus that, when removed or avoided, strengthens or increases the frequency or likelihood of a desired response. For example, a Skinner box has a grid on the floor through which a mild electrical current can be passed continuously. If a rat is placed in the box it can be given a foot shock that is an unpleasant stimulus. When the rat presses the lever on a wall of the box, the electric current is switched off and the mild shock is taken away. The removal of the shock (negative reinforcer) is referred to as negative reinforcement.

The process of **negative reinforcement** involves the removal of an unpleasant stimulus. It has the effect of increasing the likelihood of a response being repeated, thereby strengthening the response. Thus, the likelihood of the lever-pressing response will increase because the negative reinforcer (the shock) is removed as a consequence of this lever-pressing behaviour.

An important distinction between the processes of positive and negative reinforcement is that positive reinforcers are *given* and negative reinforcers are *removed* or *avoided*. However, because both procedures lead to desirable or satisfying consequences, each procedure strengthens ('reinforces') the behaviour that produced the consequence.

Negative reinforcers are evident in many aspects of everyday life. For example, when you turn off a scary movie, cover your eyes or walk away, you remove a negative event (fear associated with the movie) and the avoidance behaviour is negatively reinforced. The next time you watch a movie and a frightening scene comes on, you are more likely to repeat your avoidance behaviour. In this way, operant conditioning can *perpetuate* avoidance behaviour through negative reinforcements (This is explained in more detail in topic 9 on specific phobia).

Figure 4.15 In real life, reinforcement is not necessarily a one-way street. Children and parents continually reinforce each other. By stopping a tantrum when they get their way, the child negatively reinforces the parent. However, by giving in to the child and providing what was sought, the parent is positively reinforcing the tantrum-throwing behaviour.

Similarly, if after taking an aspirin the pain from a headache subsides, the behaviour of taking an aspirin has been negatively reinforced and it is likely you will take an aspirin the next time you have a headache. And when a P-plate driver decides not to drink alcohol at a party for fear of losing their licence if caught driving, a negative reinforcer (loss of licence) is at work. In these examples, the *removal* of the negative reinforcer is providing a satisfying or desirable consequence.

Positive and negative mean good and bad. But do not fall into the trap of giving them these meanings when using them in relation to operant conditioning. In operant conditioning, 'positive' and 'negative' mean 'added' and 'subtracted'.

To help you remember this difference, consider linking the terms with mathematical symbols:

- positive (+) reinforcer = adding something pleasant
- negative (–) reinforcer = subtracting something unpleasant.

Figure 4.16 Vasco drives safely and obeys all the road laws so that he can become a 'Rating 1' driver and save on his insurance premium (positive reinforcement). Emma drives safely and obeys all the road laws to avoid getting any more traffic fines and licence demerit points (negative reinforcement).

4.4 LEARNING ACTIVITY 3

Review

1. Define the term reinforcement with reference to an example.
2. Explain the meaning of the terms positive reinforcer and negative reinforcer.
3. In what way are positive reinforcers and rewards similar and in what way are they different?
4. For each of the following examples involving negative reinforcement, identify the aversive (unpleasant) stimulus and the behaviour being strengthened by its avoidance or removal.
   a. smoking a cigarette in order to relieve anxiety
   b. giving in to an argument
   c. turning down the volume of a very loud radio
   d. hurrying home to escape a thunderstorm
   e. fanning oneself on a very hot day to escape the heat
   f. putting on a car safety belt to stop an irritating clanging sound
   g. obeying prison rules in order to be released from solitary confinement
5. a. What do positive and negative reinforcers have in common in relation to their consequences?
   b. Identify three positive and negative reinforcers that you have observed teachers use in the classroom and three that you have observed in other real-life contexts.
   c. How are positive and negative reinforcers different?
6. Arup is an excellent athlete who plans to become an Olympic sprinter. Last time he raced competitively he forgot to take off the red sweat band around his wrist and he won his only event. Arup will now wear the red sweat band every time he competes because he believes it is his lucky charm.
   a. Using the language of the three-phase model of operant conditioning, explain how Arup has learned to wear the red sweat band every time he competes.
   b. Wearing the red sweat band in all future races is an example of what Skinner considered to be superstitious behaviour. Give another example of a superstitious behaviour and explain how it may have been acquired through operant conditioning.

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4.4.3 Punishment

If you are caught exceeding a speed limit while driving, you will receive a fine and one or more demerit points. This is an unpleasant consequence intended to reduce this type of driver behaviour in future. Alternatively, if you continue to exceed a speed limit after receiving a number of speeding fines and demerit points, you may have your licence taken away (an unpleasant consequence). In both examples, the consequence is punishment of the unwanted behaviour with the intention of weakening, reducing the frequency of or eliminating the behaviour.

Punishment is the process of delivering an unpleasant consequence following a response, or the removal of a pleasant consequence following a response. Punishment has the same unpleasant quality as a negative reinforcer, but unlike a negative reinforcer, the punishment is given or applied, whereas the negative reinforcer is prevented or avoided.

The consequence or outcome of punishment is the opposite to removal of a negative reinforcer. When closely associated with a response, punishment *weakens* the response or *decreases* the probability of that response occurring again over time.

As with reinforcement, Skinner (1953) distinguished between positive and negative punishment. Again, as with reinforcement, consider the mathematical terms of adding (+) and taking away (–), rather than 'good' and 'bad' or the 'feelings' of the recipient.

Positive punishment

Positive punishment involves the presentation (or introduction) of a stimulus, thereby decreasing (or weakening) the likelihood of a response occurring again. For example, an electric shock for a rat in a Skinner box, or having to run extra laps around a basketball court for being late to training, or being given extra chores at home for doing something wrong all involve positive punishment.

Negative punishment

Negative punishment involves the removal or loss of a stimulus and thereby decreasing (or weakening) the likelihood of a response occurring again. For example, taking food away from a hungry rat, not being allowed to join basketball training because you are late, or your parents taking away your internet access for doing something wrong all involve negative punishment.

Note that in *both* positive and negative punishment, the intended effect on the punished behaviour is to weaken and prevent it from recurring.

Figure 4.17 A speeding fine is negative punishment as it involves loss — money, demerit points and possibly the licence to drive.

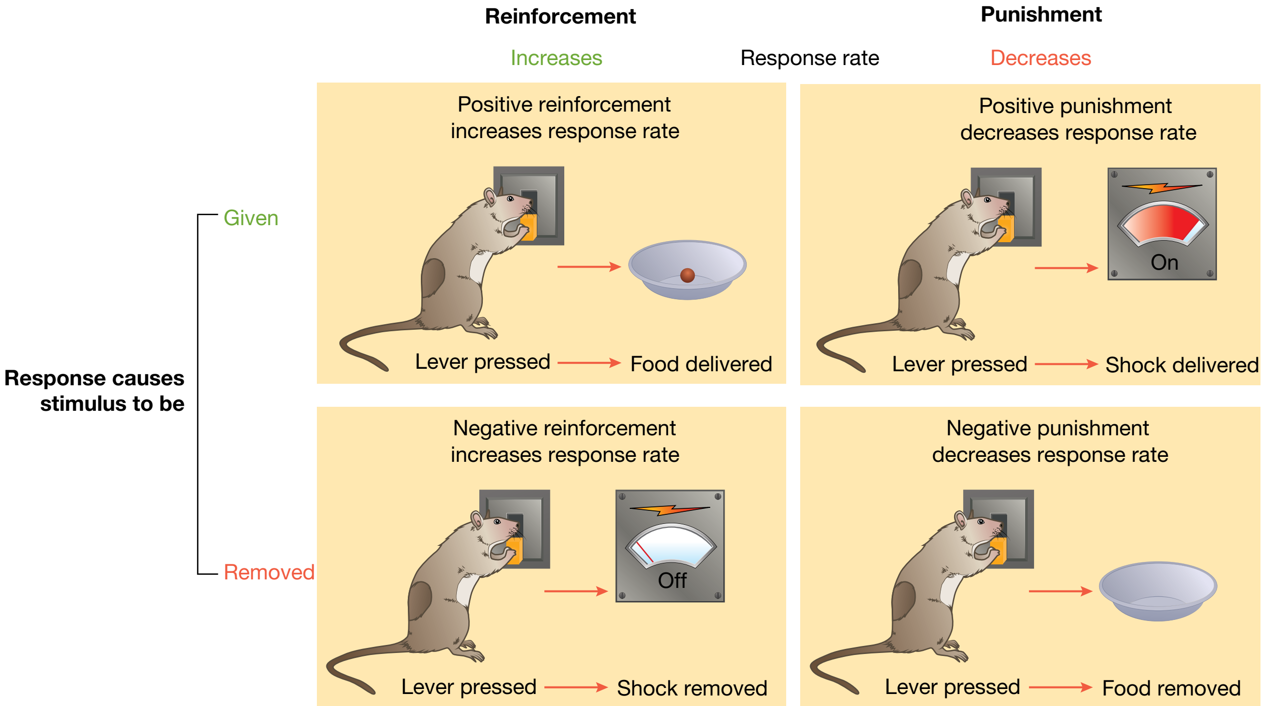

Figure 4.18 Comparing types of reinforcement and punishment

4.4.4 Factors that influence the effectiveness of reinforcement and punishment

In operant conditioning, what happens *after* the correct or desired response is performed is very important in determining the strength of learning and the rate at which it occurs. In addition, it is not just *whether* a response is reinforced or punished that influences the learning process.

Other factors associated with reinforcement also play important roles in affecting learning. For instance, *when* in the process of operant conditioning the consequence (reinforcer or punisher) is presented, the *time lapse* between the response and consequence, and the *appropriateness* of the consequence are all important in determining the effectiveness of reinforcement and punishment, and therefore learning through operant conditioning.

Order of presentation

To use a reinforcer and punisher effectively it is essential that either be presented *after* a desired response, never before. This helps to ensure that the organism learns the consequences of a particular response.

Timing

Use of either reinforcement or punishment is most effective when given *immediately after* the response has occurred. This timing helps to ensure that the organism associates the response with the reinforcer or punisher, without interference from other factors during the time delay.

Timing also influences the strength of the response. If there is a considerable *delay* between the response and the consequence, learning will generally be very slow to progress and in some cases may not occur at all.

Appropriateness

For any stimulus to be a reinforcer, it must provide a pleasing or satisfying consequence for its recipient. For example, a place in a course at a university would not be an effective reward to a student who intends to work in their family's business at the end of year 12. However, a holiday at a tropical resort before the student started paid work might be considered much more desirable, and would therefore be a more effective reinforcer.

Similarly, for any stimulus to be an appropriate punisher, it must provide a consequence that is unpleasant and therefore likely to decrease the likelihood of the undesirable behaviour. An inappropriate punisher can have the opposite effect and produce the same consequence as a reinforcer.

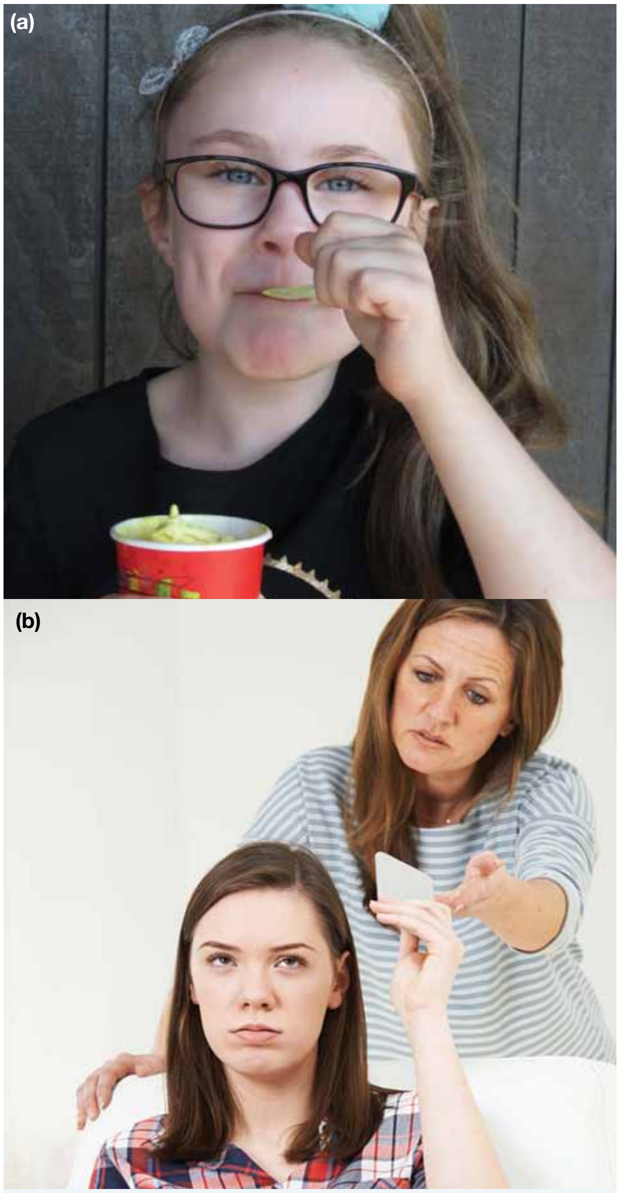

Figure 4.19 (a) For any stimulus to be a reinforcer, it must provide a pleasing or satisfying consequence for its recipient, such as ice cream provides for this girl. (b) Similarly, for any stimulus to be a punisher, it must provide a consequence that is unpleasant for its recipient, such as loss of access to their mobile phone.

For example, a talkative, attention-starved year 8 boy may respond to being verbally reprimanded in class — his teacher's intended punisher — by increasing his talkative behaviour. For him, the verbal scolding at least gives him the attention he desires, and this attention then acts as a reinforcer for the talkative behaviour.

Although punishment may temporarily decrease the occurrence of unwanted responses or behaviour, it does not promote more desirable or appropriate behaviour in its place. Throughout his career as a behavioural psychologist, Skinner remained strongly opposed to the use of punishment in everyday life. Instead, he advocated the greater use of positive reinforcement to strengthen desirable behaviours or to promote the learning of alternative behaviours to punishable behaviours (Skinner, 1974).

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Operant conditioning principles can be used to teach a chicken to play a tune on a xylophone. Access learnON to read about applications of operant conditioning for behaviour modification, including everyday behaviour, token economies and animal training.

4.4 LEARNING ACTIVITY 4

Review

1. a. Define the term punishment.
   b. Explain what punishment involves and why it is used, with reference to an example not given in the text.
2. Distinguish between positive and negative punishment with reference to an example not used in the text.
3. How does punishment differ from negative reinforcement? Explain with reference to an example.
4. Describe a situation in which a punisher might *reinforce* a behaviour rather than weaken it or reduce its frequency.
5. 'Time out' involving removal of a child from a situation is sometimes used as a punisher by parents and teachers. Explain how it can be a form of negative punishment at home and in a classroom.
6. Analyse and describe the following scenario using the language of the three-phase model of operant conditioning. Also indicate whether the scenario is an example of positive or negative reinforcement, or punishment. Explain your choice.

   Zeta's dog Belle keeps escaping from the backyard by crawling through a gap under the fence. Zeta purchases a small detector that she places either side of the gap and puts a collar on Belle that makes a high-pitched noise whenever she gets too close to the gap. The first time Belle tries to escape under the gap, the noise plays and distresses her. Soon Belle learns to avoid the noise by staying inside the backyard.

7. A teacher cannot conduct her lesson because the students are rowdy and inattentive in the last period, so she lets them out early.
   a. What are the students learning?
   b. Explain with reference to three-phase model of OC.
8. Maria had enjoyed attending the same P–12 college for ten years. Quite suddenly this year, her friendship group drifted away from her. She is now being bullied by some other girls because she has become a 'loner'. After an unsuccessful attempt to solve her problems by speaking with her year-level coordinator, Maria started to take days off school, telling her mother she wasn't feeling well. Her absenteeism increased. Although she was concerned about missing school, she couldn't face the unpleasant actions of the bullies.
   a. Which operant conditioning process explains the increase in Maria's behaviour of deceiving her mother and staying home from school? Explain how this process worked in Maria's situation.
   b. Which operant conditioning process describes the consequence of the bullying behaviour for Maria? Explain its effect on Maria's attendance behaviour.

9. Choose one of the following examples and briefly explain how operant conditioning could be used for a solution. Your explanation should use operant conditioning terms where relevant.
   - increase the number of people who use a car pooling arrangement to travel to and from work
   - encourage energy conservation in homes and at work
   - encourage drivers and passengers to use seatbelts
   - encourage students to use rubbish bins in the schoolyard during recess and lunchtime
   - discourage cigarette smoking or vaping by teenagers
   - discourage gambling on pokie machines
   - improve the study habits of a VCE student

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4.4 LEARNING ACTIVITY 5

Distinguishing between reinforcement and punishment

1. Identify the operant conditioning process that is being illustrated in each of the following examples. Choose from positive reinforcement (PR), negative reinforcement (NR), positive punishment (PP) and negative punishment (NP). Write the initials of the correct responses in the spaces provided.
   a. When Lina turns the shopping trolley down the lolly aisle, her two-year-old son, Ali, starts screaming, 'Want lollies! Lollies!' Lina moves to another aisle, but Ali continues to scream. As other customers begin staring and Lina starts to feel embarrassed, she finally gives Ali a bag of lollies. Ali is now more likely to scream in a supermarket when he wants lollies because he has experienced _____.
   b. If Lina is more likely to give in to Ali's temper tantrums in public situations in the future, it is because she has experienced _____.
   c. Feeling sorry for an apparently homeless person sitting outside a bakery, Christopher offers him a $2 coin. The person snarls at Christopher and tries to grab his leg in a threatening manner. Christopher no longer offers money to homeless people in the street because of _____.
   d. Justin is caught using Instagram on his work computer and is reprimanded by his team leader. Justin no longer accesses Instagram on his work computer because of _____.
   e. As you walk down the corridor between classes, you spot a student you greatly dislike. You immediately duck into an empty classroom to avoid an unpleasant interaction with them. Because _____ has occurred, you are more likely to take evasive action when you encounter people you dislike in the future.
   f. Having watched Superman fly in a movie, three-year-old Tran climbs onto the kitchen table, then launches himself into the air, only to fall onto the tiles and hurt himself. Because Tran experienced _____, he tried this stunt only once.
   g. Thinking she was making a good impression in her new job by showing how knowledgeable she was, Sana corrected her team leader in two different meetings. Not long after the second meeting, Sana lost her job because the company said it was making her position redundant. Because she experienced _____, Sana no longer publicly corrects her superiors.
   h. Basil's dad makes him to wash out the rubbish bin when he was caught hitting his brother. Basil hates this chore. Basil is less likely to hit his brother again because his dad administered _____.
2. An inexperienced teacher was having difficulties controlling the behaviour of students in his year 10 English class. This was stressing him considerably so he consulted a psychologist, who agreed to help him. In order to precisely identify the nature of the difficulties experienced by the teacher, the psychologist unobtrusively observed him in the classroom for twelve 50-minute lessons over three weeks. He prepared a report from which extracts are presented below.

Read the report and answer the questions that follow.

Teacher: male, 24-years-old, fully qualified with a Bachelor of Arts and a Diploma of Education, one month's experience as a replacement teacher and four months' full-time teaching experience

Students: 14 boys and 16 girls with a mean age of 16.2 years; many have reading difficulties or other language problems; two students are repeating year 10; all live locally

Class behaviour: measurements of students' behaviour during class time included:

- inappropriate talking: 29% of class time
- inappropriate turning around: 17% of class time
- walking around the classroom without permission: 12% of class time
- calling out to the teacher: 9% of class time.

Teacher's behaviour: responded to inappropriate talking about 25% of the time, usually with 'shhh' and 'be quiet' (most of these responses were directed at the whole class and rarely to offending individual students); responded to 6% of the turning around behaviour, always with the comment 'turn around'. Other inappropriate student behaviour was generally ignored and he continued trying to teach 'over the top' of this. On eight occasions he made general threats; for example, detention for the class, not allowing the class to go on a planned excursion. These were never carried out. During the observation period in which the baseline data was recorded, he was never observed to take notice of appropriate behaviour; for example, give praise for not talking.

a. What is the purpose of baseline data in this particular study?
b. Explain the difficulties experienced by the teacher with reference to the data and three operant conditioning processes.
c. Make two suggestions involving operant conditioning processes to help the teacher overcome the difficulties with his class.

Source: Adapted from Hockenbury, D.H. & Hockenbury, S.E. (2006). *Psychology* (4th ed.). New York: Worth. p.218.

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4.4 LEARNING ACTIVITY 6

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.15 (adapted); ©VCAA

Hannah is a university student who has recently signed a lease to move into a rental property in an apartment block.

Hannah enjoys the freedom of having her own apartment. Since moving into her new apartment, Hannah has hosted loud parties most weekends. This has resulted in her neighbours making a formal complaint to her landlord. Hannah's landlord has sent her an official letter stating that her lease will be terminated if she continues to have loud parties.

Which one of the following actions is most likely to reinforce quiet and considerate behaviour from Hannah?

A. the police being called when she has a loud party
B. her neighbours not reacting when she has a loud party
C. her neighbours waiting outside as guests arrive for a party
D. being given compliments by her neighbours when she has a quiet party

Question 2 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.47; ©VCAA

Toula wanted to stop her dog barking at 6 am and decided to use a strategy involving punishment. For punishment to be most effective, it should be administered

A. two hours after the dog barks, every time.
B. immediately after the dog barks, every time.
C. two hours after the dog barks, some of the time.
D. immediately after the dog barks, some of the time.

Question 3 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q26 (adapted); ©VCAA

Simran's three-year-old child, Ava, regularly throws tantrums when she is not given what she asks for, such as when she asks for chocolate just before dinnertime. Simran sought advice from Ava's kindergarten teacher, who suggested that Simran ignore the tantrums, and when Ava is calm and behaving well, Simran should praise Ava and give her a treat.

If Simran were to give Ava chocolate when she throws a tantrum, Simran would be

A. positively reinforcing the tantrum and increasing the likelihood of them occurring in the future.
B. positively reinforcing the tantrum and decreasing the likelihood of them occurring in the future.
C. negatively reinforcing the tantrum and increasing the likelihood of them occurring in the future.
D. negatively reinforcing the tantrum and decreasing the likelihood of them occurring in the future.

Question 4 (1 mark)

Source: VCAA 2014 Psychology, Section A, Q.46 (adapted); ©VCAA

Dan was born in England, but when he was five years old, his family moved to Australia. When Dan started school in Australia, the other boys teased him because they did not like his English accent; they wanted him to speak with an Australian accent. Dan quickly learned to speak with an Australian accent at school so that the boys would stop teasing him.

Dan quickly learned to speak with an Australian accent as a result of

A. negative reinforcement.
B. positive reinforcement.
C. negative punishment.
D. positive punishment.

Question 5 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.65 (adapted); ©VCAA

Every time that six-month-old Akira is tired, hungry and starts to cry, his mother immediately picks him up and cuddles him. Akira feels comforted by the cuddle and soon stops crying. His mother feels relieved that the crying has stopped.

According to this scenario, Akira is most likely to

A. cry only when he is very tired and hungry.
B. cry more often when he is near his mother.
C. cry very rarely when he is near his mother.
D. continue to cry even after he is picked up by his mother.

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4.5 Comparing classical and operant conditioning

While classical and operant conditioning are two different types of learning, they have some common features. In both classical and operant conditioning there is an *acquisition* process whereby a response is conditioned or learned. In classical conditioning, the association of two stimuli, the NS and UCS, provides the basis of learning. In operant conditioning, behaviour is associated with consequences that follow it. In addition, both types of conditioning are achieved as a result of the repeated *association* of two events that follow each other closely in time.

Figure 4.20 Is this an example of classical or operant conditioning?

In both types of conditioning, the learned response is not necessarily permanent. The response may be lost or disappear (in a process called *extinction.*) In classical conditioning, this takes place over a period when the UCS is withdrawn or is no longer present and the CS is repeatedly presented alone. For instance, when this happened in Pavlov's experiments, the dog eventually ceased salivation (CR) in response to the bell (CS) alone (which had been previously paired with the UCS). In operant conditioning, loss of the response also occurs over time, but after reinforcement is no longer given. For instance, when Skinner stopped reinforcing his rats with food, their lever-pressing eventually disappeared.

There are a number of other major differences between classical and operant conditioning. In operant conditioning the *consequence* of a response is a vital component of the learning process in that a behaviour becomes more or less likely, more or less frequent, or strengthened, depending on its consequence. In classical conditioning, the behaviour of the organism does *not* have any environmental consequence. For example, in Pavlov's experiments, the dog receives food whether or not it salivated. But in operant conditioning, the organism's response (such as lever-pressing) operates or produces effects on the environment (such as the dispensing of a food pellet). These effects or consequences, in turn, influence the recurrence of the response.

4.5.1 The role of the learner

In classical conditioning, the learner is a *passive* participant in the conditioning process. The learner does not have to do anything for the NS, CS or UCS to be presented. Furthermore, the response made by the learner occurs automatically without them having to make any effort or actively do anything. The learner essentially has no control over the learning process.

In operant conditioning, the learner is an *active* participant in the learning process. The learner must operate in the environment before reinforcement or punishment is received. The learner is neither reinforced nor punished without performing the behaviour that produces the consequence. In this sense, the learner has control over the learning process.

4.5.2 Timing of the stimulus and response

In classical conditioning, the response (e.g. salivation) depends on the presentation of the UCS (e.g. meat powder) occurring first. In operant conditioning, the presentation of the reinforcer or punisher depends on the response occurring first. The response (e.g.

pushing the lever) occurs in the presence of a stimulus (e.g. the lever). The reinforcement (e.g. the food pellet) or punisher received as a consequence of the response strengthens or weakens the stimulus–response association.

In classical conditioning, the timing of the two stimuli (NS, then UCS) produces an association between them that conditions the learner to anticipate the UCS and respond to it even if it is not presented. In operant conditioning, the association that is conditioned is between the stimulus (i.e. the lever in a Skinner box) and the response (to push the lever). The response is either strengthened by reinforcement or weakened through punishment.

In classical conditioning the timing of the two stimuli (NS, then UCS) needs to be very close (ideally about half a second) and the sequencing is vital — the NS must come before the UCS. In operant conditioning, while learning generally occurs faster when the reinforcement or punishment occurs soon after the response (behaviour), there can be a considerable time difference between them (especially in humans).

4.5.3 The nature of the response

In classical conditioning, the response is *involuntary* (e.g. salivating or blinking), usually a reflexive, automatic reaction to something happening in the environment (such as the sight of food or the sound of a bell). The response is often one involving the action of the autonomic nervous system, and the association of the two stimuli is often not conscious or deliberate.

Operant conditioning, however, involves *voluntary* responses that are initiated by the organism (such as pressing a lever, using an umbrella, throwing a tantrum or doing homework). In addition, the response may involve the autonomic nervous system but mostly involves higher order brain processes because the response is conscious, intentional and often goal-directed.

Figure 4.21 In operant conditioning, the learner is an 'active' participant in the learning process; in classical conditioning, the learner is a 'passive' participant. This pokie machine player must pay then push a button to receive reinforcement, but she is left guessing as to when a payout might occur.

on Resources

Weblink TED-Ed animation on the difference between classical and operant conditioning 4 m 12 s

4.5 LEARNING ACTIVITY 1

Review

1. Complete the table to summarise similarities and differences between classical and operant conditioning.

Feature	Classical conditioning	Operant conditioning
how a response is acquired		
role of learner		
timing of stimulus and response		
nature of response (reflexive/voluntary)		

2. Consider each of the following scenarios and state whether the behaviour that is described is best explained by classical conditioning, operant conditioning or a combination of both these types of learning. Give a reason for each answer with reference to relevant processes.
   a. Stephanie cries whenever she hears a barking dog. Before this, Stephanie had reached out to pat a stray dog and the dog barked and bit her hand. The next time Stephanie tried to pat the dog, it barked and bit her hand.
   b. Hamish's ex-girlfriend always wore a musk perfume. Hamish still cringes whenever he comes across someone wearing musk perfume.
   c. A father refuses to let his daughter borrow his car after she has 'borrowed' it previously and returned it with a near-empty petrol tank.
   d. Emilia arrives home on time after having been grounded for being home late the last time she went out with her friends.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

4.5 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.10; ©VCAA

Which of the following is a difference between classical conditioning and operant conditioning?

	Classical conditioning	Operant conditioning
A.	learning is more permanent	learning is less permanent
B.	association made between stimuli influences the response	involuntary and automatic response
C.	the response occurs to a specific stimulus for stimulus discrimination	behaviour occurs to similar stimuli for stimulus discrimination
D.	stimulus directly produces the response	antecedent does not directly produce the response

Question 2 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.29; ©VCAA

Orla and Anthony are focused on playing a video game and are talking to each other intently. Orla is excited and does not realise time is passing quickly.

Orla finds it difficult to stop playing the video game.

Which type of conditioning is this likely a result of and why?

	Type of conditioning	Why
A.	operant	Orla progresses to higher levels in the video game than Anthony.
B.	operant	Orla feels excited each time Anthony invites her to play the video game.
C.	classical	Orla get bonus points in the video game when she reaches higher levels.
D.	classical	Orla has been conditioned to keep trying to reach the next level in the video game.

Question 3 (1 mark)

Source: VCAA 2012 Psychology 2, Section A, Q.8; ©VCAA

Danny's older brothers like to pop balloons near him. The sudden loud noise frightens him.

Now, every time Danny sees balloons he becomes fearful. He cries and runs away so that he can avoid the balloons. Danny also cries when he sees beach balls.

Elements of operant and classical conditioning may occur in the same situation.

In the case of Danny, which one of the following responses is evidence of operant conditioning?

A. running away to avoid balloons
B. showing fear and trembling when balloons are presented
C. being very passive before the conditioning process began
D. being very sad and clinging to adults at the conclusion of the conditioning

Question 4 (1 mark)

Source: VCAA 2010 Psychology 2, Section A, Q.43; ©VCAA

Which of the following statements is correct?

A. In classical conditioning reinforcement occurs after the response.
B. In operant conditioning reinforcement occurs before the response.
C. In classical conditioning learners control their response to a stimulus.
D. In operant conditioning learners control their response to a stimulus.

Question 5 (1 mark)

Source: VCAA 2009 Psychology 2, Section A, Q.41; ©VCAA

One of the key differences between classical and operant conditioning is that

A. in classical conditioning responses can be extinguished, while in operant conditioning responses cannot be extinguished.
B. in classical conditioning responses cannot be extinguished, while in operant conditioning response can be extinguished.
C. in classical conditioning learning is based on a reflexive response, while in operant conditioning learning is based on voluntary behaviour.
D. in classical conditioning learning is based on voluntary behaviour, while in operant conditioning learning is based on a reflexive response.

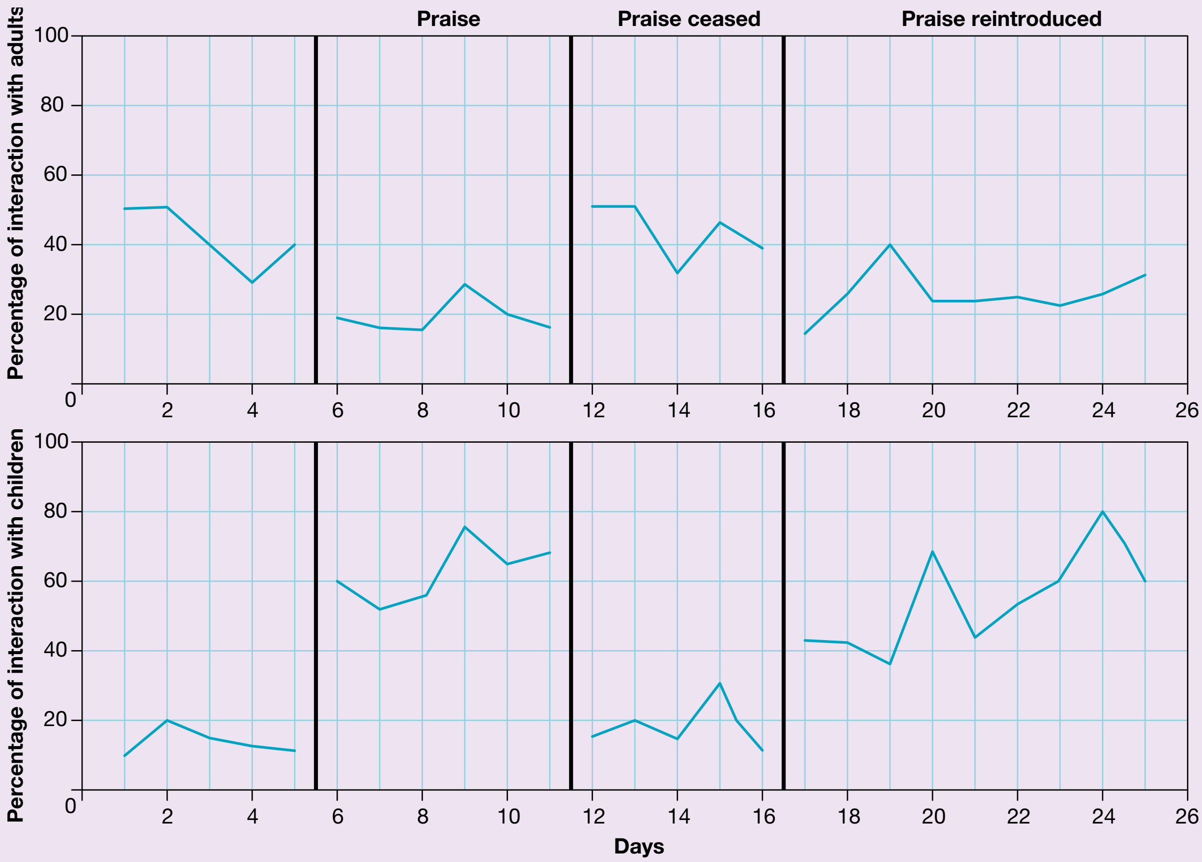
To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

4.5 LEARNING ACTIVITY 3

Analysis and evaluation of research on the use of operant conditioning to change a student's behaviour

A group of preschool teachers worked with a team of psychologists in applying operant conditioning processes to help a young girl overcome her shyness when playing with her peers. The girl spent most of her time at the preschool standing close to her teachers rather than playing with children her own age, and the teachers were concerned that this was interfering with her social development. Like most young children, the girl enjoyed teacher praise, so it was decided that the teachers would only praise her when she played with her peers, and ignore her when she stayed close to them. The results of using praise in this way are shown in the graphs on the next page.

In order to measure learning of the desired response, the teachers initially recorded the frequency with which the little girl played with other children and the frequency with which she interacted with adults. They then began using praise whenever she played with her peers, but gave her very little attention for other interactions. To be certain that the praise alone was responsible for the behavioural change, the teachers stopped using it for a time and then reintroduced it. This is shown in the third and fourth sections of the graphs on the next page. These graphs indicate that the little girl began interacting with adults again once the praise ceased (third section), and recommenced interacting with her peers once the praise was used again (fourth section).



Source: Based on Allen et al. (1964). Effects of social reinforcement on isolate behaviour of a nursery school child. *Child Development*, *35*, 511–518.

a. What is the independent variable?

b. **i.** On which days was the 'control' condition conducted?

ii. What was the purpose of this condition in this particular study?

iii. Write a single word header for section 1 of the graph.

c. In which condition was the young girl's interaction with other children at its lowest? At its highest? What do these data tell you about the success or failure of the program devised by the team of psychologists and undertaken by the teachers?

d. Identify the key elements of operant conditioning, in terms of the three-phase model, that are evident in this study during the

i. 'control' condition before intervention

ii. post-intervention.

e. What are two key features of the reinforcement strategy used for behaviour change?

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4.6 Social-cognitive approaches to learning

While behaviourist approaches emphasise learning through association of different stimuli, social-cognitive approaches emphasise the social context in which learning occurs and cognitive processes that influence the individual and the learning process. The most prominent theory based on the social-cognitive approach was proposed by Canadian-born psychologist Albert Bandura in the 1980s.

Bandura argued that from the time we are born we are surrounded by other people displaying a huge variety of behaviours, all of which we are able to observe. This provides us with a rich source of information about our behaviour in our social world and we can learn from observing the experience of others.

Through observation we learn many behaviours, not by actually carrying out the behaviour and experiencing the consequences, but simply by watching the behaviour and its consequences being experienced by someone else. Moreover, we are more likely to reproduce responses that are observed to be desirable and reinforcing, and avoid behaviours that are observed to be associated with punishment.

However, Bandura argued that learning through observation of others is not a totally separate form of learning from conditioning. His experiments demonstrated that both classical and operant conditioning can occur *vicariously* through observing others. This means that learning can involve being conditioned *indirectly* by observing someone else's conditioning.

Bandura also emphasised that learning through observation involves crucial cognitive processes. A person does not simply 'see' and then automatically reproduce a behaviour without any intervening mental activity. As with the student who observes someone else getting detention for calling out, the observer must become aware of and consciously process information relevant to the observed event. For example, mental processing of information on the consequences for doing what is observed is required, which can in turn influence the observer's expectations of the likely outcome of reproducing the behaviour.

A mental representation must also be stored in memory of what was observed so that it is available for reproduction if the learner chooses to do so. This means that we sometimes learn through observation but what is learnt remains *latent* (unexpressed or 'hidden') without any immediately observable change in our behaviour simply because there is no motivation, reinforcement or need to reproduce it.

Bandura's (1986) *social-cognitive theory*, also referred to more simply as *social learning theory*, has been described as a 'bridge' between the purely conditioning theories of Pavlov and Skinner and contemporary cognitive learning theories. This is because his social-cognitive approach encompasses environmental stimuli, cognitive processes such as attention, memory and motivation, as well as learning processes such as conditioning, reinforcement and punishment.

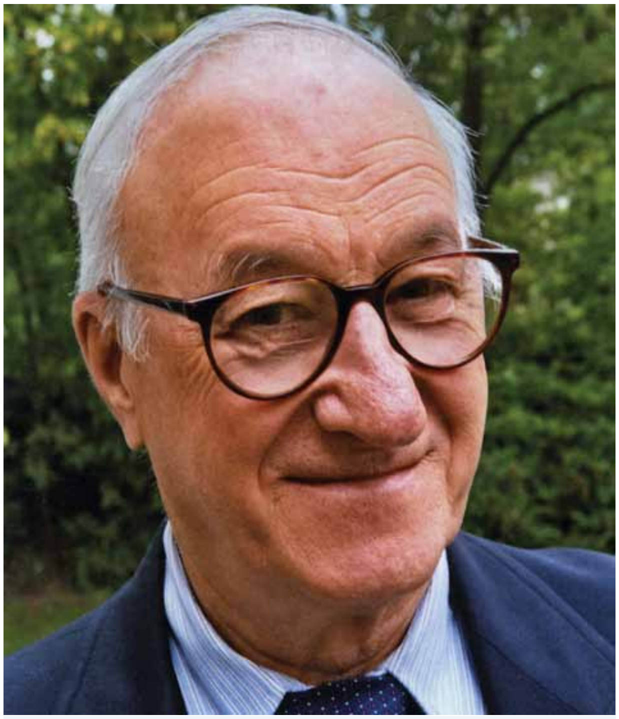

Figure 4.22 Albert Bandura (1925–2021) extensively researched and described observational learning. His studies of observational learning processes with children in particular led him to develop a social-cognitive theory and explain observational learning as a method of social learning.

on Resources

Teacher weblink Two videos on social-cognitive theory 28 m 21 s; 4 m 21 s

4.6 LEARNING ACTIVITY

Review

1. List three key assumptions of the social-cognitive approach to learning.
2. Explain the meaning of vicarious conditioning.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

4.7 Observational learning

Observational learning involves the acquisition of information, skills or behaviour through watching the performance of others, either directly or indirectly via some form of media or other means. Learning is said to occur when someone uses observation of a model's actions and the consequences of those actions to guide their future actions.

A *model* is who or what is being observed and may be live or symbolic. A *live* model is a real-life person who may be demonstrating, acting out and/or describing or explaining a behaviour. A *symbolic model* is a real or fictional character displaying behaviour in books, movies, TV programs, online and other media. As observational learning involves watching models, it is often called *modelling*, sometimes *social learning* or *vicarious learning*.

Attention

In order to learn through observation, we must pay attention to or closely watch a model's behaviour and the consequences. If we do not attend to the model's behaviour, we will not recognise the distinctive features of the observed behaviour. And we may fail to notice the consequences.

Attention may be influenced by several factors. These include the perceptual capabilities of the observer, the motivation and interest level of the observer, the situation in which the behaviour is being observed, the kinds of distracters that are present and the characteristics of the model, such as attractiveness.

Figure 4.23 The reproduction of behaviour modelled by a real-life model (a) and a symbolic model (b)

Our level of attention is also influenced by such factors as the importance of the behaviour (e.g. whether we consider it to be a necessary behaviour, such as keyboarding skills required to obtain a particular job), its distinctiveness (such as whether it is unique, different, unusual) and the effect it might have on us (such as satisfaction, convenience, security).

According to Bandura (1977a), we pay closer attention and are more likely to imitate models who have the following characteristics:

- the model is perceived positively, is liked and has a high status
- there are perceived similarities between features and traits of the model and the observer, such as age and sex
- the model is familiar to the observer and is known through previous observation
- the model's behaviour is visible and stands out clearly against other 'competing' models
- the model is demonstrating behaviour that the observer perceives themselves as being able to imitate.

In general, the greater the similarity between the model and the observer, and the more attractive or successful the model, the more likely we are to follow their example.

Research studies also indicate that the higher the status of the model, the more the observer will imitate the behaviour — which is why many advertisements feature celebrities. Similarly, a cricket coach advising a batter on how to play a straight drive during a cricket match will suggest the batter pays more attention to an elite professional cricketer's style than to that of a weekend cricketer at a local oval.

Retention

Having observed the model, we must be able to remember the model's behaviour. Behaviour learned through observation is often not needed until some time after it has been acquired. We need to store in memory a mental representation of what we have observed, and the more meaningful we can make that representation, the more accurately we will be able to replicate the behaviour when necessary. For example, linking a visual image with a verbal description of the model's actions is an effective strategy to assist the memory processes.

Therefore, the cricketer in the previous example might try to visualise the batting style of the model cricketer, while describing the action as something like: 'He (or she) leans in towards the ball with his front shoulder while his eyes are fixed on the ball. His front foot steps towards the pitch of the ball and he has a high back swing. At the moment of contact his bat is kept straight with wrists relaxed, and his head is over the ball. He also ensures he has a high follow-through after striking the ball.'

Reproduction

When the model's behaviour has been closely attended to and retained in memory, we can attempt to reproduce, or imitate, what has been observed. We must, however, have the ability to put into practice what we observed. For example, we would not be able to imitate someone riding a surfboard if we were paralysed.

Similarly, we must have the potential to be competent enough to develop the necessary skills to imitate the behaviour. For example, no matter how well the cricket stroke-making style of an elite cricket player is lodged in an observer's memory, it is unlikely that this behaviour will be reproduced with the same skill. The elite cricketer may well possess attributes that cannot be learned: his (or her) reflexes and agility, his balance and poise, his perceptual judgments of the trajectory and distance of an incoming ball, and his superior motor coordination.

Figure 4.24 An Australian specialist batter for cricket is a suitable model to whom one could pay attention to develop an excellent batting technique.

Motivation

The observer must also be motivated to perform the behaviour; that is, they must have the desire and want to reproduce what was observed. Unless the behavioural response is useful or provides an incentive or reward for the observer, it is unlikely that they will want to learn it in the first place, let alone perform it or continue to perform it.

Reinforcement

Reinforcement influences the motivation to reproduce the observed behaviour and increases the likelihood of reproduction. Bandura distinguished between different types of reinforcement that impact on motivation, in addition to the standard types described by Skinner.

External reinforcement is comparable to learning by consequences. Thus, if the girl in Figure 4.25 receives a reinforcer such as praise for her leaf collecting or mat waving, then her motivation to become more highly skilled at these tasks will be influenced in a positive way.

Vicarious reinforcement occurs indirectly by observing the modelled behaviour being reinforced without personally experiencing the reinforcement. For example, a young child observing the positive reinforcement received by an older sibling who works hard at school to get into the tertiary course of their choice may well model the same studious behaviour as a result of vicariously experiencing the reinforcement.

Self-reinforcement occurs when we are reinforced by meeting certain standards of performance we set for ourselves; for example, the sense of pride, achievement or fulfilment you may experience if you achieve the end-of-year VCE results you would like to achieve and believe you are capable of achieving.

Although this sense of pride, achievement and fulfilment typifies positive reinforcement, self-reinforcement can also include negative reinforcement. For example, avoiding a future of being bored in a mindless job may also be the self-reinforcement for achieving academic success.

If the modelled behaviour is reinforced, this will motivate the person to repeat those actions; the next time, the person will expect the behaviour to be reinforced. If the behaviour is not reinforced, it is less likely to be repeated. In this case, it could be said that the person lacks the motivation to behave in that particular way. Of course, seeing modelled behaviour being punished also influences a person's motivation to reproduce the observed behaviour — the observer will be less likely to do something when punishment is the observed consequence.

Bandura found that certain personal characteristics of the observer can influence each of the observational learning components. For example, our perception of a model and whether or not we pay attention to what they are doing, as well as the social context in which the modelled behaviour occurs, can be influenced by perceptions of our 'self'.

Figure 4.25 This First Nations girl from Arnhem Land in the Northern Territory is able to reproduce the pandanus leaf collecting and mat weaving skills she has learnt by observing her mother and grandmother.

We are more likely to imitate a model's behaviour if we have low self-confidence and low self-esteem, as compared with people who do not. Self-confidence and self-esteem influence our level of *self-efficacy* — our belief in our ability to accomplish tasks and succeed in particular situations.

According to Bandura (1977b), self-efficacy underlies how we think, feel and behave, and plays a major role in how we approach tasks and goals. Individuals high in self-efficacy are those who believe that they are capable of performing well, and are more likely to view challenges as something to be mastered rather than something to be avoided.

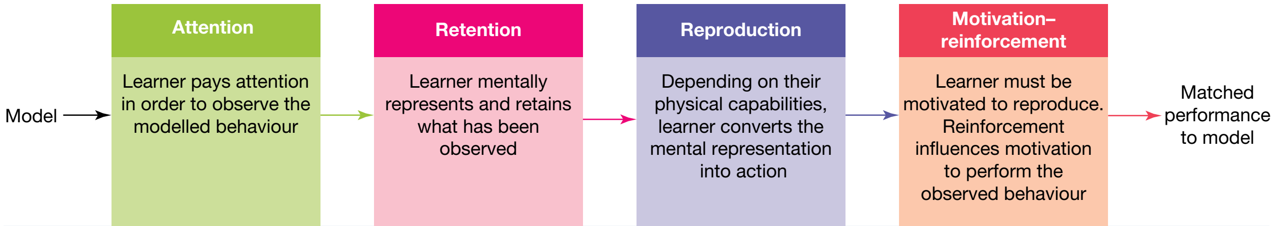

Figure 4.26 The sequence of observational learning processes

4.7 LEARNING ACTIVITY 1

Review

1. Define observational learning with reference to an example.
2. Why is observational learning also referred to as modelling?
3. Distinguish between a live model and symbolic model with reference to relevant examples.
4. Give an example of a learned behaviour that is *not* acquired through observational learning. Explain your choice of example.
5. What is the role of the learner in observational learning?
6. Describe and explain how one of the following ways of thinking, feeling or behaving may have been acquired by someone through observational learning with reference to the sequence of processes. You may present your answer in a flow chart format, as in Figure 4.26.
   - littering in public places
   - offering one's seat on a crowded bus to an elderly person
   - abusing umpires as a spectator of a football match
   - voting preference at a Federal election
   - being empathetic to a friend who is very upset by providing a cuddle, reassurance and an offer of support.
7. Explain how one of your characteristic behaviours may have been acquired through observational learning.
8. In the 1940s, a Japanese violinist and teacher developed the Suzuki method for teaching the violin to very young children. It has since been successfully applied to the learning of all types of musical instruments.

   Suzuki advised parents to teach violin information only when the child is actually looking at and watching the parent. Parents are told to stop teaching and wait if the child is distracted or talks about unrelated things.

   Suzuki had parents present information in ways that a young child can mentally picture or code in some way. Because a three- to four-year-old child has limited language and verbal skills, little time is spent giving verbal instructions. Instead, the child is taught to play the violin through games and musical activities. For example, children are taught how to hold the violin, use the bow and press the strings by playing games with their hands. They are taught how to read musical notes only when they have reached a certain stage of technical skill at playing the violin.

   Suzuki suggested that children start at the earliest age that they can physically perform the required movements and imitate their parents and teachers. Taking account of the physical capabilities of three-to four-year-olds, the violins used are small replicas. Girls are generally allowed to start learning violin at a younger age than boys as they physically mature earlier.

Suzuki emphasised that the most important role of the parents is to constantly reinforce the child for observing and doing what ‘mummy, ‘daddy’ or ‘the teacher’ says. Suzuki suggested several ways to maintain motivation at a high level, such as being an active and interested model for the child, playing violin games that are fun for the child, and avoiding games or lessons that involve competition.

Describe the processes of Bandura’s observational learning theory that are apparent in the Suzuki method.

Present your description in the form of a diagram or flow chart showing the process as a series of steps in their correct order, such as in Figure 4.26.

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4.7 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.11; ©VCAA

William, aged five, adores his big brother Sam, aged seven. Sam recently learnt how to ride a skateboard.

William is also likely to learn how to ride a skateboard due to which stage of observational learning and associated reason?

	Stage of observational learning	Associated reason
A.	attention	William idolises his brother.
B.	retention	William wants to learn how to ride a skateboard.
C.	motivation	William anticipates himself being able to balance on the skateboard.
D.	reproduction	William can create a mental representation of riding a skateboard.

Question 2 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.12; ©VCAA

Hamish wanted to learn yoga but could not afford to attend classes with his friends. Instead, he decided to watch videos on the internet to learn the technical poses. Hamish could describe all of the poses in detail. However, despite practising and the encouragement of his friends, Hamish could not successfully perform each pose.

Which aspects of observational learning did Hamish most likely achieve?

A. attention, retention, motivation, reproduction
B. attention, retention, motivation, reinforcement
C. motivation, attention, reproduction, reinforcement
D. motivation, retention, reproduction, reinforcement

Question 3 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.53; ©VCAA

Phoebe is eight years old and loves playing cricket. She really admires the Australian female cricket captain, who has blonde hair, like Phoebe, and often hits balls over the fence for six runs. She tells her father, ‘I’m going to be like her one day and play for Australia and be on TV like she is’.

The stage of observational learning that most applies to Phoebe choosing the female captain as the model for her behaviour is

A. attention.
B. retention.
C. motivation.
D. reproduction.

Question 4 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.31; ©VCAA

Patsy was attempting to build a car from blocks that her grandmother, Merran, had given her. She was very eager to please Merran by making the car out of blocks as quickly as possible. Initially, Patsy took 20 minutes to connect the pieces correctly. She did not follow the instructions, made many mistakes, and needed to pull it apart and start again. Eventually, Patsy finished the car and was very pleased with herself. Merran praised Patsy for her effort in completing the car.

Patsy's little brother, Max, watched her build the car with the blocks. Max then built the car on his own.

Max's motivation for building the car was most likely

A. Patsy's praise of Max.
B. Merran's praise of Patsy.
C. playing with the completed car.
D. piecing the car together more quickly than Patsy.

Question 5 (1 mark)

Source: VCAA 2014 Psychology Exam, Section A, Q.45; ©VCAA

Romish began to crawl at 10 months and started to read and write simple words at age four. His parents tried to teach him to walk, and to read and write at the earliest possible age by demonstrating the desired behaviour, and then smiling and clapping if Romish reproduced a similar behaviour.

The strategy used by Romish's parents is best described as using elements of

A. operant conditioning.
B. classical conditioning.
C. observational learning and operant conditioning.
D. observational learning and classical conditioning.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

4.8 Aboriginal and Torres Strait Islander ways of knowing

Aboriginal and Torres Strait Islander peoples are among the oldest known continuous cultures in the world. There is a diversity of nations, clans, languages, cultural practices and spiritual beliefs that have survived for over 50 000 years. Their knowledge systems represent the oldest and longest continuing forms of learning and knowledge production in Australia.

Aboriginal and Torres Strait Islander peoples' ways of knowing and learning are holistic and relational to Country – the land, waterways and seas to which they are connected through ancestral ties and family origins. The connection to Country is spiritual and physical, including responsibility for physical safeguarding of the land.

Demonstrating where one is from - what Country and cultural group they belong to - is critical to any Aboriginal and Torres Strait Islander person in their self-identity and when introducing oneself to other First Nations people. Connection to Country also has ongoing life responsibilities to the land where a person is born or where their ancestors were born (Gee et al., 2014).

The vast amount of knowledge accumulated by Aboriginal and Torres Strait Islander people over many thousands of years is embedded in Country, and their ways of knowing and learning are embedded within the different relationships they have as learners, including with family, community, the land, waters, and the skies which reflect everything on the land.

According to Joe Williams (2022), First Nations author and adjunct associate professor at the School of Psychology, University of Queensland, the reason why Aboriginal and Torres Strait Islander knowledge systems have lasted many thousands of years is 'due to the intimate and respectful relationships we have with all things between the people and Country. Respecting Country, and everything that is on and a part of Country, is what makes the essence of the relationship so strong.'

Knowledge is attached to numerous locations along navigational tracks (songlines) throughout Australia. The knowledge is often in multimodal form and is shared and learnt in multimodal ways, such as narratives (stories), song, dance and ceremony. The crucial role of songlines in learning and memory is described in topic 5.

Connection to people, the relationship to each other, animals and plant life, and the earth, are integral in the cultures of Aboriginal and Torres Strait Islander people. When human beings interact as communal people, the connection to each other and the modelling of behaviours in 'natural' contexts are picked up and replicated generationally. Basically, Aboriginal and Torres Strait Islander people model behaviours to their young people, those young people in return mimic and replicate the same or similar behaviours.

Relationship to each other and to story of the land, living by the values that were taught has been pivotal in learning and sharing the behaviours associated with Aboriginal and Torres Strait Islander cultures.

Over thousands of years, learning has existed due to the story of the landscape — telling stories on Country, walking Country and learning the story that is written within the land. According to Williams (2022),

> 'Every mountain range, creek and river have stories that tell us how they came to be. The knowledges, the values, the lessons of those stories have been shared within family and kin systems and handed down through the generations over many thousands of years.
>
> The stories of the land and seas make up knowledge systems. Over many thousands of years, first peoples have lived by and with those stories. It is in these stories, the values within the stories, that teach us how we should be behaving. The more we connect to and live with these values in our life, the more it impacts our behaviours and how we should be living.
>
> We believe everything is now and has always been living. The stories tell us, it is not only the things that appear physically to be alive such as humans, animal and plant life, but everything. Every animal, every rock, every tree. It is in the ancient knowledge and belief systems we believe that all things come from a place of living spirit; everything has spirit and spirit continues to live.
>
> There are stories for everything with spirit, on land and in the seas. Everything comes from a place of spirit. Every animal, every plant and everything being. It is in these stories, where the values of how we are to behave are stored.
>
> These behaviours hold a particular value. Behaviours repeated over time is what forms a culture of expectation. It is these values that impact physically on how people should be behaving in community interactions. Every person must uphold the responsibilities of the old stories, but not only live by them. When we know and live by these values and stories, we must behave with obligations of helping others to achieve the same.'

Figure 4.27 Aboriginal and Torres Strait Islander ways of knowing and learning are holistic and relational to Country — the land, waterways and seas to which they are connected through ancestral ties and family origins.

4.8 LEARNING ACTIVITY

Multiple-choice questions

1. Aboriginal and Torres Strait Islander peoples' ways of knowing are dependent on _____ and _____.
   A. formal schooling; quality teaching
   B. written communication; culture
   C. multimodal oral communication; relationships
   D. multimodal communication; demonstrating where one is from
2. The entire body of Aboriginal and Torres Strait Islander peoples' knowledge that has been transmitted through numerous generations is embedded in
   A. knowledge systems.
   B. spiritual beliefs.
   C. Country.
   D. holistic individuals.
3. The process of sharing and learning vital knowledge within Aboriginal and Torres Strait Islander communities is primarily influenced by
   A. Country.
   B. cultural practices.
   C. the land, waterways and seas.
   D. different forms of multimodal knowledge.
4. Aboriginal and Torres Strait Islander people model behaviours to their young people, those young people in return mimic and replicate the same or similar behaviours. This learning process primarily involves
   A. classical conditioning.
   B. operant conditioning.
   C. associative learning.
   D. observational learning.
5. Which one of the following will best assist learning of crucial knowledge by Aboriginal and Torres Strait Islander people?
   A. books
   B. pen and paper
   C. oral narratives
   D. digital media (including internet)

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

4.9 Review

Topic summary

- **Behaviourist approaches to learning**
- **Classical conditioning as a three-phase process**
  - The three-phase model of classical conditioning
  - Factors that influence classical conditioning
    - Nature of the response
    - Association of stimuli
    - Timing of the NS and UCS pairing
- **Operant conditioning**
  - The three-phase model of operant conditioning
  - Reinforcement
    - Positive reinforcement
    - Negative reinforcement
  - Punishment
    - Positive punishment
    - Negative punishment
  - Factors that influence the effectiveness of reinforcement and punishment
    - Order of presentation
    - Timing
    - Appropriateness
- **Comparing classical and operant conditioning**
  - The role of the learner
  - Timing of the stimulus and response
  - The nature of the response
- **Social-cognitive approaches to learning**
- **Observational learning**
  - Attention
  - Retention
  - Reproduction
  - Motivation
  - Reinforcement
- **Aboriginal and Torres Strait Islander ways of knowing**

Key terms

antecedent p. 285
attention (in observational learning) p. 305
behaviour p. 286
behaviourist approach (to learning) p. 273
behaviourism p. 273
classical conditioning p. 276
conditioned response (CR) p. 277
conditioned stimulus (CS) p. 277
conditioning p. 271
consequence p. 286
discriminative stimulus p. 286
learning p. 270
maturation p. 276
motivation (in observational learning) p. 307
negative punishment p. 293
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neutral stimulus (NS) p. 277
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operant p. 284
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vicarious conditioning p. 304
vicarious punishment p. 304
vicarious reinforcement p. 307
unconditioned response (UCR) p. 276
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way of knowing p. 310

Note: The **References** for the entire title can be accessed in learnON and are also available as a downloadable PDF.

on Resources

Digital documents	Key terms glossary — Topic 4 (doc-37101) Topic summary — Topic 4 (doc-37102) Key diagrams PowerPoint — Topic 4 (doc-37104)
Exam question booklet	Exam question booklet — Topic 4 (eqb-0097)

4.9 Topic 4 test

Section A: 35 marks **Section B:** 60 marks **Total:** 95 marks

Access learnON to answer the following test questions online and receive **immediate feedback**.

Section A — Multiple-choice questions

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

Source: VCAA 2017 Psychology, Section A, Q.21; ©VCAA

Millie the dog is always fed her dinner in the garage. Now Millie salivates every time her owner, Priya, opens the garage door.

Millie's response of salivating every time the garage door is opened is the

A. neutral stimulus.
B. conditioned response.
C. conditioned stimulus.
D. unconditioned stimulus.

Question 2

Source: VCAA 2016 Psychology, Section A, Q.27; ©VCAA

Simran's three-year-old child, Ava, regularly throws tantrums when she is not given what she asks for, such as when she asks for chocolate just before dinnertime.

Simran sought advice from Ava's kindergarten teacher, who suggested that Simran ignore the tantrums, and when Ava is calm and behaving well, Simran should praise Ava and give her a treat.

If Simran gave Ava chocolate just before dinnertime and Ava's tantrum subsequently stopped, Simran's behaviour would be

A. positively reinforced, increasing the likelihood of her giving Ava chocolate the next time she throws a tantrum.
B. positively reinforced, decreasing the likelihood of her giving Ava chocolate the next time she throws a tantrum.
C. negatively reinforced, increasing the likelihood of her giving Ava chocolate the next time she throws a tantrum.
D. negatively reinforced, decreasing the likelihood of her giving Ava chocolate the next time she throws a tantrum.

Question 3

Which of the following statements is **not** true of learning?

A. Learning involves some sort of experience.
B. Learning involves responses that are inborn or instinctive.
C. Learning involves a relatively permanent change in behaviour.
D. Learning involves some sort of change in the organism.

Question 4

Source: VCAA 2014 Psychology, Section A, Q.55; ©VCAA

Miss Athorn set up a practical activity for her Psychology class. She gave each student a packet of sherbet powder with a small spoon. First, Miss Athorn asked the students to put a spoonful of sherbet powder on their tongues and notice the salivation response produced by tasting the sherbet. Then, she told the students to continue with their work, but to be ready to quickly eat a spoonful of sherbet powder every time she blew a whistle.

Miss Athorn blew her whistle 10 times during the lesson and, each time, the students ate some sherbet powder. Towards the end of the class, Miss Athorn took the sherbet powder away. Then she blew the whistle again and asked the students if they noticed a salivation response. Most of the class reported that they salivated. Miss Athorn then blew the whistle five more times without the students having any sherbet powder. By the fifth time, all of the students said that salivation had stopped.

The unconditioned response (UCR) and the conditioned response (CR) respectively were

A. salivation to tasting sherbet, no response.
B. no response, salivation to tasting sherbet.
C. salivation to the whistle, salivation to tasting sherbet.
D. salivation to tasting sherbet, salivation to the whistle.

Question 5

The social-cognitive approach to learning was pioneered by

A. Bandura
B. Skinner
C. Pavlov
D. Watson

Question 6

Which of the following behaviours is a learned behaviour?

A. the transition from nappies to underpants
B. washing your hands after using the toilet
C. the transition from crawling to walking
D. salivating at the smell of freshly baked bread

Question 7

Which of the following is the simplest form of learning?

A. classical conditioning
B. operant conditioning
C. social-cognitive learning
D. observational learning

Question 8

Source: VCAA 2015 Psychology, Section A, Q.3; ©VCAA

In classical conditioning, the learned response is

A. voluntary, whereas in operant conditioning the learned response is reflexive.
B. reflexive, whereas in operant conditioning the learned response is voluntary.
C. involuntary, whereas in operant conditioning the learned response is reflexive.
D. spontaneous, whereas in operant conditioning the learned response is involuntary.

Question 9

Source: VCAA 2015 Psychology, Section A, Q.4; ©VCAA

Which one of the following elements is involved in classical conditioning but not in operant conditioning?

A. extinction
B. acquisition
C. punishment
D. an involuntary response

Question 10

Source: VCAA 2015 Psychology, Section A, Q.32; ©VCAA

Patsy was attempting to build a car from blocks that her grandmother, Merran, had given her. She was very eager to please Merran by making the car out of blocks as quickly as possible. Initially, Patsy took 20 minutes to connect the pieces correctly. She did not follow the instructions, made many mistakes, and needed to pull it apart and start again. Eventually, Patsy finished the car and was very pleased with herself. Merran praised Patsy for her effort in completing the car.

To successfully build the car, which was the correct order of processes that Max followed?

A. attention, retention, reproduction, motivation
B. motivation, attention, retention, reproduction
C. motivation, retention, attention, reproduction
D. attention, retention, motivation, reproduction

Question 11

Source: VCAA 2014 Psychology, Section A, Q.53; ©VCAA

Edward loved and admired his grandmother. Edward always watched carefully as his grandmother knitted. Edward's grandfather always praised Edward's grandmother for her beautiful knitting. Edward praised her too. One day, Edward decided to try knitting. His grandfather saw him knitting and praised his skill. When Edward's grandmother heard that he was trying to knit, she spent an hour teaching him and praised him on his efforts.

Vicarious reinforcement may have occurred when

A. Edward praised his grandmother.
B. Edward's grandfather praised Edward's knitting skills.
C. Edward heard his grandfather praise his grandmother's knitting.
D. Edward's grandmother taught Edward more knitting skills and then praised him.

Question 12

Source: VCAA 2013 Psychology, Section A, Q.58 (adapted); ©VCAA

Jane has to walk down a long, dark corridor from her bedroom to get to the bathroom at night. Often, her brother, John, jumps out from behind one of the doors along the way and frightens her. After this happens a few times, Jane's heart races and she feels very fearful as soon as she steps into the corridor at night, even when John is not there.

Which one of the following best describes Jane's experience?

A. operant conditioning
B. classical conditioning
C. observational learning
D. a response dependent on maturation

Question 13

Source: VCAA 2016 Psychology, Section A, Q.25 (adapted); ©VCAA

Simran's three-year-old child, Ava, regularly throws tantrums when she is not given what she asks for, such as when she asks for chocolate just before dinnertime. Simran sought advice from Ava's kindergarten teacher, who suggested that Simran ignore the tantrums, and when Ava is calm and behaving well, Simran should praise Ava and give her a treat.

Which one of the following best describes the kindergarten teacher's suggested strategy of ignoring Ava's tantrums?

A. operant conditioning that reinforces the response
B. classical conditioning that reinforces the response
C. operant conditioning that extinguishes the response
D. classical conditioning that extinguishes the response

Question 14

Source: VCAA 2015 Psychology, Section A, Q.26 (adapted); ©VCAA

Vicki wanted to teach her dog, Misha, to sit on command. When first teaching Misha, Vicki would say 'sit' and then would give Misha a pat and a dog biscuit every time Misha sat on command. After a number of training sessions, Vicki noticed that Misha began to salivate whenever she said 'sit'.

Eventually, Misha sat and salivated whenever she saw Vicki, despite Vicki not asking Misha to sit.

In this situation, Vicki is the

A. stimulus.
B. conditioned stimulus.
C. discriminative stimulus.
D. unconditioned stimulus.

Question 15

In classical conditioning, an unlearned involuntary response to an unconditioned stimulus is called a/an

A. neutral stimulus.
B. conditioned stimulus.
C. unconditioned response.
D. conditioned response.

Question 16

In classical conditioning, the learner is relatively _____ when either the neutral or unconditioned stimulus is presented, whereas in operant conditioning the learner must be _____ to obtain a reinforcer.

A. active; neutral
B. passive; active
C. passive; neutral
D. active; passive

Question 17

In operant conditioning, an antecedent stimulus enables the organism to

A. predict the likely consequence of a specific response.
B. respond automatically to a specific stimulus.
C. perform a previously learned response that has remained unexpressed due to the absence of a reinforcer.
D. distinguish between responses that will and will not impact on the environment.

Question 18

In classical conditioning there is always a specific _____ that elicits the desired response, whereas in operant conditioning the _____ must first produce the desired response.

A. operant; stimulus
B. reflex; learner
C. stimulus; learner
D. reflex; reinforcer

Question 19

A mother asks her daughter to switch off the TV. The daughter refuses because her favourite program is on. The mother reacts to her daughter's disobedience by sending her to the laundry, where she is required to sit and do nothing for 10 minutes.

In this example, sending the daughter to the laundry is an example of

A. positive reinforcement.
B. negative reinforcement.
C. positive punishment.
D. negative punishment.

Question 20

A factory worker decides that timing a trip to the toilet to coincide with weekly team meetings with his supervisor and other factory workers allows him to avoid being reprimanded for not working hard enough. In this situation, going to the toilet to avoid being told off is an example of

A. positive reinforcement.
B. negative reinforcement.
C. negative punishment.
D. positive punishment.

Question 21 (1 mark)

Source: VCAA 2008 Psychology 2, Section A, Q.25; ©VCAA

In classical conditioning, a conditioned response is

A. an unlearned reaction to a stimulus.
B. a learned reaction to a stimulus.
C. a stimulus that evokes a response.
D. a previously neutral stimulus that has acquired the capacity to evoke a learned response.

Question 22

Source: VCAA 2011 Psychology 2, Section A, Q.13 (adapted); ©VCAA

When Spot was a puppy he was taken to the vet several times to get his injections. Dr Brown gave the injections each time, and each time Spot experienced pain. Since then, each time Spot is taken to the vet and sees Dr Brown, he becomes fearful and trembles.

The type of learning experienced by Spot is best described as

A. classical conditioning.
B. operant conditioning.
C. observational learning.
D. vicarious learning.

Question 23 (1 mark)

Source: VCAA 2010 Psychology 2, Section A, Q.27; ©VCAA

Every time Robert opened a can of dog food in the laundry, his new puppy Max responded by turning around in circles and barking. After a couple of weeks, Robert noticed that Max turned around in circles and barked every time Robert went into the laundry, even if he did not have the can-opener or the dog food with him.

After conditioning, Max's behaviour of turning around in circles and barking was the

A. neutral stimulus.
B. conditioned stimulus.
C. conditioned response.
D. unconditioned response.

Question 24 (1 mark)

Source: VCAA 2008 Psychology 2, Section A, Q.30; ©VCAA

When Elijah was a child he spent many happy weekends with his grandmother and they had lots of fun baking scones together. Now whenever Elijah smells freshly baking scones he feels happy.

The feeling of happiness when Elijah smells the scones is

A. an unconditioned stimulus.
B. an unconditioned response.
C. a conditioned stimulus.
D. a conditioned response.

Question 25

Which of the following is the most significant influence on Aboriginal and Torres Strait Islander peoples' customary ways of learning and knowing?

A. Country
B. knowledge systems
C. personal beliefs
D. access to schooling

Question 26

Which of the following statements about Aboriginal and Torres Strait Islander peoples' customary ways of learning and knowing is correct?

A. Aboriginal and Torres Strait Islander knowledge systems are reliant on written communication.
B. Aboriginal and Torres Strait Islander ways of knowing and learning are holistic and relational.
C. Aboriginal and Torres Strait Islander knowledge systems are embedded within all young people.
D. Aboriginal and Torres Strait Islander ways of knowing and learning have not survived colonisation.

Question 27

Which of the following is not an example of observational learning?

A. A new student learns vicariously that Mr Brown puts poorly behaved students on detention.
B. A piano student watches the technique of her instructor to learn how to play a difficult piece of music.
C. A teacher works alongside a school principal for a week to learn about the role.
D. A student whose VCE results are very disappointing learns how much work was required to achieve the university entrance score she needed.

Question 28

As a child you were playing in the backyard one day when a big black crow landed near you. Your father suddenly screamed and snatched you into his arms. His unusual behaviour caused you to cry. You now have a fear of big black birds.

Your reaction of crying when your father grabbed you is the _____, and the fear of big black birds you now have is the _____.

A. unconditioned response; conditioned response
B. conditioned response; unconditioned response
C. neutral stimulus; unconditioned response
D. unconditioned stimulus; neutral stimulus

Question 29

According to social-cognitive approach to learning,

A. learning may be unexpressed unless a person is motivated to reproduce observed behaviour.
B. learning may be described as any change in behaviour.
C. an antecedent must be present for a particular learned response to occur.
D. reinforcement is a vital element of classical conditioning.

Question 30

During classical conditioning, the _____ is paired with the _____.

A. conditioned stimulus; conditioned response
B. neutral stimulus; unconditioned stimulus
C. unconditioned stimulus; unconditioned response
D. conditioned stimulus; neutral stimulus

Question 31

Source: VCAA 2006 Psychology 2, Section A, Q.29; ©VCAA

The word 'operant' in Skinner's operant conditioning refers to

A. the environment in which an organism is conditioned.
B. The process by which an organism learns to discriminate between different types of reinforcers.
C. An organism's response or behaviour that acts on the environment and leads to some sort of outcome.
D. The positive or negative outcome of an organism's behaviour.

Question 32

Source: VCAA 2009 Psychology 2, Section A, Q.42; ©VCAA

Sam vividly remembers an occasion when his older brother Jason was very ill after eating too many chocolates.

After this, Sam has never eaten more than one or two chocolates at a time.

The effect on Sam's behaviour of witnessing Jason's illness is an example of

A. negative reinforcement.
B. positive reinforcement.
C. maturation.
D. modelling.

Question 33

Jason remembers seeing his brother James sustain a serious injury as a result of sticking his arm out of a car window. Since the incident, Jason has never attempted to put his arm, or any other part of his body, out the window of a moving vehicle.

In this example, Jason has observed _____, and has been vicariously _____ not to repeat his brother's behaviour.

A. reinforcement; punished
B. modelling; conditioned
C. punishment; conditioned
D. reinforcement; conditioned

Question 34

Which of the following presents the elements of the observational learning process in the correct order?

A. attention, retention, reproduction, motivation, reinforcement
B. attention, retention, motivation, reinforcement, reproduction
C. attention, reproduction, retention, motivation, reinforcement
D. attention, reproduction, retention, reinforcement, motivation

Question 35

A difference between negative reinforcement and punishment is that negative reinforcement _____ a response, whereas punishment _____ a response.

A. strengthens; weakens
B. always involves an unpleasant consequence for; does not necessarily elicit
C. weakens; strengthens
D. always involves a pleasant consequence for; always elicits

Section B

Question 1 (1 mark)

Culturally significant Aboriginal and Torres Strait Islander peoples' knowledge is embedded in _____.

Question 2 (1 mark)

Source: VCAA 2008 Psychology 2, Section B, Q.9a; ©VCAA

James used to enjoy his job working in an office. However, for some time, James has been constantly criticised by his supervisor. James now feels anxious whenever he arrives at work.

Name the type of conditioning that has caused James to be anxious whenever he arrives at work.

Question 3 (1 mark)

Define the meaning of learning.

Question 4 (1 mark)

Bianca teaches her pet rabbit to come to her when she makes a short, high-pitched whistling sound. At first, she gently approaches the rabbit, whistling and holding a carrot, but stops within half a metre or so of the rabbit. The rabbit approaches and nibbles the carrot. Gradually, Bianca expands the distance between herself and the rabbit. Every time Bianca whistles, she presents the carrot. Eventually, the rabbit learns that approaching Bianca after hearing a whistle generally results in a reward.

This example illustrates the use of _____ in the process of operant conditioning.

Question 5 (2 marks)

Distinguish between classical and operant conditioning in relation to each of the following features.

a. timing of the stimulus and response. 1 mark

b. nature of the response 1 mark

Question 6 (7 marks)

Source: VCAA 2021 Psychology, Section B, Q.5; ©VCAA

Achara was sharing stories with her son Kris about his childhood. Achara told Kris that every time they visited a supermarket, he would cry for her to buy chocolates. Achara was able to stop Kris from crying by ignoring his crying and continuing with her shopping.

a. According to operant conditioning, what were the antecedent, behaviour and consequence for Achara in this story? 3 marks

b. What type of consequence for Achara is demonstrated in this story? 1 mark

c. With reference to operant conditioning, describe another way Achara could have stopped Kris from crying. 3 marks

Question 7 (3 marks)

Source: VCAA 2020 Psychology, Section B, Q.4a; ©VCAA

Advertisers often use learning principles when promoting products. An advertisement for a new soft drink features people having a good time while consuming the product. This is intended to make potential customers experience positive emotions when thinking about the soft drink.

What type of conditioning is used to generate positive emotions towards the new soft drink? Give two reasons to justify your response.

Question 8 (2 marks)

Source: VCAA 2015 Psychology, Section B, Q.10c (adapted); ©VCAA

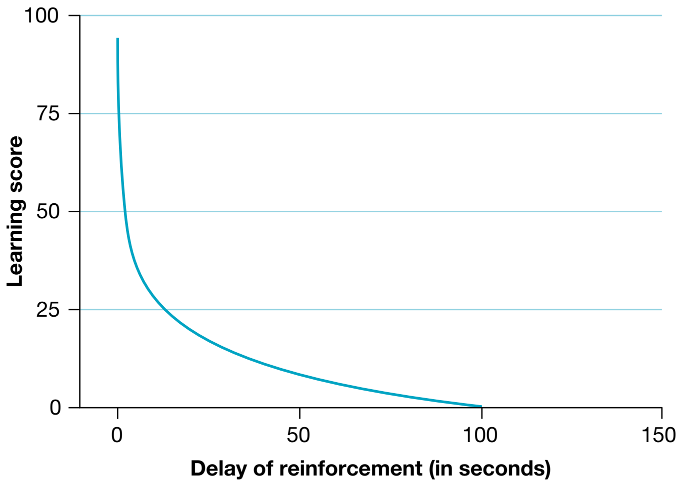
Every evening after school, Najida's father pestered her to do her homework. After a lot of pestering, Najida did her homework to make her father's pestering stop.

Najida's mother decided she would withdraw Najida from her favourite weekend activity every time Najida did not do her homework.

Name the learning principle Najida's mother is applying and state why this may be effective in getting Najida to do her homework.

Question 9 (2 marks)

What do the experimental results in the following graph suggest about timing of reinforcement as a variable that influences its effectiveness?



Question 10 (3 marks)

William winces and covers his ears whenever someone blows up a balloon as he is fearful that it will burst with a loud bang.

Explain how William may have acquired this fear through classical conditioning.

Question 11 (4 marks)

Mr Ying is a young, handsome Psychology teacher who has just been appointed to a girls' college. Unfortunately, his Psychology class is so distracted by his appearance that they find it difficult to focus on their work and on his instructions. There is a lot of giggling, whispering and a general lack of attention.

Mr Ying is determined to make a good impression with his classroom control and with his teaching methods. He decides to use detention as a means of pulling the girls' behaviour into line. He runs a lunchtime detention session for six girls whose behaviour has been the worst. In the next class, not only do these six girls misbehave, but they are joined at the next detention by four others. This trend continues until it is not long before almost the entire class is on detention.

a. Which operant conditioning procedure is Mr Ying trying to use to change the girls' behaviour? 1 mark

b. Explain whether this procedure will be effective. 2 marks

c. How could Mr Ying change his strategy with the girls and still use operant conditioning? 1 mark

Question 12 (4 marks)

Source: VCAA 2016 Psychology 2, Section B, Q.11a; ©VCAA

Tim was once fined for crossing the road at an intersection when the pedestrian signal was red. Now he always crosses legally, when the pedestrian signal is green.

Using the three-phase model of operant conditioning, explain why Tim has now learnt not to cross the road when the pedestrian signal is red.

Question 13 (5 marks)

Research studies have found that adolescents are more likely to begin smoking cigarettes if their parents, siblings and friends smoke. Explain this finding in terms of the observational learning model.

Question 14 (8 marks)

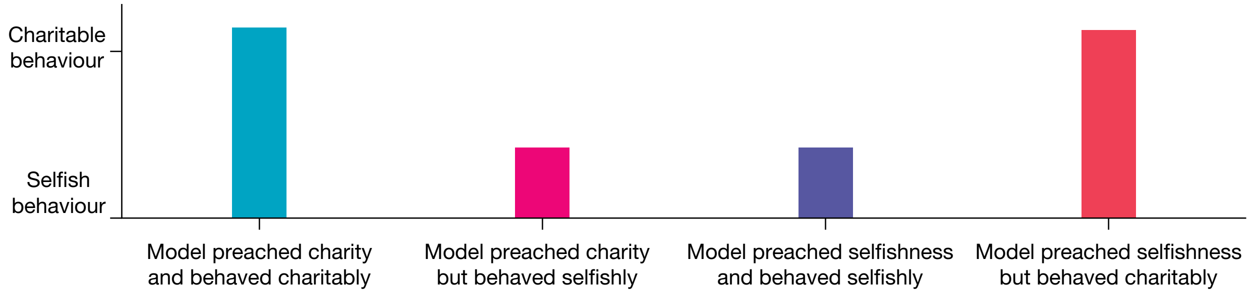
During a close soccer match, an opponent tackles Jack roughly. Jack retaliates by starting a fight with the opponent. Jack's coach considers the behaviour unacceptable and suspends him for one match, which also means Jack will not get paid for playing at a time when he needs the money. When Jack next plays and is again tackled roughly, he reacts by telling off the player and complaining to the referee, stopping short of starting another fight.

a. Explain whether the scenario is an example of positive or negative reinforcement or punishment. 2 marks
b. Analyse and describe the scenario in terms of the three-phase model of operant conditioning. 6 marks

Question 15 (10 marks)

A psychologist had four groups of five- to seven-year olds hear and see an adult engage in specific behaviour. Group 1 heard and saw an adult being generous and saying that it was good to donate things to poor children. The adult was then seen giving some valuable items to charity. Group 2 heard the adult talking generously, but the adult did not give anything away. Group 3 heard an adult saying that it was all right to be greedy and asking why they should give their money to anyone else. The adult then refused to make a donation. Group 4 heard the greedy adult talking, but then saw the adult being generous.

The children were then each given some stickers that could be traded for lollies. They were asked if they would like to donate some of their lollies to poor children. The results are shown in the graph below.



a. Suggest an aim for the research. 1 mark
b. Formulate a research hypothesis that could have been tested in the experiment. 1 mark
c. Identify the independent and dependent variables. 2 marks
d. Name the type of experimental research design. 1 mark
e. Draw a conclusion from the results in relation to your hypothesis. 1 mark
f. Are the results consistent with observational learning theory? Explain your answer. 2 marks
g. Explain the relevance of informed consent and debriefing to this particular study and how these ethical standards could be adhered to. 2 marks

The following information relates to questions 16 to 18.

A researcher wanted to demonstrate that children of three and four years of age could be influenced by behaviour they observed around them.

The researcher selected two groups of ten children, ensuring that they were as alike as possible in age, intelligence and personality. The children were then randomly allocated to each of two different groups. Each group watched a different Punch and Judy puppet show. Group A, which consisted of seven girls and three boys, saw Punch behaving very badly. He laughed when he saw Judy fall over and wouldn't help her to stand up. Group B, which consisted of six girls and four boys, saw Punch become upset when Judy fell over and went to help her straight away.

The children were then observed in their playgroups for the next week and the number of times each child ignored another who was upset or went to help was counted.

The results are shown in the following table.

Group	Offers to help	Times ignored
Group A	7	18
Group B	21	5

Question 16 (2 marks)

Identify the independent and dependent variables.

Question 17 (2 marks)

Formulate a research hypothesis for the experiment that would be supported by the results obtained.

Question 18 (2 marks)

Explain whether the results support observational learning theory.

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on Resources

Go to learnON to access answers to the Topic 4 test. A customisable Word version of the test can also be downloaded from the **Digital documents** tab of the Resources panel.

learnMORE | Applications of classical conditioning

Classical conditioning is a systematic procedure through which associations between stimuli or events in the environment are learned, resulting in a conditioned response. It is considered a relatively simple type of learning, but one which accounts for many of our learned responses and behaviours. Behaviours that have been classically conditioned may occur so automatically that they appear to be reflexive. In fact, Pavlov used the term ‘conditioned reflex’ to describe what has since come to be known as a conditioned response. Essentially, classically conditioned responses are conditioned reflexes that are acquired through associative learning; that is, they are ‘conditional’ upon an organism’s experience.

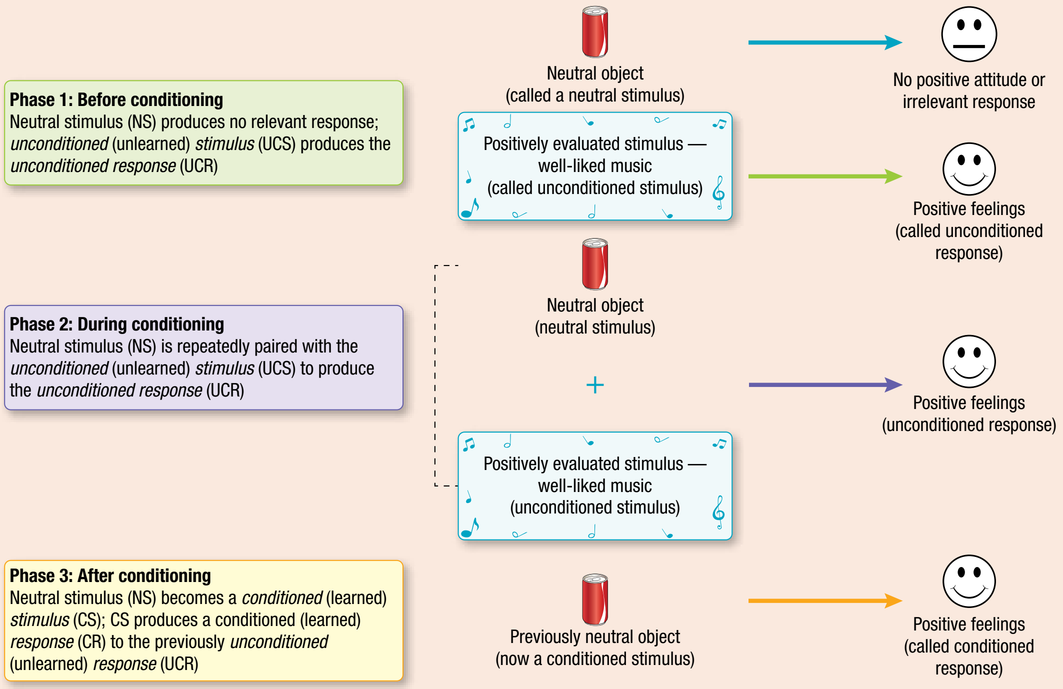
By learning to make associations between stimuli through everyday experience, we gain information about our environment, some of which we take for granted but which is nevertheless valuable. Classical conditioning can account for the learning of many relatively simple responses in everyday life, such as learning to pack up your books at the sound of the bell to end the lesson, to answer the doorbell or phone when it rings, to leave your umbrella at home when there is a clear blue sky, to expect a crack of thunder following a flash of lightning and to check your mobile phone for a text message when you hear it play a specific tone. However, classical conditioning can also account for more complex behaviours such as fears and phobias, which are examined in Topic 9. Its principles have also been applied to the development of therapies used by psychologists and psychiatrists. In addition, classical conditioning principles have been applied to the treatment of persistent bedwetting and there are also many examples of their use by advertisers.

Advertising

Advertisers often use classical conditioning in an attempt to get consumers to associate a product or service with a particular person, object or event. For example, soft drink or fast food advertisements that show young, attractive people having fun use a neutral object (the drink or food item) and try to create positive associations with it. The intention is that consumers will learn to associate the product with good times and consequently buy the product.

Another way that advertisers use classical conditioning to influence our attitudes to products is by contracting celebrities or well-known sporting identities to endorse products. For example, many professional sportspeople wear brand-name logos on their sports gear. Again, the intention is that the advertisers want consumers to learn to associate their product with the skills and success of the athlete endorsing the product.

In this advertisement, singer Jessie J is endorsing a brand of cosmetics.



By repeatedly pairing a product with stimuli that targeted consumers are likely to feel positive about, the advertiser is using classical conditioning to make people learn to associate positive feelings with the product.

Behaviour therapies

In most cases, a conditioned response acquired through classical conditioning will no longer occur if the unconditioned stimulus (UCS) is not paired with the conditioned stimulus (CS) at least occasionally. However, the association is sometimes so strong and well established that it persists over time unless there is some kind of intervention. This is most often necessary when the conditioned response interferes with ‘normal’ functioning in everyday life, such as with conditioned responses involving maladaptive behaviour. This has led psychologists to apply classical conditioning processes in developing behaviour therapies.

Behaviour therapy is a form of psychotherapy that applies the principles of classical conditioning and other types of learning to eliminate symptoms and modify ineffective or maladaptive patterns of behaviour. The focus of this therapy is upon the behaviour itself, rather than the exploration of underlying psychological causes of the behaviour as occurs with ‘talking therapies’.

A wide variety of therapeutic techniques are used in behaviour therapy. One of these techniques is called exposure therapy, which may involve graduated exposure or flooding.

Graduated exposure

Graduated exposure involves presenting successive approximations of the CS until the CS itself does not produce the conditioned response. Essentially, the technique involves progressively, or ‘gradually’ introducing, or ‘exposing’, the client to increasingly similar stimuli that produce the conditioned response requiring elimination (called ‘extinction’), and ultimately to the CS itself. In this way, the client is gradually ‘desensitised’ to the fear- or anxiety-producing object or event.

Graduated exposure has been successfully used to eliminate a range of disorders involving fear and anxiety responses, such as fear of flying, fear of heights, public speaking anxiety and a wide range of phobias. A form of graduated exposure called systematic desensitisation has been successfully applied to the treatment of phobias. *Systematic desensitisation* involves a gradual, step-by-step approach to encountering the feared situation or stimulus while attempting throughout to maintain a non-anxious state. The technique is examined in Topic 9.

Fear of flying can be treated through the application of classical conditioning principles.

Flooding

Flooding is another type of exposure therapy for treating fears, phobias and other mental health problems in which fear and/or anxiety play a prominent part. *Flooding* involves bringing the person into direct contact with the anxiety- or fear-producing stimulus and keeping them in contact with it until the conditioned response is extinguished. For example, an individual diagnosed with claustrophobia might be asked to spend extended periods of time in a small room.

With flooding, there is no attempt made to lessen or avoid anxiety or fear during the exposure. The contact may be for 2 hours or longer, depending on the stimulus and the individual. It is believed that people will stop fearing the stimulus and experiencing the anxiety associated with it when they are exposed to it directly and made to realise that it is actually quite harmless.

Flooding can be conducted using visual imagery, in vivo (real life) or using a virtual reality device. In one case, a 31-year-old man reported a fear of being in falling lifts. The fear developed when he was trapped in a lift on the seventh floor for about an hour. He became increasingly fearful that it would fall. His treatment involved confronting his fear by riding in lifts for a period of 90 minutes. After just one session, his fear of lifts disappeared (Sue, et al., 2006).

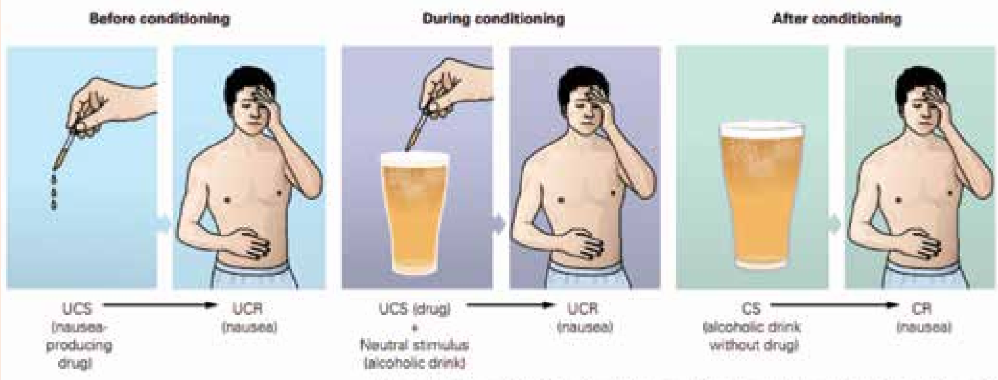
Aversion therapy

When people develop behaviours that are habitual and harmful to themselves or others, such as substance (drug) dependence, a gambling addiction or inappropriate sexual behaviours, it is often difficult to help them permanently stop the unwanted behaviour. This is especially so when the behaviour is immediately followed by a sense of pleasure or relief from discomfort.

Aversion therapy is a form of behaviour therapy that applies classical conditioning processes to inhibit or discourage undesirable behaviour by associating (pairing) it with an aversive (unpleasant) stimulus such as a feeling of disgust, pain or nausea. Aversion therapy aims to suppress or weaken the undesirable behaviour. For example, to stop an unwanted behaviour such as nail biting, your fingernails could be painted with a foul-tasting substance. The association between the unwanted behaviour (nail biting) and the unpleasant taste is learned very quickly. Before long, even the thought of biting your nails (and its unpleasant consequences) will be a strong enough deterrent for you to avoid the undesirable behaviour (hence the term ‘aversion’).

Aversion therapy was first used in the 1930s to treat alcoholism by giving individuals with an alcohol addiction an aversive stimulus (painful electric shocks) whenever they could see, smell or taste alcohol. Today, instead of electric shocks, nausea-inducing drugs may be paired with alcohol consumption to make the individual feel ill. The idea is that alcohol, which was originally neutral with respect to nausea, becomes the conditioned stimulus. After repeated pairings of alcohol (CS) with a drug (UCS) that causes nausea (UCR), an association is established between alcohol and nausea. This association becomes so strong that the person begins to anticipate nausea as an inevitable result of consuming alcohol. This is the intention of the therapy; that is, to establish an anticipation of nausea that is so distasteful to the person that they choose not to drink the alcohol.

Aversion therapy may also be used to help people quit smoking. Using aversion therapy, the therapist might have the person smoke a cigarette from a device that also holds a second cigarette containing a nausea-inducing chemical. When the person smokes using this device, they inhale chemicals from both cigarettes and experience nausea soon after. However, this pairing of the CS (regular cigarette) with the UCS (nausea-inducing cigarette) may only have short-term results. The client may learn that the nausea is only experienced when they smoke two cigarettes in this type of apparatus, and not when they smoke a single regular cigarette.



Using classical conditioning, a nausea-producing drug is paired with alcohol to create an aversion to drinking.

Treatment of persistent bedwetting

Some children continue to wet their beds long after they are toilet-trained and out of nappies. Persistent involuntary discharge of urine, when in bed or dressed, after the age when bladder control is expected, and not due to a medical problem, is called *enuresis*. This condition is more common in boys and may occur only at night or both at night and during the day. The prevalence of enuresis is 5-10% among 5-year-olds, 3-5% among 10-year-olds and around 1% among individuals 15 years or older (APA, 2013).

Although some cases of persistent bedwetting are caused by physiological problems, such as small bladder capacity or weakness in the muscles near the bladder, enuresis is often found to be associated with problems during toilet training, stressful situations such as hospitalisation, and underlying emotional problems relating to entering school or the birth of a sibling.

English doctor Ian Wickes was one of the first researchers to show that classical conditioning procedures could be successfully applied in treating enuresis. Wickes (1958) believed that, in many cases of enuresis, the individual had simply failed to learn to wake up in response to the stimuli arising from a full bladder and that this necessary learning could be brought about by classical conditioning. For instance, if a person were to awaken when there was bladder tension that precedes urination, then bedwetting could be prevented.

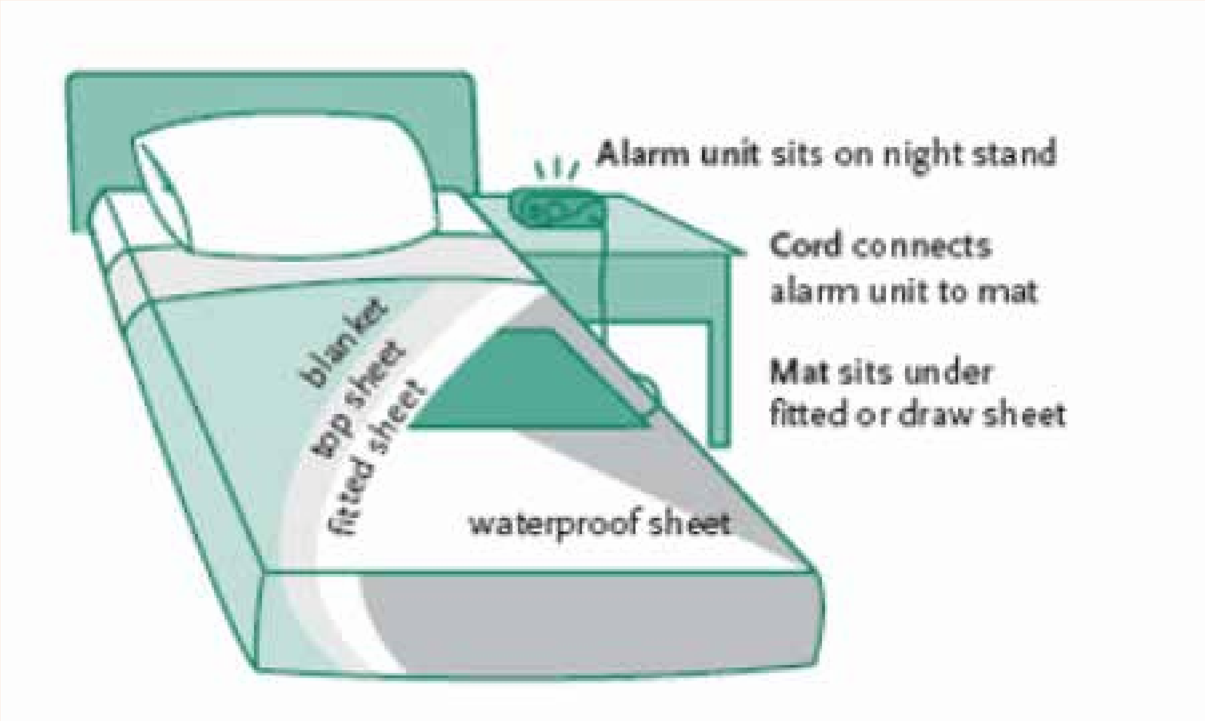
To find out, Wickes conducted an investigation using 100 ‘persistently enuretic’ research participants – 81 males and 19 females. He decided to use the sound of a buzzer as a UCS to ‘reliably awaken a person sleeping’. The sound of the buzzer would follow the stimulation from a full bladder (CS). He reasoned that after a series of such paired presentations, the response of waking up—at first made only to the buzzer (UCR)—should begin to occur in response to stimulation from a full bladder (CR). Then, the person would go to the toilet instead of wetting the bed while asleep.

Wickes' main problem was to arrange for a buzzer to sound shortly after the person's bladder was full. His solution was to have the person sleep with a gauze pad appropriately positioned so that the first drop of urine closed a circuit that set off the buzzer. This ensured that soon after the sleeping person was stimulated by a full bladder, the person was awakened by the buzzer.

Wickes found that his treatment proved to be an effective method for curing enuresis, as many participants began to wake up in response to the stimulation from a full bladder—before wetting the bed.

Prior to treatment, 60 of the participants wet their beds on more than 75% of nights, 27 wet their beds 50–75% of nights, and 13 wet their beds on less than 50% of nights. After three months of treatment, 44 never wet the bed on any night, 10 wet the bed less than 10% of nights, 14 wet the bed between 10–20% of nights, and 17 wet the bed 20% or more of nights. Overall, 50 responded rapidly and completely, 15 responded almost completely, 9 improved markedly but slowly and 26 failed to show any improvement. He attributed most of the failures to a lack of cooperation from parents.

Wickes' treatment method is still used but has been enhanced by better technology such as more sensitive and comfortable devices. However, the classical conditioning principles underlying the method remain unchanged.



A diagram of Wickes' bedwetting alarm system

on Resources

Teacher digital documents Practical activity — Eye-blink conditioning
Practical activity — Conditioning a pupillary response to an auditory stimulus

learnMORE | Superstitious behaviour

Do you have a lucky charm? Have you ever noticed that many footballers kicking for a goal from a set shot perform a little ritual before kicking? Typical behaviours include rubbing the ball, rotating the ball in their hand, pulling up their socks, rubbing their nose, scuffing the ground with a boot, or practising the kick. This also applies to cricket, golf, baseball, softball and just about any other endeavour that requires performance of skilled behaviour. All these examples are called superstitious behaviour – behaviour that is continually repeated because it is thought to cause desired effects although in reality the behaviour and the effects are probably unrelated. (Superstitious behaviour is not the same as a superstition like fearing black cats. A superstition is folklore that we learn from others.)

An experiment conducted by Skinner (1948) enhances our understanding of what causes superstitious behaviour. Skinner reinforced pigeons with food pellets every 15 seconds, no matter what the birds did. Eventually, most of the pigeons acquired very noticeable types of behaviour which they tended to repeat over and over again. For example, one pigeon kept turning in anticlockwise circles, another kept making jerking movements with its head, and another kept hopping from side to side. Although Skinner was not using the food to reinforce any particular behaviour, the pigeons came to associate the food with whatever action they were doing when the food was originally delivered. Their response was reinforced, and they repeated the action in order to receive more food. The pigeons had formed a connection between the food and the behaviour. Even when *they were reinforced irregularly, they persisted with their behaviour.*

Similarly, people are not immune from forming such a connection between a behaviour and a reinforcer. In the case of sportspeople, there's a good chance that the particular superstitious behaviour they engage in can be traced back to good performances and success when the behaviour first occurred.

Professional athletes sometimes develop quirky superstitious rituals, such as Steve Smith the cricketer who wears a headband underneath his helmet.

learnMORE | Operant conditioning in practice

The principles of operant conditioning were originally developed with animals in laboratory experiments, but they have since been applied to people as well as animals in numerous everyday settings, both formally and informally. Some applications have been described briefly throughout the topic in illustrating various operant conditioning principles and processes. Its principles have also been applied to the development of behaviour therapies used by psychologists and psychiatrists; for example, as part of cognitive behaviour therapy (CBT). This is described in Topic 9 in the treatment of phobias. In this section, we focus on applications for behaviour modification, as used in everyday behaviour, token economies and animal training.

Behaviour modification

Behaviour modification involves the systematic application of learning principles to 'modify', or change, a person's 'behaviour', especially a problem behaviour. Various therapies based on operant (and classical) conditioning principles are usually grouped under the label of behaviour modification, or behaviour therapy, when used in a mental health setting.

Behaviour modification makes extensive use of positive reinforcement administered under various schedules (e.g. continuously or partially), and of the withdrawal of reinforcement in order to eliminate inappropriate behaviour or teach new responses. It is used in all kinds of everyday life settings – for example, in family homes, classrooms, day care centres, nursing homes, psychiatric units, sports fields, rehabilitation centres, factories and offices.

Psychologists have used behaviour modification for all kinds of purposes. For example, to help parents toilet train their children; to help teachers deal with students who continually behave inappropriately, interfering with their own learning and that of others; to teach autistic children who have never spoken a word to use a vocabulary of several hundred words; to train adults with severe intellectual abilities to communicate, dress themselves, mingle socially and gain paid employment in the community; and to help people eliminate unwanted habits, like smoking and nail biting, or acquire wanted ones, like practising the piano or studying.

Behaviour modification involves a series of well-defined steps to change behaviour. The starting point is usually to define a problem behaviour in specific terms. For example, if a teacher sought help from a psychologist about a student who was disruptive in class, the teacher would have to define 'disruptive' in operational or measurable terms. The teacher would need to pinpoint exactly what behaviour is to be modified; for example, the student does not sit quietly for more than two minutes, calls out answers to classroom questions without first raising a hand, distracts other students when writing time commences, roams around the classroom during reading time, takes pencils from other students without their permission, and so on. This is usually called the baseline data against which observable behaviour change can be measured. The data required usually also includes the frequency of occurrence.

The underlying causes of the inappropriate behaviour are rarely addressed in behaviour modification. Instead, psychologists concentrate on the factors that are currently maintaining the inappropriate behaviour and develop and administer a system of reinforcement to eliminate the inappropriate behaviour and increase the likelihood of a preferred alternative behaviour.

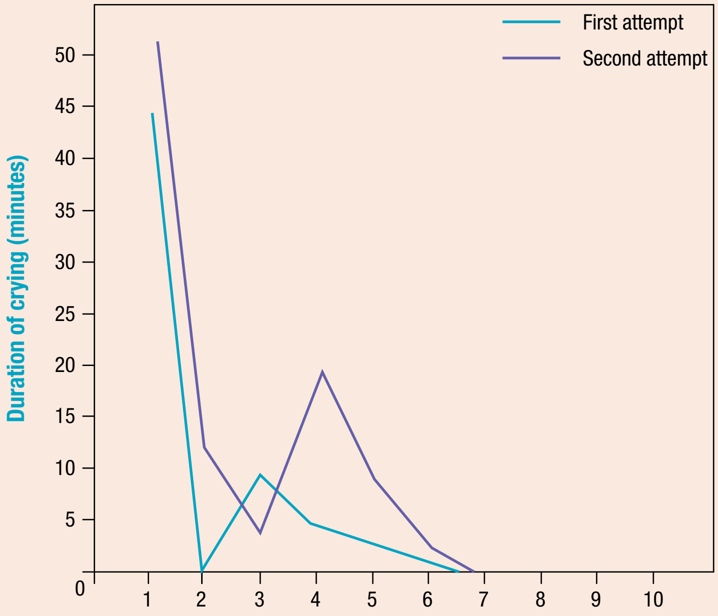
Example: Using behaviour modification to extinguish tantrum behaviour

A child, called 'Jack', was seriously ill for the first 18 months of his life. While he was sick, he received more attention than average and became accustomed to the special care. By the age of 21 months, Jack had become healthy. He had also become a household tyrant, guarding and defending numerous privileges and comforts. Jack's behaviour was especially distressing at bedtime when he demanded undivided attention and cried and fussed if his adult companion (parent or aunt) left the room before he had fallen asleep. Because Jack fought sleep as long as he could, a family member usually spent one-half to two hours each bedtime sitting with him.

A psychologist helped the family work out a plan to modify Jack's behaviour. The parents and aunt were instructed to put the boy to bed cheerfully in a 'leisurely and relaxed fashion'. After the pleasantries, the adult was to leave the bedroom and close the door. Jack, outraged at this change in routine, would cry, scream and fuss. But the adults were instructed to exercise self-control and ignore him entirely.

The members of Jack's family stuck with the plan, and by the tenth night Jack had stopped whimpering, fussing and crying when the adult left the room, and was actually smiling. However, about one week after Jack's crying stopped (i.e. was 'extinguished'), it recovered – apparently spontaneously. Jack screamed and fussed after his aunt tucked him in. In a weak moment, his aunt gave in. She returned to the boy's side and stayed there until he fell asleep. After this incident, it took nine additional sessions of ignoring Jack's tantrum behaviour to extinguish the response a second time.

The graph below shows how the treatment progressed. Two years after this program, a follow-up visit by the psychologist found that Jack's behaviour had changed in a lasting way. He had no further temper tantrums at bedtime.



Animal training

Most children and many adults are amazed by tricks performed by animals in circuses, in television and movie productions, and in animal shows such as at Sea World. The training of these animals typically involves the use of operant conditioning principles.

In one experiment, Skinner decided to train a pigeon to turn a full circle in an anticlockwise direction. This behaviour, like most other behaviour in everyday life, does not occur spontaneously. To provide reinforcement and condition the desired behaviour, Skinner had to wait around for a long time for that behaviour to occur spontaneously. When Skinner placed the pigeon in a Skinner box its behaviour was, not surprisingly, entirely random.

In order to get the pigeon to perform what Skinner called the target behaviour, he used an operant conditioning procedure called *shaping* to gradually 'mould' or 'edge' responses to the target behaviour. Shaping is a strategy in which a reinforcer is given for any response that successively approximates and ultimately leads to the final desired response or target behaviour. Consequently, shaping is also known as the *method of successive approximations*.

In using a shaping procedure, Skinner initially reinforced the pigeon each time it turned slightly to the left. The reinforcer was a food pellet which was delivered through a mechanically operated door. Once the pigeon's response of making a slight turn to the left had been conditioned, reinforcement was no longer provided for this response. Instead, Skinner waited until the pigeon turned a little further left before giving any further reinforcement. By reinforcing only those responses that gradually edged towards the target behaviour, Skinner was able to train the pigeon to turn complete circles regularly. The pigeon learned to perform the desired response because it was reinforced for each successive step leading to the target behaviour but not for any of the former responses. This differential reinforcement increased the likelihood of progressive steps ('approximations') being taken towards the final response of turning a full circle in an anticlockwise direction.

Shaping is used when the desired response has a low probability of occurring naturally. It is essentially a method for indicating to an animal (or person) those responses that lead to a desired behaviour. Through programmed use of successive reinforcements, animals can learn to perform many complex behaviours, as long as it is capable of performing the behaviour. For example, it would not be possible to train a koala to swim using the butterfly stroke or to safely paraglide. Many tricks performed in circuses and animal shows have been learned through shaping.

A pigeon in a Skinner box using food pellets as a reinforcer

Use of chaining in teaching animals

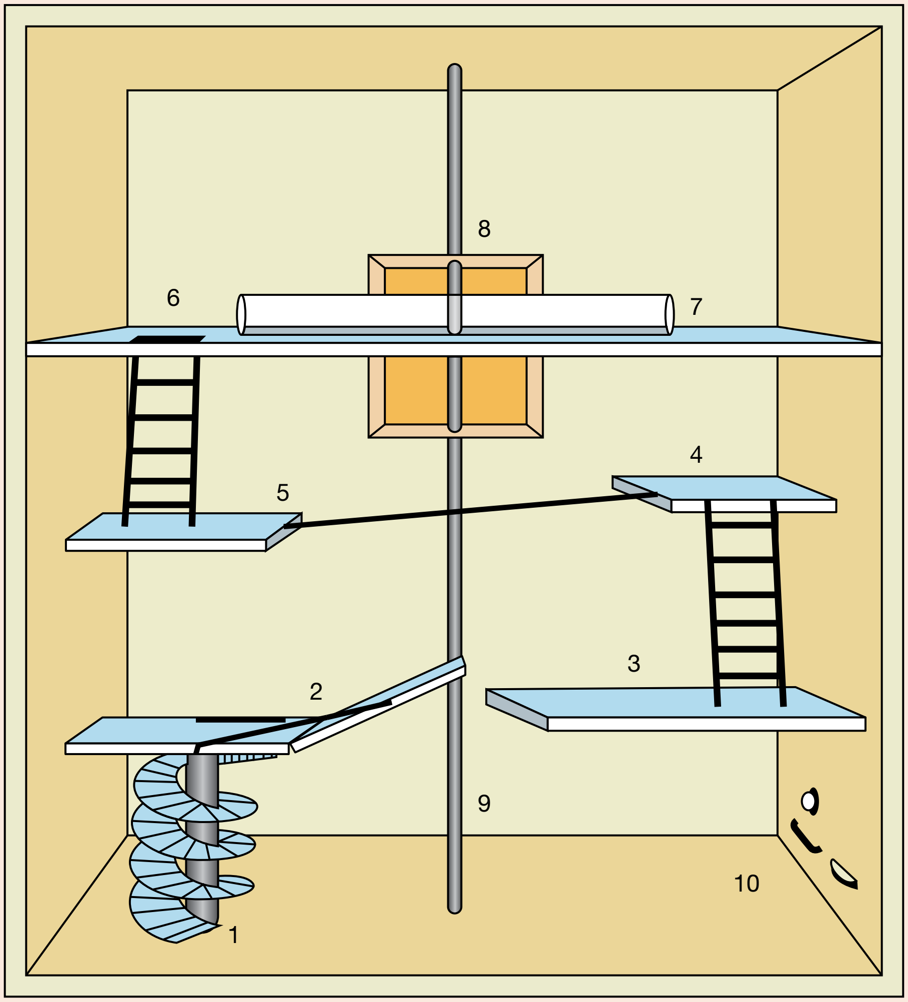
To teach a complex sequence of actions, shaping can be combined with a related procedure called *backward chaining*. In this procedure, the 'bits' of behaviour in the final desired response, or sequence of responses, are shaped backwards from the order in which they are to be performed; the final response in a sequence is reinforced first, then the second-last response, and so on.

For example, consider the long sequence of responses taught to Barnabus the rat by two psychologists in the 1960s. Barnabus learned to climb a spiral staircase, lower a narrow drawbridge and cross over to a platform, climb up a ladder, pull a chain to fetch a toy car, get into the car and pedal it to another ladder, climb this ladder, run through a tube, board an elevator, pull a chain to raise a flag and lower himself back to the starting platform where he would press a lever to get one food pellet. After he ate the pellet, Barnabus would start the sequence all over again

How was Barnabus trained to perform such a long sequence of responses? Starting backwards from the order in which each response is to be performed, Barnabus first learned to press the lever, then operate the elevator, then raise the flag, and so on. Because the sequence is so long, if Barnabus were reinforced for behaviours early in the sequence, he would run directly to the food dish, omitting the rest of the responses in the sequence (or chain). Instead, each behaviour is reinforced by the opportunity to perform the next behaviour in the sequence.

After Barnabus learned to perform the last behaviour in the sequence, the psychologists set up the apparatus so that Barnabus could reach the chamber with the lever only after he performed the second-last behaviour. Once this behaviour was established, the psychologists set up the apparatus so that the opportunity to perform the second-last behaviour came only after Barnabus performed the one before that, and so on (Whaley & Malott, 1971).

Using shaping and chaining, Skinner was able to train pigeons to play a form of table tennis with their beaks and to use a small wooden ball to 'bowl' at tiny bowling pins in a miniature bowling alley. There are now many YouTube videos featuring all types of animals (including birds) performing various 'tricks' or problem-solving tasks which have been taught using operant conditioning.



Chaining was used to teach Barnabus the rat to perform a long sequence of activities in an apparatus like this one. Barnabus started the performance at point 1 and concluded at point 10 where he pressed a lever to receive a food pellet as a reward.

Animal training to benefit society and zoo animals

Shaping has been successfully used for animal training to benefit society; for example, teaching dogs tracking skills useful in search and rescue operations, and to do guide work and be companions for people with visual impairments or mental health problems.

Operant conditioning principles have also been applied to solving behavioural problems of zoo animals. For example, it was common for some species of animals to develop problems through sheer boredom – a polar bear may bang on the door of its enclosure hour after hour and a chimpanzee may sit in a corner all day plucking the hairs out of its arms. In the case of dolphins that are kept in solitude, boredom can actually be fatal.

American psychologist Karen Pryor (1981) identified these types of problems in zoos and pioneered the use of behaviour modification to address the problems. In one study, she attended a zoo and taught basic operant conditioning principles to the animal keepers. For example, ‘You let the animal discover that every time you blow a whistle, it gets a piece of food. Then you let it discover that it can make you blow the whistle by, say, moving toward its den. Presto. You are training the animal to move to its den.’

The keepers were then required to shape a behaviour of an animal in their charge. Under the supervision of Pryor, an orang-utan believed to be suffering from depression was taught to play ‘Simon says’. Gradually, the orang-utan spent less time sitting slumped against the wall and more time playing this game with visitors. She also started to interact with monkeys in adjacent enclosures. In another case, giraffes that refused to go indoors, even when bitterly cold weather threatened their health, learned to go indoors when the attendant rang a bell.

Although in some cases the interaction between the keeper and the animal that took place during the learning process may have accounted for the better-adjusted behaviour. Operant conditioning in zoos is now considered a valuable addition to animal management practices.

These dogs have been trained for their societal roles using shaping – the production of new behaviour by reinforcement of successive approximations to the behaviour

on Resources

Weblink How To Understand Zoo Animal Training — Why Animals Do The Thing

Savannah - add to site checklist if not on there: https://www.whyanimalsdothething.com/how-to-understand-zoo-animal-training

Token economies

Implementing a token economy is a form of behaviour modification using reinforcement tokens to influence behaviour change. A token economy functions like a miniature economy that is similar in some ways to an actual larger economy in the real world. A *token economy* is a setting in which an individual receives tokens (reinforcers) for desired behaviour and these tokens can then be collected and exchanged for other reinforcers in the form of actual, or 'real', rewards.

For example, in a prison, tokens (or 'points') may be received for being quiet after lights-out and these may be 'cashed in' for rewards such as cigarettes and privileges. In a psychiatric unit, certain psychotic symptoms of a person with schizophrenia may be reduced by ignoring their descriptions of delusions (false beliefs) and positively reinforcing appropriate 'social talk' by providing tokens when this occurs. Tokens may also be withdrawn and, in many cases, penalties are used and individuals are 'fined' a certain number of tokens for inappropriate behaviour.

The advantage of using tokens in a large group situation is that real, tangible rewards can be difficult to administer immediately when a desired behaviour occurs. Furthermore, using a range of rewards for which tokens can be exchanged helps to ensure that the reinforcement is appropriate and satisfying for all the different individuals participating in the token economy. Once a desired behaviour is established, tokens can be phased out and replaced by more 'natural' and easily administered reinforcers, such as praise or a smile.

Token economies have been successfully established in a variety of settings such as schools, play therapy groups, psychiatric units, prisons and family homes. They have been used to increase reading by students, decrease television watching by children, improve the social skills of people with an intellectual disability, and so on.

In this token economy classroom, student behaviour is reinforced with varying amounts of points which can be used to 'buy' reinforcers, such as free time, a treat or the chance to play an iPad game.

5 The psychobiological process of memory

TOPIC CONTENT

5.1 Overview

KEY KNOWLEDGE

- the explanatory power of Atkinson-Shiffrin multi-store model of memory in the encoding, storage and retrieval of stored information in sensory, short-term and long-term memory stores
- the roles of the hippocampus, amygdala, neocortex, basal ganglia and cerebellum in long-term implicit and explicit memories
- the role of episodic and semantic memory in retrieving autobiographical events and in constructing possible imagined futures, including evidence from brain imaging and post-mortem studies of brain lesions in people with Alzheimer's disease and aphantasia as an example of individual differences in the experience of mental imagery
- the use of mnemonics (acronyms, acrostics and the method of loci) by written cultures to increase the encoding, storage and retrieval of information as compared with the use of mnemonics such as sung narrative used by oral cultures, including Aboriginal peoples' use of songlines

Source: © VCAA, *VCE Psychology Study Design: 2023–2027.* p.35.

Imagine for a moment what life would be like without your memory. You would have no recollection of what happened to you 2 seconds ago, 10 minutes ago or even 10 years ago. Without memory, every moment would be a new experience. Each person you met would be a stranger and each task you tackled would be a new challenge. Even the most basic tasks that most of us take for granted, such as tying a shoelace or walking the dog, would be difficult because we would have no memory of how to do them.

Imagine the effect on your social life. You would not be able to hold a conversation and you would have no friends because you would have no memory of ever having met them or knowing anything about them from one encounter to the next. Without memory you would have no self-concept or true sense of yourself as an individual. Our self-concept develops from the many experiences we have during our lives. With no recollection of these experiences we would have no basis for developing an understanding of 'who I am'. Each time you looked in the mirror you would be confronted by a complete stranger.

In this sense, it is memory that provides meaning to our lives by integrating the past and the present, and enabling us to think about the future. It is an essential part of what it means to be a human being.

Human memory is not a single 'thing' or process located in one specific area of the brain. Psychologists describe it as consisting of a collection of interconnected and interacting systems, each of which has distinguishable functions and is represented throughout the brain by different neural mechanisms. This means that we do not have *a memory* — we have different *memory systems.*

Despite their differences and the uncertainty about precisely how many memory systems we have, where they are all located and how they interact, human memory operates in a unitary way, as if it were a single system. Although the systems share a common function of storing whatever we learn so that we can retrieve and use it when required, they process and store different types of information in different ways.

Given the amount of information processed by our memory over a lifetime, its accuracy and reliability is remarkable. However, human memory is not perfect. Every moment of our lives is not automatically stored somewhere in the brain as if on a USB, to be filed away for future reference. Often we fail to properly

Figure 5.1 Human memory is not a single 'thing' or process located in one specific area of the brain. Nor are memories automatically stored somewhere in the brain as if on a USB.

process, store or access information that we need to retrieve and use at a later point in time. And when we retrieve information, it is not always entirely accurate because of the reconstructive nature of memory.

Given the relationship between human memory and learning, **memory** is often defined as the processing, storage and retrieval of information acquired through learning. This is an information processing approach which likens memory to how a computer works.

Some psychologists, however, describe memory more simply as expression of learning. Furthermore, given that a stored memory can be viewed as a neurological representation of prior experience, an increasing number of psychologists are now defining memory with reference to neural processes; for example, as 'a representation of a past experience' or 'the capacity of the nervous system to acquire and retain information and skills'.

Psychologists have devised a number of models to describe and explain human memory. These models usually include boxes to represent components and arrows to represent the movement of information from one part to another. Despite their differences, all models typically refer to memory as involving three fundamental, yet essential, core processes:

- **encoding**: conversion of sensory information into a usable form so that it can be neurologically represented ('placed') and stored in memory
- **storage**: retention of the encoded information over time
- **retrieval**: recovery of stored information for use when needed.

As shown in Figure 5.2 below, these three processes occur in a sequence, interact and are interdependent. Encoding is first because it occurs at the time of learning. It is through encoding that the brain can 'acquire' and represent incoming sensory information in a usable form. How well information is encoded determines how well that information is stored and how efficiently the information can subsequently be retrieved.

Although many models have advanced understanding of the process of memory, no single model is viewed as having captured all aspects of human memory. However, some models have been more influential than others.

In this topic we consider the best-known and most widely used model to describe and explain human memory. We then examine brain areas and structures that are involved in the encoding, storage and retrieval of long-term memories.

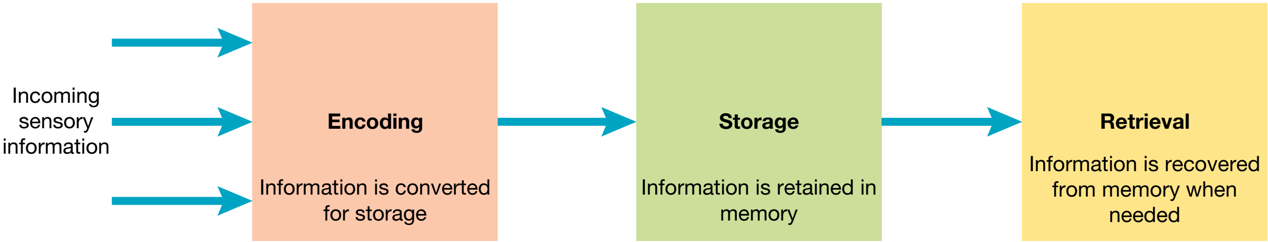


Figure 5.2 A simplified representation of the three fundamental processes required for human memory: encoding, storage and retrieval. If any one of these processes fails, memory will fail.

5.1 LEARNING ACTIVITY

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2006 Psychology 2, Section A, Q.11 (adapted); ©VCAA

In order to pass from short-term memory to long-term memory, information must be

A. recoverable.
B. encoded.
C. meaningful.
D. useful.

Question 2 (1 mark)

Source: VCAA 2007 Psychology 2, Section A, Q.1 (adapted); ©VCAA

Sam is able to retain the vocabulary he learned in his French class long after the class has ended. The main memory process that accounts for the fact that Sam can hold information in his memory for extended periods of time is

A. encoding.
B. retrieval.
C. acquisition.
D. storage.

Question 3 (1 mark)

Source: VCAA 2004 Psychology 2, Section A, Q.1; ©VCAA

The process of transforming information into a form that can be placed in memory is called

A. acquisition.
B. encoding.
C. transduction.
D. storage.

Question 4 (1 mark)

Source: VCAA 2003 Psychology 2, Section A, Q.2; ©VCAA

Which sequence represents the flow of information following a training experience?

A. storage → encoding → retrieval
B. retrieval → encoding → storage
C. encoding → storage → retrieval
D. storage → retrieval → encoding

Question 5 (2 marks)

Source: VCAA 2002 Psychology 2, Section B, Q.1; ©VCAA

What is the difference between encoding of information and retrieval of information in memory?

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

5.2 Atkinson–Shiffrin multi-store model of memory

In the 1960s, psychology had shifted from the assumption that human memory was a single system towards the idea that two, three or perhaps more memory systems were involved. A very influential model that represented this change in thinking was proposed by American psychologists Richard Atkinson and Richard Shiffrin in 1968.

The **Atkinson–Shiffrin multi-store model** represents memory as consisting of three separate stores (components) called sensory memory, short-term memory and long-term memory. Each store processes information in different ways and also differs in terms of its *function* (purpose and roles), *capacity* (the amount of information it can hold at any given moment) and *duration* (the length of time it can hold information). Despite their distinguishing features, the three stores operate simultaneously and interact in an integrated way.

According to the multi-store model, *sensory memory* is the entry point for new information. It stores vast quantities of incoming sensory information for up to several seconds. If we pay attention to any of the information in sensory memory, it is transferred to short-term memory. Sensory information that is not attended to is lost from memory completely.

Information received in *short-term memory* is processed (encoded) and stored for up to about 18–20 seconds, depending on the type of information and whether a conscious effort is made to keep it there longer (Atkinson & Shiffrin, 1968). The transfer of information from short-term memory involves a further level of processing (encoding) for storage in long-term memory.

Information transferred to *long-term memory* may be stored for up to a lifetime. Information may also be retrieved from long-term memory and brought back to short-term memory when needed. Short-term memory maintains information in conscious awareness for immediate use. Sometimes, however, we may be unable to retrieve information from the long-term store, which we commonly refer to as 'forgetting'.

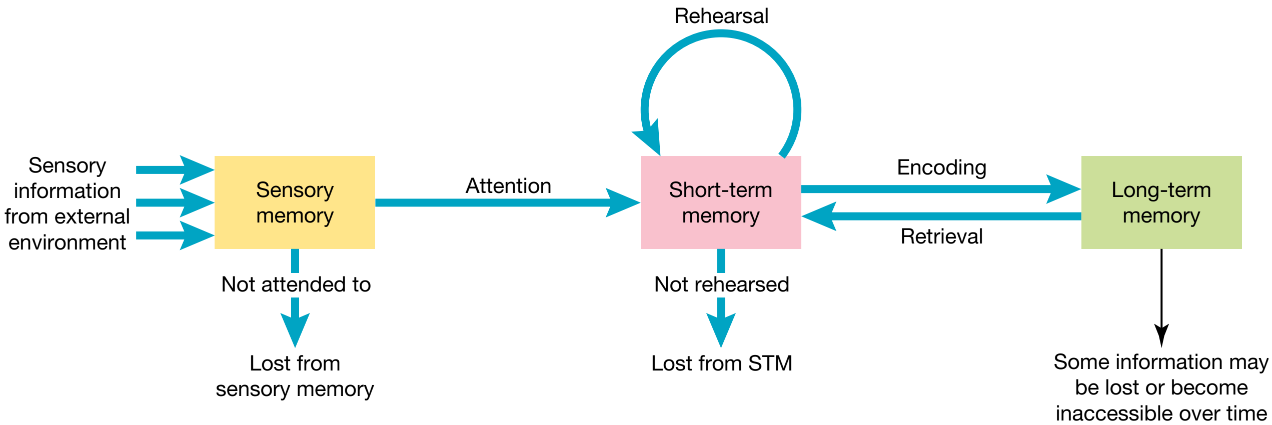


Figure 5.3 A contemporary representation of the Atkinson–Shiffrin multi-store model showing the transfer of information through the memory stores. The original model refers to short-term memory as 'working memory' and the two terms are often used interchangeably.

TABLE 5.1 Key features of the three memory stores

Store	Function	Capacity	Duration
Sensory memory	• Receives sensory information from the environment • Enables perceptual continuity for the world around us	Vast, potentially unlimited	Momentary — about 0.2–4 seconds
Short-term memory (STM)	• Receives information from sensory memory and transfers information to and from LTM • Maintains information in conscious awareness for immediate use	7 ± 2 pieces of information	• Temporary — 18–20 seconds, possibly up to 30 seconds • Longer if renewed (e.g. repetition/maintenance rehearsal; using for 'working memory')
Long-term memory (LTM)	Information storage for re-access and use at a later time	Vast, potentially unlimited	• Potentially permanent • Some information may be lost or inaccessible over time • Indefinite

on **Resources**

Weblink Video on the multi-store model of memory 3 m 45 s

5.2.1 Sensory memory

In the course of a typical day, thousands of sights, sounds, smells and other stimuli from the external environment bombard your sensory receptors. All this information from each of the senses, whether you pay attention to it or not, is briefly held in sensory memory.

Sensory memory is the entry point of memory where new incoming sensory information is stored for a very brief period. The information received there is assumed to be retained as an exact copy of its original, 'raw', sensory form (rather than in an encoded form). We can store vast amounts of sensory information in sensory memory and it is commonly described as having a potentially unlimited storage capacity.

An important function of sensory memory is that it stores sensory impressions long enough for each impression to slightly overlap the next. This helps ensure we perceive the world around us as continuous, rather than as a series of disconnected visual images or disjointed sounds.

To test this, quickly wave a pen back and forth in front of your face. You should see the fading image trailing behind the pen. This is assumed to be an example of your visual sensory memory at work. It seems as if our visual sensory memory momentarily stores a snapshot of the image, then replaces it with another overlapping image.

Sensory information remains in sensory memory just long enough for us to attend to and select the information to be transferred to short-term memory (STM) for processing. It is therefore a *temporary* storage system for information that may subsequently undergo further processing.

We are not consciously aware of most information in our sensory memory. Nor can we consciously manipulate it or extend the time it is retained there. When we direct our attention to information in sensory memory, this has the effect of transferring it to STM where we become consciously aware of it. For example, if your attention is focused on reading this page, you will be unaware of many of the sounds around you. Although this auditory information is received by your sensory memory, it is not until you direct your attention to the sounds that you become aware that this information was initially 'registered' in your sensory memory.

It is assumed that any stimulus received in sensory memory is available to be selected for attention and processing in STM. For example, all the objects in your visual field and all the sounds loud enough for you to hear are available for transfer to STM at any given moment. If the sensory information is not attended to and no further processing occurs, its impression fades and therefore cannot be transferred to STM or subsequently to long-term memory (LTM), and is permanently lost from experience.

Incoming sensory information is assumed to be stored in separate sensory systems called *sensory registers*, each of which retains sensory information for different periods. Many psychologists believe that there probably is a separate sensory register for each of the senses. For example, the numerous visual images you process while at a nightclub will be stored in your visual sensory register (called *iconic memory*), while the sounds of music and voices of people will be stored in your auditory sensory register (called *echoic memory*).

Figure 5.4 If you went to a popular nightclub, your senses would be bombarded by thousands of different sights, sounds, smells and other stimuli. These would initially be stored in separate sensory stores called sensory registers. It is believed that there probably is a separate register for each of the senses.

Iconic memory

The term **iconic memory** is used to describe visual sensory memory — the brief sensory memory for incoming visual information. We usually retain visual images in their original sensory form in iconic memory for about a third of a second. However, they last just long enough to recognise and process the sensory information.

To experience iconic memory, close your eyes for a minute. Near the end of the minute, hold your hand about 25 centimetres in front of your eyes. Then open your eyes and rapidly close them again. You should see an image of your hand that fades away in less than a second (Ellis, 1987).

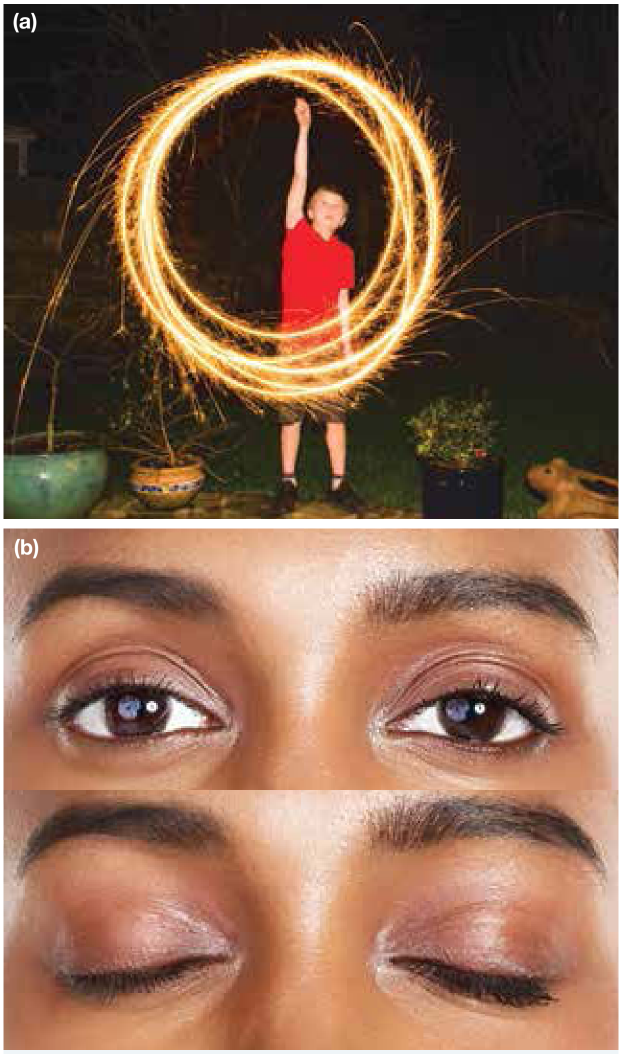


Figure 5.5 (a) The persistence of the image of the sparkler allows the child to 'draw' a series of circles. (b) Without iconic memory, your world would disappear into darkness during each eye blink.

When you go to the movies, you see what appears to be a continuous scene in which people, animals and objects move quite normally. What is actually presented to your eyes, however, is a series of individual still images, interspersed with brief periods of darkness. In order to see a continuously moving image it is necessary for your visual system, which includes iconic memory, to store the information from one frame until the next frame is presented (Baddeley, 1999).

Echoic memory

The term **echoic memory** is used to describe auditory sensory memory — the brief sensory memory for incoming auditory information. Echoic memory registers and retains all kinds of sounds, such as speech, the barking of a dog and the sirens of emergency vehicles. It is called echoic memory because sounds linger in it like an echo. To experience echoic memory, clap your hands once and notice how the sound remains for a very brief time and then fades away.

Studies of echoic memory indicate that it functions like iconic memory, storing sounds (rather than visual images) in their original sensory form. Apart from the sensory register involved, the main difference between iconic and echoic memories seems to be the length of time it takes for information to fade. Echoic memory stores information for longer periods than does iconic memory — typically 3 or 4 seconds — while visual information is retained in iconic memory for an average of 0.3 of a second.

Although the retention period is brief, the availability of auditory information for 3 or 4 seconds is generally long enough to select what has been heard for further processing and interpretation before the sound disappears completely.

Consider the times when your attention has been focused on a book you are reading, a television program you are watching or a social media activity, and someone asks you a question. Often you are aware they are speaking, but since your attention is focused elsewhere, you do not immediately comprehend the message. However, within a couple of seconds you say 'What?' and then answer the question before the person has time to repeat it. It is believed that because the sound of the original question is held in echoic memory for a few seconds, when you directed your attention to what the person said, the information was then passed on to STM where it was processed and interpreted. The tail-end of the question was temporarily stored in echoic memory while earlier parts of the incoming message were being processed. The response of 'What?' may have occurred just before the last bit of the message in echoic memory was transferred to STM where it became a complete message in conscious awareness.

The relatively longer duration of echoic memory is important for understanding speech. You perceive speech by blending successive spoken sounds you hear. When you hear a word pronounced, you hear individual sounds, one at a time. You cannot identify a word until you have heard all the sounds that make up the word, so auditory information must be stored long enough for you to receive all the sounds involved.

For example, if someone says 'compare', you will think of judging something against something else, but if someone says 'compute', you will think of something completely different. The first syllable you hear (*com*) has no meaning by itself in English, so you do not identify it as a word. However, once the last syllable is heard, you can put the two syllables together, recognise the word and give it meaning. If echoic memory storage were as brief as iconic memory storage, speech might sound like a series of separate, distinct sounds instead of meaningful words, phrases and sentences.

Findings from the results of various experiments suggest that although sensory memory can store virtually all the information provided by our sensory receptors, this information fades rapidly (with the rate varying among the senses). Information is lost and replaced so rapidly in the sensory registers that we are rarely aware of our capability for retaining sensory information.

Figure 5.6 Echoic memory stores information for a longer duration than iconic memory. If you hear this cockatoo's squawk, your echoic memory will retain the auditory information for about 3 to 4 seconds. However, if you see a photograph of this bird flashed on a screen for a split second, your iconic memory will hold the visual information for about one-third of a second.

Considering the many trillions of bits of information detected by our senses in a lifetime, if we processed everything that reached sensory memory, it would probably lead to confusion, frustration and inefficiency in daily living.

For example, when walking through the Melbourne CBD, your echoic memory will register thousands of different sounds but you will attend to and remember only a select few. While crossing Flinders Street, if you hear the screech of car brakes nearby, you will probably pay attention to and act on that information because of the potential threat to your safety. At that moment when you are attending to and processing the sound of the screeching brakes, you will ignore many other sounds that enter echoic memory, such as people talking, the clicking sound of the traffic lights, the sound of a tram bell or that of a bus departing. It would be chaotic and even dangerous at times if we attended to all of the sensory information detected by our receptors.

When you attend to information in sensory memory, it is transferred to STM. Only the information selected for transfer to STM is encoded and has a chance of being stored permanently. Information in sensory memory that is not attended to is lost very quickly — usually within seconds.

Figure 5.7 When crossing the street at a busy intersection, selective attention helps ensure the huge amount and variety of incoming information that reaches sensory memory is filtered to keep out irrelevant and unimportant information.

TABLE 5.2 Storage duration of iconic and echoic memories

iconic (visual) memory	about 0.2–0.4 of a second
echoic (auditory) memory	about 3–4 seconds

5.2 LEARNING ACTIVITY 1

Review

1. What is sensory memory?
2. Distinguish between sensory memory and sensory register.
3. Why can sensory memory be described as a memory system or sub-system rather than a sensory or perceptual system?
4. Complete the following table to distinguish between key features of iconic memory and echoic memory.

Sensory register	Type of sensory information	Storage duration	Storage capacity
iconic memory			
echoic memory			

5. Is information in sensory memory subject to an encoding process? Explain your answer.
6. a. What is required for information to transfer from sensory memory to STM?
   b. What happens to information that is not transferred to STM?

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

5.2 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2012 Psychology 1, Section A, Q.18; ©VCAA

Which of the following best describes the sequential stages of the formation of new memory according to the Atkinson–Shiffrin multi-store model of memory?

A. sensory memory, short-term memory, long-term memory
B. long-term memory, sensory memory, short-term memory
C. short-term memory, long-term memory, sensory memory
D. sensory memory, long-term memory, short-term memory

Question 2 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.11; ©VCAA

The multi-store model of memory can be used to explain how a person uses their knowledge of times tables to verbally answer a mathematics problem that is presented briefly on a computer screen. Which of the following identifies the memory stores used to complete the aspects of solving the problem?

	Visual registration of problem	Storage of times tables	Storage of problem
A.	sensory memory	short-term memory	long-term memory
B.	short-term memory	sensory memory	long-term memory
C.	short-term memory	episodic memory	sensory memory
D.	sensory memory	long-term memory	short-term memory

Question 3 (1 mark)

Source: VCAA 2010 Psychology 2, Section A, Q.1 (adapted); ©VCAA

Derek perceived Jack playing on the swing as a continuous moving image rather than a sequence of still frames moving quickly. This is because of Derek's

A. iconic memory.
B. echoic memory.
C. working memory.
D. short-term memory.

Question 4 (1 mark)

Source: VCAA 2009 Psychology 2, Section A, Q.4; ©VCAA

In the standard model of memory, information is described as flowing through a series of stages. According to this model, the three storage systems through which information in memory passes are

A. primary memory; secondary memory; long-term memory
B. sensory memory; short-term memory; long-term memory
C. iconic memory; echoic memory; sensory memory
D. visual memory; verbal memory; spatial memory

Question 5 (1 mark)

Source: VCAA 2003 Psychology 2, Section A, Q.7 (adapted); ©VCAA

Visual and auditory stimuli are first registered in our

A. short-term memory.
B. long-term memory.
C. sensory memory.
D. multi-store memory.

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5.2.2 Short-term memory (STM)

Short-term memory (STM) is a memory system with limited storage capacity in which information is retained for a relatively short time, unless renewed in some way. STM stores information temporarily, but for a longer time than sensory memory (and less than LTM). In STM, the information is no longer an exact replica of the sensory stimulus, but an encoded version.

When you pay attention to information in your sensory memory (or to information retrieved from LTM), the information enters your STM. For example, because you are paying attention to this sentence, it has now entered your STM. In contrast, other information in your sensory memory, such as the feeling of your socks against your skin, did not enter your STM until you directed your attention to it.

STM holds all the information you are consciously aware of at any moment in time. It enables short-term maintenance and manipulation of information in conscious awareness. Consequently, STM is where all conscious learning, perceiving, feeling, thinking, reasoning and other mental processes take place.

Duration of STM

Generally, most types of information can be retained fairly well in STM for the first few seconds. After about 12 seconds, however, recall starts to decline and by about 18 seconds almost all of the information disappears entirely if it has not been renewed in some way.

A commonly used method of renewal is continual repetition (called *maintenance rehearsal*). Some research findings indicate that information can occasionally linger in STM for up to 30 seconds (especially 'muscle memory' type information associated with body position and movement), so STM duration is now commonly described as 'up to about 30 seconds'.

It is theoretically possible to retain information in STM indefinitely through continual renewal as this also involves sustained attention. For example, if you repeat a previously unknown phone number over and over to yourself, it can be retained in STM indefinitely. But if someone tells you their phone number and you are then distracted by something else that requires your attention, you are likely to forget the number almost immediately. The distraction not only prevents rehearsal, resulting in loss of the information, but the new information acquired when distracted may exceed the limited capacity of STM and displace, or 'push out', the number from STM, thereby causing you to forget it.

Figure 5.8 When you have to wait for a while to make a point in a conversation, the information you wanted to share will progressively fade from your STM unless you renew it in some way.

Capacity of STM

Compared to sensory memory and LTM, STM has a very limited storage capacity. The amount of information it can hold at any one time is about seven 'bits of information'. This was first described by American psychologist George Miller (1956) in a journal article called 'The magical number seven, plus or minus two'.

Miller reached this conclusion after analysing the results of many research studies showing that STM has a capacity of between five and nine units of information at any given moment. Some individuals have a smaller or larger STM capacity. More recent studies have found that Miller may have over-estimated STM capacity.

Estimates of STM capacity are obtained by asking research participants to memorise simple lists of data of different lengths; for example, randomly ordered numbers, letters, nonsense syllables or unrelated words. The length of the list is continually increased until the person is correct only 50% of the time (Miller, 1956). Research in non-western cultures using Chinese characters has also shown an STM capacity of 7 ± 2 pieces of information (Yu et al., 1985).

We can get around the limited capacity of STM. One way is to learn information well enough to transfer it to LTM for storage or use one of the mnemonics (memory aids) described later in the topic.

Another way is to put more information into each of the 7 ± 2 units that can be stored in STM. To illustrate this, read the sequence of letters below:

W N V D C E I V D C S V

Now close your eyes and try to repeat the letters aloud in the same order. Unless you have an exceptional STM, you probably could not repeat the whole sequence correctly. Now try this sequence of letters:

N S W V I C V C E D V D

People usually recall more of the second sequence, even though it is made up of exactly the same letters. The increased ability to recall the second letter sequence demonstrates chunking.

Chunking is the grouping of separate bits of information into one or more larger units, or 'chunks', of information. The first sequence of letters was probably perceived as 12 separate items, which probably exceeded your STM capacity. The second letter sequence can be perceived as four 'chunks' — NSW, VIC, VCE, DVD — which is within the capacity of STM and is therefore more likely to be remembered.

When STM is 'full', new items can only be added by pushing old items out (as shown in Figure 5.10). Space in STM is also filled when we think and when information is temporarily retrieved from LTM to be used or updated. This is one reason why you cannot remember a new phone number you have just heard if you begin thinking about what you might say before you dial the number.

Information stored in STM is lost primarily through *decay* (not being used) and *displacement* (being pushed out) by new information (Reitman, 1974).

Decay of information in STM occurs when information is not renewed (e.g. through repetition) and simply fades away with the passage of time. For example, this occurs when you forget what you want to say in a conversation while you wait for another person to finish what they are saying. Your thoughts quickly fade from STM because listening to what the speaker is saying prevents you from repeating the information and therefore maintaining in STM the point you wanted to make.

Similarly, fading or displacement can explain the experience of forgetting someone's name straight after they have been introduced to you. If you engage the person in a conversation, the lack of opportunity for 'rehearsal' of their name can result in fading from STM. Furthermore, the new additional items of information introduced during the conversation may result in the capacity of STM being exceeded and displacement of the person's name.

Figure 5.9 Chunking shows that we can increase the capacity of STM. (a) Some wait staff chunk information to remember big orders without using a notepad. (b) Interpreters must store long and often complicated segments of speech in STM while checking LTM for equivalent expressions in the language they are translating into. This task is assisted if the speaker's words are chunked into phrases or sentences.

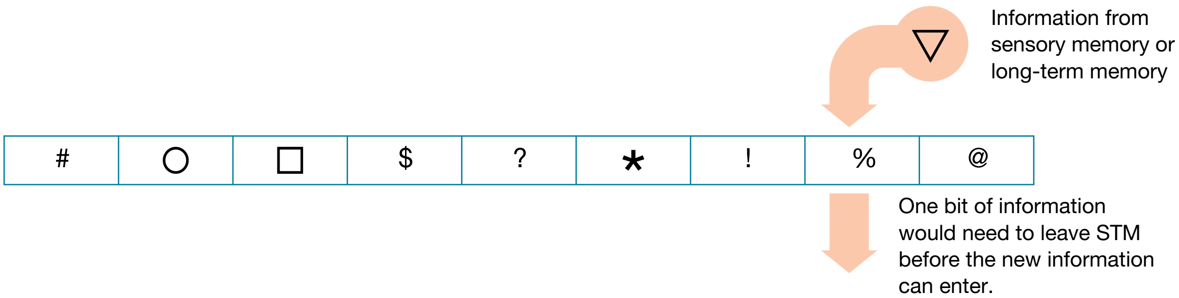

Figure 5.10 When STM is 'full', new items can only enter though displacement — by pushing an old item out.

on Resources

Teacher digital document Practical activity — STM capacity

STM functions as working memory

Many psychologists now prefer to use the term *working memory* instead of STM to emphasise the active processing and use of information that occurs there. Generally, it is believed that the term 'short-term memory' understates its roles and importance, not only in human memory, but also in our conscious experience of the world and our ability to function effectively in everyday life.

As our 'working memory', STM enables us to maintain information in conscious awareness whilst we actively 'work on' and manipulate it as we undertake our everyday tasks. Depending on the task, information may be retrieved from LTM for use in 'working memory' or we may combine information from sensory memory and LTM.

Interpretation of emotions and feelings, language comprehension, daydreaming, creativity, problem solving, analysing, reasoning, planning and decision making all involve 'working memory'.

For example, when you think about past events, such as who you shared a cabin with at the last school camp you attended, or when you mentally add the numbers 17 + 5 + 12, the information is temporarily held in 'working memory' while it is being used. Your 'working memory' enables you to read by holding words from the beginning of a sentence while you continue to process the rest of the sentence. Thus, 'working memory' provides a temporary storage facility and mental 'workspace' for information currently being used in some conscious cognitive activity (Baddeley, 1999).

In both the language and arithmetic examples, temporary storage of information was needed in order to perform some other task — in these examples, understanding and calculating. Information only remains in 'working memory' while we consciously process, examine or manipulate it. Once the required task has been achieved, the information stored there is no longer required and is either transferred to LTM or discarded.

Figure 5.11 We combine information from sensory memory and LTM to perform all kinds of mental activities, such as when texting on a mobile phone.

5.2 LEARNING ACTIVITY 3

Review

1. Explain what short-term memory is with reference to its storage capacity and duration.
2. In what ways is STM like sensory memory and unlike sensory memory?
3. Explain, with reference to an example, why STM may be described as working memory.
4. In what two ways is information most commonly lost from STM?
5. How could you temporarily extend the duration of your STM?
6. You walk from one room to another to pick something up, and when you arrive you have forgotten why you went to the room. You realise that you were thinking about something else and this made you forget the reason for being in the room. Explain why this forgetting occurred in terms of STM capacity and duration.

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5.2 LEARNING ACTIVITY 4

VCAA exam questions

The following information relates to questions 1–3.

Justin is listening to the radio in his car when a 'guess the song' competition is announced. Justin thinks he knows the song, so he listens for the phone number to call.

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.14; ©VCAA

According to the Atkinson-Shiffrin multi-store model of memory, how long will the phone number remain in Justin's short-term memory if he does not write the number down or engage in any other practices to remember it?

A. 5–10 seconds
B. 10–20 seconds
C. 15–30 seconds
D. 30–45 seconds

Question 2 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.15 (adapted); ©VCAA

Which of the following methods is most likely to assist Justin with transferring the phone number to long-term memory and why?

	Independent variable	Dependent variable
A.	Repeat the number to himself out loud	The repeated auditory exposure will help with the transfer.
B.	Try to have a nap.	The encoding process is aided by sleep.
C.	Relearn the number in the car where he first heard it.	The environment in the car will act as a memory cue.
D.	Use displacement.	The loss of some numbers will assist with recall.

Question 3 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.16; ©VCAA

According to the Atkinson-Shiffrin multi-store model of memory, when Justin wants to retrieve the phone number from long-term memory, the number will be

A. recalled directly from long-term memory.
B. moved from long-term memory to short-term memory.
C. moved from long-term memory directly to sensory memory.
D. moved from long-term memory to sensory memory, via short-term memory.

Question 4 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.18; ©VCAA

Jonas is at the shops. While he is there, he calls his father to ask if there is anything his father would like him to buy. Jonas's father gives him a list of eight items he would like Jonas to buy. Jonas continues to speak to his father about his plans for the day. Thirty seconds pass between Jonas hearing the list and writing it down. What is the likely outcome when Jonas writes down the list and why?

	Outcome	Why
A.	Jonas remembers only the first few items.	Rehearsal transferred the first few items into long-term memory and the others were lost from short-term memory.
B.	Jonas forgets all the items.	Thirty seconds is beyond the capacity of short-term memory.
C.	Jonas forgets the middle few items.	The first few items are in long-term memory and the last few items are still in short-term memory.
D.	Jonas remembers all the items.	The list is within the capacity limits of short-term memory.

Question 5 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.22; ©VCAA

Which one of the following statements about memory is correct?

A. The duration of short-term memory can be increased by chunking.
B. The greatest number of items that can be held in short-term memory is nine.
C. The capacity of short-term memory can be increased by using maintenance rehearsal.
D. Short-term memory receives information from both sensory memory and long-term memory

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

5.2.3 Long-term memory (LTM)

Long-term memory (LTM) stores a potentially unlimited amount of information for a very long time after original learning, possibly permanently. LTM is not considered to be a single store for all kinds of information. Different types of LTM are associated with different kinds of information and memory processes.

As shown in Figure 5.12, the two main LTM types are called explicit and implicit memory, each of which has two (or more) sub-types. Generally, explicit and implicit memory differ in terms of the way information retrieved from memory is expressed; that is, with or without conscious awareness. Each of these memory types is associated with distinctive neural mechanisms and operates relatively

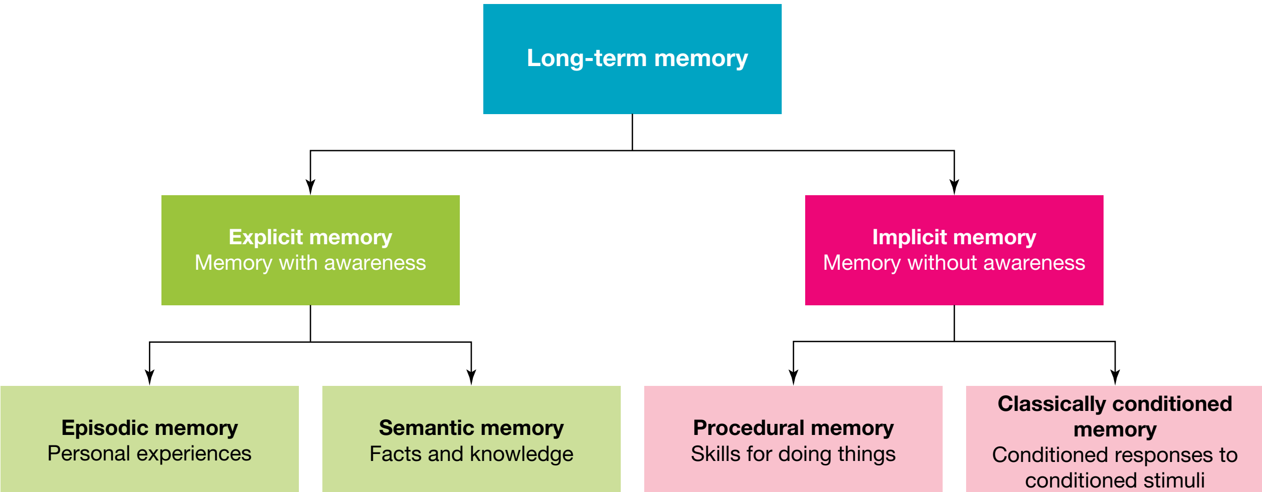

Figure 5.12 Long-term memory types and sub-types

independently of one another. Many psychologists consider them to be separate sub-systems of LTM, processing different types or aspects of information but interacting when required (Schacter, 1992).

Psychologists first identified explicit and implicit memory in the 1980s when reviewing the results of studies with patients who had amnesia due to brain damage. It was found that some could demonstrate implicit memory but not explicit memory, thereby suggesting two memory types, each of which was associated with damage to different brain areas or structures (Graf & Schacter, 1985).

Explicit memory

Explicit memory is LTM that can be consciously retrieved and stated. It is therefore commonly described as 'memory with awareness'.

Explicit memories involve general knowledge or information about personal experiences that an individual retrieves in response to a specific need or request to do so. There is a deliberate and conscious attempt to retrieve previously stored information.

Remembering someone's name, an address, a password, the colours of the Italian flag, where you went for a holiday or when a pet died are all examples of explicit memory. You would also rely on explicit memory when recognising someone in an Instagram a Facebook post, correctly answering a multiple-choice question, identifying a type of flower, explaining a statistics formula to someone, remembering what you ate for dinner last night, and whenever you recall a happy or sad event from some time in the past.

Explicit memories are also called *declarative memories* because, if asked, we can consciously retrieve the information and can 'declare' (state) or 'explicitly' (openly) express it. In addition, there are two sub-types of explicit memory called episodic memory and semantic memory.

Episodic memory

Episodic memory is the long-term memory of personally experienced events ('what') associated with a particular time ('when') and place ('where'). Your memory of your first day at school, where you went for a holiday during the last Christmas vacation, how you felt during a dental visit a week ago, and what you had for breakfast this morning and how the food tasted, are all examples of episodic memories.

Episodic memories always include the self as the initiator or recipient of some action. For example, the memory of falling off your new bicycle (what) on your birthday (when) and skinning your knee on your driveway (where) is an episodic memory.

Some psychologists refer to certain memories of personal experiences as autobiographical memories, rather than episodic memories. Others often use these terms interchangeably. Although autobiographical and episodic memories may be related and can overlap, they are different.

Autobiographical memory is a person's memory for events that occurred in their own life that can consist of information stored in episodic memory (i.e., personal experiences at a particular time and place), semantic memory (i.e., factual knowledge), or a mix of the two.

For example, the autobiographical memory of our first day at school can include episodic information, such as meeting the teacher, but it might also contain semantic information, such as knowledge that the teacher's name was Ms Smith. An episodic memory would not include the teacher's name (Tulving, 1993; Roediger & Marsh, 2003; APA, 2022).

Figure 5.13 Episodic memory is the long-term explicit memory of personally experienced events associated with a particular time and place. For example, veterans attending the Anzac Day parade often get together afterwards and consciously retrieve and share some of their war experiences.

Semantic memory

Semantic memory is the long-term memory of facts and knowledge about the world. It includes:

- facts and knowledge of the kind learned in school — e.g. that humans are mammals and a pie chart is a circular graph
- everyday facts and general knowledge — e.g. that hair can be dyed blonde or that the 2020 summer Olympic Games were held in Tokyo in 2021
- the meaning of words — e.g. that 'assist' means to help
- rules — e.g. the spelling rule 'i before e except after c', or the formula for calculating a mean score
- concepts — e.g. abstract ideas such as the meaning of 'justice' or 'moral dilemma'
- areas of expertise — e.g. that in a game of chess, a king can be moved only one space in any direction.

Unlike episodic memories, semantic memories are not 'tagged' with details of time and place. For example, you can access a fact such as 'Harry Styles was a member of the boy band called One Direction' that you know you have learnt at some time in the past and not have any idea of when and where you first learned this piece of information.

Canadian psychologist Endel Tulving (1993), who first described episodic memory, argued that semantic and episodic memories are sub-systems that store different kinds of information but often interact when we form new memories. In such instances, the memory that is ultimately encoded may be an autobiographical event that consists of episode *and* semantic information, but with each type of information stored separately.

For example, if a close friend texted you last night to tell you that their dog was hit by a car and got seriously injured, this would probably become part of your general knowledge about your friend, and therefore part of your semantic memory as well as your episodic memory. Of course, you might eventually forget the episodic details of the memory, such as where or when you received the texted information. If you subsequently recall the particular occasion when and where you had learned the bad news, then this would be an instance of episodic memory (Baddeley et al., 2009).

Figure 5.14 Semantic memory involves memories of facts and knowledge that we consciously retrieve and can express to others. For example, this tour guide is relying on her semantic memory.

Implicit memory

Implicit memory is long-term memory that does not require conscious or intentional retrieval. You are not aware that you are remembering, nor are you necessarily trying to remember or are aware of ever having remembered something you know you know or can do. However, the remembering usually occurs effortlessly.

Implicit memory is therefore commonly described as 'memory without awareness'. Examples include motor skills like brushing your teeth, kicking a football and riding a skateboard. Implicit memory also includes simple classically conditioned responses, such as fears and taste aversions (Schacter et al., 2009).

The term 'implicit memory' is used because the existence of a specific memory can be 'implied' by (or inferred from) responses that can be observed. For example, your memory for knowing how to tie your shoelaces or ride a bicycle can be judged by watching you do it rather than by asking you to state how you do it.

The psychologists who first described implicit memory considered adopting the term 'unconscious' or 'unaware' instead of 'implicit' but decided these terms could create confusion as they are also used to describe other psychological concepts that do not necessarily involve memory (Schacter, 1987).

Implicit memories are also referred to as *non-declarative memories* because people often find it

Figure 5.15 If this patient can recall unfamiliar words presented when unconscious during surgery and is unaware of when the words were learned, then she would be demonstrating implicit memory.

difficult to state or describe in words ('declare') what is being remembered, but the memory can be expressed through behaviour. This does not mean that we cannot describe any implicit memory. Sometimes we can and sometimes we can't. It depends on the specific type of information involved.

For example, not all implicit memories are 'how to …' memories. We can remember words, shapes or other objects without having a conscious memory of ever having been exposed to them before or any awareness that they actually may be in our memory. When the right cue is used, however, we can retrieve and state this information.

Different sub-types of implicit memory have been identified. Two of the most commonly described are called procedural memory and classically conditioned memory.

Procedural memory

Procedural memory is the long-term memory for the skills involved in particular tasks. It is essentially our memory of 'how to do something'. Tasks that require you to use procedural memory include those involving motor skills, such as knowing how to type, drive a car, use chop sticks, play a G chord on a guitar, and how to roller blade, even if you have not done so for a long time. Procedural memories can also involve cognitive skills such as those involved in knowing how to read, use a computer, like on Facebook or complete a jigsaw puzzle.

Procedural memories are based on practice and demonstrated through performance (i.e. behaviour) and include what are sometimes called *motor* or *muscle* memories.

Procedural memories typically require little or no intentional or conscious attempt to retrieve. For example, if you have not ridden a bicycle for many years, the skills required to do so will be reactivated and brought into conscious awareness with little or no mental effort. What we remember is automatically translated into actions. All you have to do is 'will' the action and it happens, but it happens because you have an implicit memory of how to make that action happen (Schacter et al, 2009).

Procedural memories are often particularly difficult to put into words. For example, try explaining how you balance on a bicycle without falling off when you ride down the street. Similarly, consider a more complex sequence of actions performed by an experienced hockey player. In the course of a match, the player scores a goal after taking a pass and weaving their way through several opponents while maintaining possession of the ball. If asked about the rapid series of motor activities involved in this play, the player will probably have a difficult time stating how to perform every single movement involved.

Figure 5.16 Procedural memory involves implicit memory of motor and cognitive skills, which are relied on to complete this jigsaw puzzle.

Figure 5.17 Cooking a pie can involve explicit and implicit long-term memories. Procedural memory is involved in knowing how to prepare the pastry and use the appliances. Remembering the recipe involves semantic memory. A memory of the time and place of a previous cooking disaster with apple pie would involve episodic memory.

Classically conditioned memory

Conditioned responses to conditioned stimuli acquired through classical conditioning are also considered to be a type of implicit memory, particularly those involving fear or anxiety. For example, if you immediately experience fear or anxiety at the sight of a spider or when you think about having to go to the dentist because of past associations with anxiety or pain, implicit memory is involved, whether or not you have an explicit 'declarable' recollection of a relevant past event.

Consider also a taste aversion that may be acquired involuntarily without conscious awareness through classical conditioning. Suppose, for example, that you developed a taste aversion to yoghurt after tasting or eating it and feeling nauseated. If you feel sick whenever you see or think about yoghurt, even if you have tasted it once only, this is a type of classically conditioned response. The memory of feeling sick comes into your conscious awareness automatically, without any deliberate effort, because of the past association. This means that the memory is implicit.

There are also simple conditioned reflex responses that involve implicit memory. For example, eye blinking to a puff of air and head turning to the sound of a tone that has been acquired through classical conditioning will occur automatically without conscious awareness in response to a relevant stimulus. This also means that the memory is implicit.

Figure 5.18 If you immediately feel sick at the sight or thought of oysters because of a past association between the food and nausea, you probably have a taste aversion involving a classically conditioned implicit memory.

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5.2 LEARNING ACTIVITY 5

Review

1. Explain what long-term memory (LTM) is with reference to its function, storage capacity and duration.
2. a. LTM is sometimes described as storing 'inactive' information. Explain whether this is a suitable description.
   b. Which other memory store or system could also be described as storing inactive information? Why?
3. a. Distinguish between implicit and explicit memory with reference to two key features and examples of relevant types.
   b. Why are implicit and explicit memory often described as declarative or non-declarative?
   c. Give examples of when implicit and explicit memory may occur independently of each other.
4. A competent keyboarder ('typist') would not find it too difficult to key in the phrase 'most zebras cannot be extravagant' with closed eyes. However, reciting the seven letters on the bottom row of the keyboard from left to right would probably be very difficult. Give an explanation of this research finding with reference to implicit memory.
5. The Uber driver pictured below has just received a job call to pick up and deliver to a regular customer at their usual address. Give an example of information that may be retrieved from explicit and implicit memory systems when completing the job.

6. What are two differences between episodic and semantic memories?
7. For each of the following activities, name the LTM type/s (explicit or implicit) and the relevant sub-type/s. Briefly explain each answer.
   a. describing your first day in year 7 at school
   b. planning where to move your queen in a chess game
   c. climbing stairs
   d. recalling the names of Santa's reindeer
   e. stating a lunch order in a fish-and-chip shop
   f. feeling anxious at the sight of a mouse because of a traumatic previous encounter with a mouse
   g. calculating a mean score
   h. giving directions to the principal's office
   i. writing up a prac. report
   j. recalling a New Year's Eve party you attended at a friend's house
   k. writing a computer program
   l. becoming extremely anxious when stuck in a lift because of a fear of having been in an enclosed place at some time in the past
   m. playing a car-racing video game

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5.2 LEARNING ACTIVITY 6

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.22; ©VCAA

Nadeem was asked to purchase 12 items from the bakery. On his way to the bakery, he tried to repeat the items over and over again in his head. When Nadeem arrived at the bakery, he could not remember all of the items. According to the Atkinson-Shiffrin multi-store model of memory, the most likely reason Nadeem was unable to recall all of the items was due to limited

A. rehearsal in his sensory memory.
B. duration of his long-term memory.
C. capacity of his short-term memory.
D. retrieval from his implicit memory.

Question 2 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.43; ©VCAA

As a child, Enid learned how to knit, but she has not knitted for 50 years. When a charity organisation asks her to knit some socks, she finds that she still knows how to knit and is able to knit the socks. This is due to her

A. echoic memory.
B. episodic memory.
C. short-term memory.
D. procedural memory.

Question 3 (1 mark)

Source: VCAA 2010 Psychology 2, Section A, Q.14 (adapted); ©VCAA

Five years ago Samantha sustained permanent brain damage when she was in a serious cycling accident. Samantha can remember most aspects of her life prior to the accident. However, she cannot recall anything about the accident and she is unable to learn and remember new information. Which part of Samantha's long-term memory is most likely to have been affected by her accident?

A. sensory
B. implicit
C. procedural
D. declarative

Question 4 (1 mark)

Source: VCAA 2009 Psychology 2, Section A, Q.5; ©VCAA

The memory system that stores information about personal events and general knowledge is the

A. episodic system.
B. semantic system.
C. procedural system.
D. declarative system.

Question 5 (1 mark)

Source: VCAA 2005, Psychology 2, Section A, Q.7: © VCAA

Remembering the name of the breed of your horse is an example of ____ memory; remembering the first time you rode your horse is an example of ____ memory; and your memory of how to ride your horse is an example of ____ memory.

A. episodic; semantic; declarative
B. long-term; short-term; sensory
C. semantic; procedural; episodic
D. semantic; episodic; procedural

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5.3 Brain areas involved in long-term implicit and explicit memories

All our long-term memories are not formed and stored in any one specific brain location. There are, however, certain brain areas and structures with distinctive roles in the encoding, storage or retrieval of different types of explicit and implicit memories. This does not mean that all areas of the brain are equally involved in long-term memory processes. Different areas may become active as we encode, store and retrieve different types of information.

In this section we focus on the roles of the hippocampus, amygdala, neocortex, basal ganglia and cerebellum in long-term implicit and explicit memories. Generally, the hippocampus, amygdala and neocortex play important roles in explicit memories, whereas implicit memories rely on the basal ganglia and cerebellum.

When considering their roles, however, it should be kept in mind that they are all anatomically interconnected and interact with each other in various memory processes together with other structures and areas. They are all part of an integrated learning and memory system that extends throughout the brain.

5.3.1 Hippocampus

Just above each ear, deep within the brain's medial ('middle') temporal lobe area, on the edge of and just under the cerebral cortex, is the **hippocampus**. It is also part of the brain's limbic system involved in emotion and various other functions, together with the amygdala and other structures. The hippocampus is therefore connected to the amygdala and also has numerous connections to adjacent cortex and sub-cortical areas.

As shown in Figure 5.19, the hippocampus is tubular and curved, somewhat like the shape of a seahorse (after which it is named). In humans, it is about 3.5 centimetres long and we have two of them — one in each hemisphere.

The hippocampus has a crucial role in the formation and encoding of new semantic and episodic memories. It also helps ensure they are neurologically stable and long-lasting explicit long-term memories.

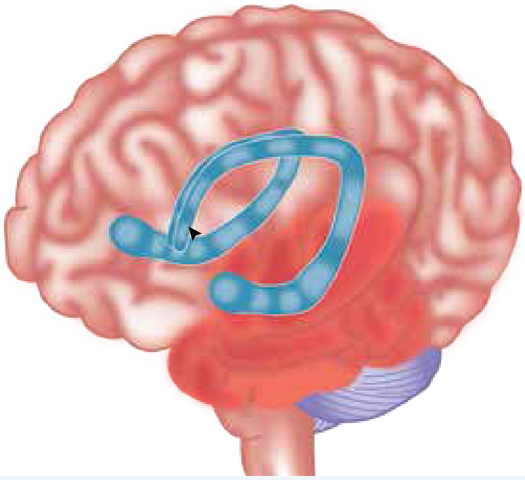

Figure 5.19 We have a hippocampus in each cerebral hemisphere, deep within the brain.

Lasting memories are not created immediately at the time of a new experience. A period of time is required to ensure the experience becomes long-lasting when transferred to long-term memory for storage. Consolidation is required for this to be achieved.

Consolidation is the neurobiological process of making a newly formed memory stable and enduring following a learning experience. Time is required after learning takes place to enable the new information to consolidate ('set') as a durable long-term memory. It is often described as comprising two phases — an initial rapid process for temporary storage, followed by a slower, more permanent process for long-term storage that may take days, weeks, months or years depending on such variables as the information, its storage requirements and how often the information is used (Gazzaniga et al, 2014).

The hippocampus has a vital role in the consolidation of most of our memories. Once consolidated, encoded memories are not necessarily fixed or unchangeable. Whenever a memory is retrieved, it is open to further consolidation and has to be 're-stabilised' through the process called *reconsolidation*. If information in the original memory is changed, which is common when we rehash a memory, then the revised version is 'reconsolidated'.

Figure 5.20 The hippocampus is vital to the formation and encoding of new semantic and episodic memories so that they are neurologically stable and long-lasting. This helps ensure pleasant holiday memories are stored relatively permanently.

However, the hippocampus is not directly involved in the formation of implicit procedural or classically conditioned memories. For example, you could have your hippocampus surgically removed and probably still encode and store memories for motor skills and classically conditioned responses (Ogden & Corkin, 1991; Thompson, 2000; Milner & Corkin, 2010).

Although the hippocampus is a vital processing site for explicit long-term memories, it is believed that it does not permanently store any memories itself. Instead, it transfers them to the neocortex for long-term storage, most likely in the areas that initially processed the information.

Links need to be established between different interrelated bits of a memory to enable their retrieval as a single memory. The hippocampus plays a significant role in achieving this by integrating new incoming information with existing information to form networks of memories. It is believed that this occurs through interaction with the cortex and other medial temporal lobe areas before the memory is gradually transferred. Integration of information also helps ensure long-term storage in an organised way and supports its efficient location and retrieval when needed (Squire, 2015).

Precisely when hippocampal involvement is no longer required after a memory is transferred to cortical areas remains unclear. Studies of people and animals with brain damage and experiments using neuroimaging techniques with non-brain damaged participants suggest that the hippocampus has a role in the retrieval of explicit long-term memories as well (Eichenbaum et al, 2016).

Through its interaction with the amygdala, the hippocampus also plays a role in the formation of emotional memories, particularly the explicit memory component of an emotional event. When emotionally aroused, we form semantic and episodic memories about the situations in which these occur and the hippocampus enables neural representations of this information as explicit memories.

For example, when you have an emotionally traumatic experience, your amygdala and hippocampus encode different aspects of the emotionally arousing event for storage in your long-term memory. When you retrieve the memory from the cortex at some time in the future, the activity of the hippocampus during memory formation will enable you to remember such aspects as where the event happened, when it happened, and whom you were with at the time when you retrieve the memory. These details are *explicit* memories.

Meanwhile, as your amygdala is activated during the retrieval process, you will also remember the emotional arousal content, and sympathetic nervous system reactions that have been linked to the memory may be initiated; for example, your muscles may tighten, your heart may beat faster, your stomach may feel as if it is tied up in knots, and so on. This component is *implicit* memory.

The hippocampus is also important for *spatial memory*, which is an explicit memory for the physical location of objects in space. Spatial memory is what enables us to navigate from place to place and to learn and remember locations. It is sometimes described as our brain's inner global positioning system — its GPS.

Because the hippocampus has so many connections to other brain areas and structures, it remains unclear as to whether some part of a spatial memory is actually stored there. There is research evidence, however, that the hippocampus is involved to some extent in the retrieval of spatial memories. For example, neuroimaging studies with people show activation of the right hippocampus in particular when navigating in familiar locations and retrieving directions (Maguire et al., 2000).

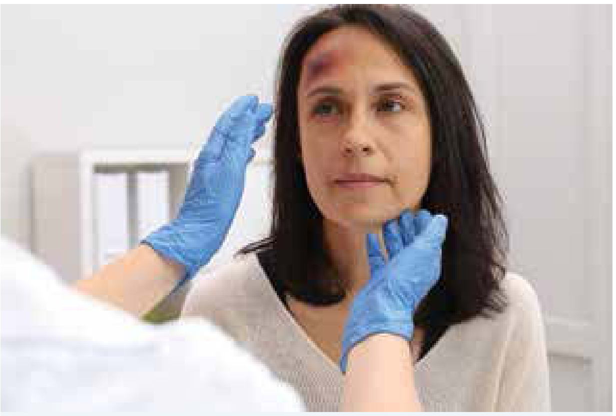

Figure 5.21 The hippocampus has a crucial role in the consolidation of our explicit long-term memories. A severe blow to the head may disrupt the process and result in failure to encode and store in LTM.

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5.3.2 Amygdala

The **amygdala** (pronounced *uh-MIG-duh-lh*) is a small structure (about 1.5 cm long) located just above and interconnected with the hippocampus in the medial temporal lobe. Like most other brain structures, we have an amygdala in each hemisphere. The amygdala is also connected with many other brain areas and structures, thereby allowing it to participate in a wide variety of neurological activities.

The amygdala is best known for its role in processing and regulating emotional reactions, particularly emotions such as fear and anger (including aggression) that may be experienced intensely and can motivate certain types of behaviour. For example, your amygdala enables you to detect possible danger when approached by a snarling dog and to recognise fear in other people from their facial expressions before they even say a word.

There is considerable research evidence that both people and animals without an amygdala cannot learn to fear things that signal danger, to express fear in appropriate situations and also lose their memory of learned fears. For example, a monkey normally feels threatened by and is afraid of snakes. But if its amygdala is damaged, a monkey loses its fear of snakes and other natural predators (Davis & Whalen, 2001; Thompson, 2000).

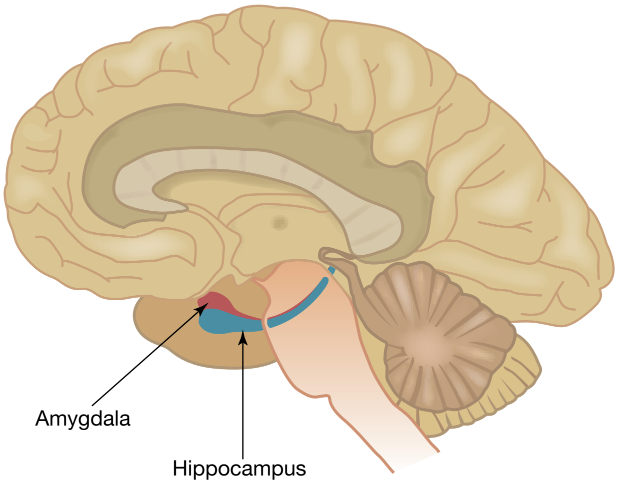

Figure 5.22 The amygdala and hippocampus are located near one another beneath the cerebral cortex.

The amygdala is also involved in the formation and consolidation of a wide range of other emotional memories; that is, memory for events that evoke an emotional reaction. A considerable amount of the research on its role has been on classically conditioned fear responses involving implicit memory.

In a typical experiment, rats are exposed to a specific stimulus such as blue light that is neutral — the light is 'meaningless' and does not produce any initial reaction by the rat. The light is then followed by an electric shock, which produces a fear response. Eventually, through pairing of the light and shock so that they occur at about the same time, the previously neutral blue light produces the fear response on its own. If one particular part of the amygdala is then damaged or removed, this interferes with the acquisition and expression of the conditioned fear response to the light alone learned during the experiment. As a result, these rats no longer fear the blue light (LeDoux, 2000).

Similarly, people with damage to their amygdala are typically unable to acquire a conditioned fear response. These individuals are likely to form conscious long-term explicit memories involving the details of the experience, but not an implicit memory that would enable them to produce or express the fear response.

Classically conditioned emotional responses involve long-term implicit memory because they occur involuntarily in the presence of a relevant environmental stimulus. There is no intentional conscious recall and the memory can be observed through the specific reactions associated with the conditioned response. We just 'react' immediately and consciously evaluate whether there is any actual danger afterwards.

As you have probably experienced, we are more likely to remember events that produce strong emotional reactions than events that do not. It appears that the level of emotional arousal at the time of encoding influences the strength of the LTM formed of that event. This is believed to be partly attributable to the increased amount of the noradrenaline in the amygdala during times of heightened emotional arousal. When released at such times, adrenaline induces the release of noradrenaline in the amygdala.

Figure 5.23 A rat typically reacts with an unlearned fight-or-flight-or-freeze response to a cat. But without a fully functional amygdala, the rat may show no signs of fear of an aggressive cat. As observed in one study, the rat may climb on a cat and try to bite it. Acquisition of conditioned fear responses appears to critically involve the amygdala. People (and other mammals) without an amygdala or severe damage to both are typically unable to acquire a conditioned fear response. These individuals can usually form conscious explicit memories of the details of the experience, but not implicit classically conditioned memories that would enable them to express fear, such as fight, flight or other fear reactions. (Thompson, 2000).

The presence of noradrenaline is believed to stimulate the amygdala to attach more emotional significance to the experience and signal the hippocampus to encode and ensure long-term storage of the relevant emotional details during the memory consolidation process. Consequently, the amygdala also contributes to the formation and storage of long-term explicit memories. This is apparent in a specific type of episodic memory known as a flashbulb memory.

A *flashbulb memory* is a vivid, highly detailed and long-lasting memory of an event that is very surprising, consequential or emotionally arousing, often including details of their personal circumstances at the time the event; for example, when hearing about the unexpected death of an important person in their life or of a shocking incident that dominates the news. Many years later people can remember details about where they were, what they were doing, who they were with and what their emotional reaction was to the event (Brown, & Kulik, 1977; Hamann, 2009; Reisberg, 2013).

Although the amygdala has a vital role in the formation of emotional memories and the expression of their emotional qualities it is believed that it does not permanently store emotional memories. This also includes emotional memories that do not involve fear, such as pleasant memories associated with reward (Thompson, 2000; Paré, 2003).

on Resources

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Figure 5.24 Flashbulb memories are so named because of the photographic nature of the memory of the event. Many people throughout the world report flashbulb memories for the emotionally charged event of the September 11, 2001, terrorist attack on the World Trade Center in New York.

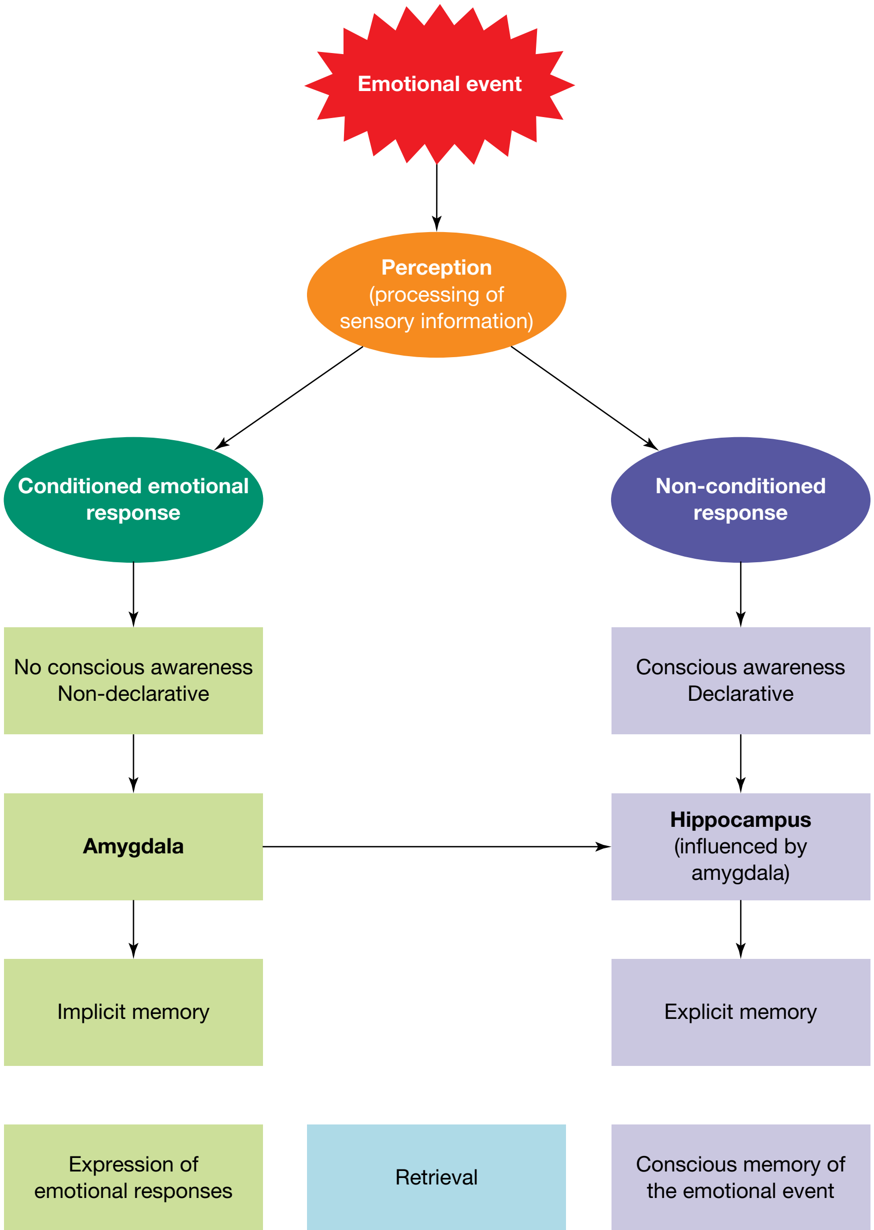

Figure 5.25 The amygdala is crucial to the formation of implicit memories involving classically conditioned fear responses, and can also contribute to explicit memories by influencing the activity of the hippocampus.

5.3.3 Neocortex

The cerebral cortex is the sheet of wrinkly looking neural tissue that forms the outer surface of the brain. The largest and most recently evolved part of the cerebral cortex is called **neocortex** (meaning new cortex). It is found in the brains of all mammals.

In humans, about 90% of the cerebral cortex is neocortex. The neocortex is anatomically distinguished by its six layers of neurons. Generally, the terms cortex, neocortex and cerebral cortex are used interchangeably.

Figure 5.26 About 90% of the human brain's cerebral cortex is neocortex.

The neocortex covers the two cerebral hemispheres, each of which has four lobes. Unlike most structures that connect only to a limited number of brain areas, the neocortex is connected to virtually all parts of the brain, including other cortical areas. This allows it to take part in almost everything we consciously think, feel and do. Basically, the neocortex is what makes us who we are as human beings and distinguishes us from other animals.

The neocortex has important roles in a range of memory processes. A crucial role is interaction with the hippocampus in the formation, consolidation, storage and retrieval of long-term explicit memories.

As time passes after learning and consolidation has occurred, long-term memories stored in the neocortex tend to gradually become independent of the hippocampus, amygdala and other medial temporal lobe structures. The neocortex then has a vital role in the retrieval process. This has been found by studies of patients who cannot recall long-term explicit memories following damage to or surgical removal of their hippocampi (Milner & Corkin, 2010; Squire, 2015).

Generally, long-term explicit semantic and episodic memories are widely distributed throughout the neocortex. Their permanent storage tends to be in the areas where the relevant information was first processed. For example, an episodic memory of a rock concert you may attend will have different components, such as the name of the band, visual images of the various band members, the band's sounds and so on. It is therefore likely that the name of the band will be stored in a cortical area involved with language (frontal lobe), images in visual cortex (occipital lobe) and sounds in auditory cortex (temporal lobe). Furthermore, the different components are linked to ensure they do not remain a collection of separate memories.

When required, the separate parts are gathered together and reconstructed as a single, integrated memory for retrieval into our conscious awareness. This can be likened to pieces of a jigsaw coming together to create a vivid recollection. The neocortex has a crucial role in this process, particularly for explicit memories (Bergland, 2015).

Through continual use of this network when recalling the concert, the groups of neurons involved in storing the different bits of information will repeatedly fire together, strengthening their connections as they become tied together as a single memory. Of course, some components of the memory may also be involved in other memories within the same network or alternative networks.

Given that different cortical lobes are associated with different functions and processing of specific types of information, researchers have investigated whether particular lobes are more likely to store semantic or episodic memories.

Although more research remains to be done on this question, neuroimaging studies indicate that semantic memories tend to be stored throughout the cortex, most likely in both of the frontal and temporal lobes. Episodic memories tend to also be stored throughout the cortex, perhaps especially in the right frontal lobe (particularly the prefrontal cortex just behind the forehead) and the right temporal lobe. Studies of brain-injured patients also implicate the frontal and temporal lobes as being more significantly involved in explicit memory processes than the other lobes (Gazzaniga et al., 2014; Breedlove & Watson, 2020).

Surgical removal of one or more cortical areas can result in serious memory impairments. Although explicit memories are stored throughout the cortex, some areas seem to specialise in different memory processes and/or storing different kinds of information. For example, studies of people with damage to the frontal lobes indicate these are primarily involved in memory processes rather than storage.

Differences have been observed between hemispheres as well as at more specific areas within the different lobes. For example, greater injury in the left hemisphere is often worse for recall of verbal material (such as a name or phone number) than non-verbal 'visual' material (such as a face or spatial location) (Thompson, 2000; Gazzaniga et al., 2014).

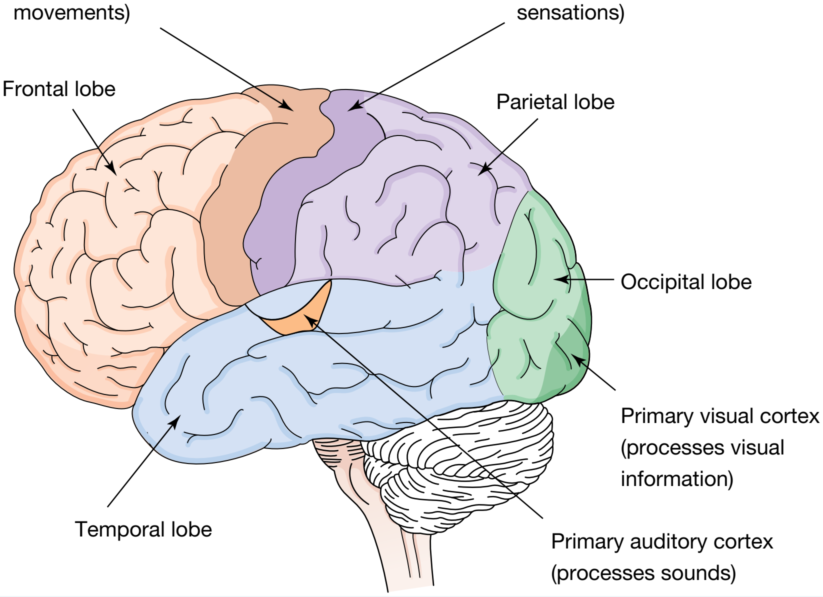

Figure 5.27 The four lobes of each cerebral hemisphere and some prominent areas and roles

5.3.4 Basal ganglia

The **basal ganglia** lying deep within the brain with extensive connections to the neocortex and other brain areas has a role in long-term implicit memories involving motor skills. This role has been associated with the impaired voluntary movements of people diagnosed with Parkinson's disease; for example, tremors and repetitive movements of the hands and fingers, difficulty starting and sustaining voluntary movements such as standing up and walking and so on.

Other people with damage to one or more of the nuclei that form the basal ganglia or damage to connections between nuclei and therefore basal ganglia circuitry have also been found to have these types of difficulties, especially those with damage to the dopamine producing substantia nigra.

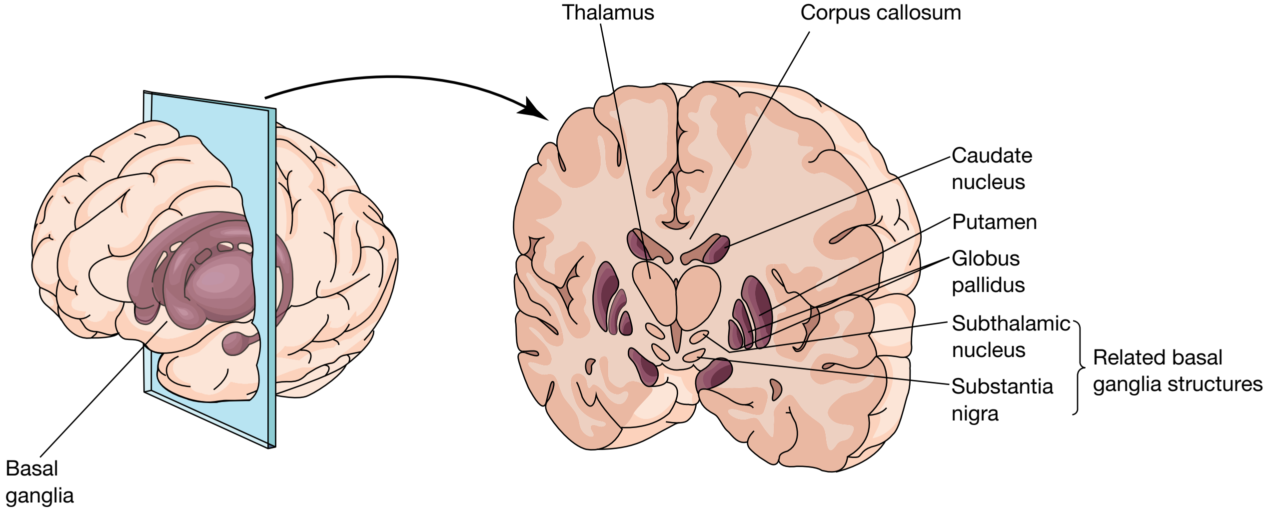

Figure 5.28 The basal ganglia and related nuclei which interact in the input and output of motor skills information

In addition, researchers have found that medications that restore basal ganglia dopamine can improve acquisition and retention of various simple motor tasks requiring implicit memory, such as the mirror tracing task shown in Figure 5.29, alternate tapping of two keys, and moving the body toward two targets. When the dopamine medication is withheld, performance on these tasks gradually deteriorates (Anderson et al., 2014).

Research studies with people diagnosed with Huntington's disease have also been found to have difficulties learning and remembering motor skills. Huntington's disease is a hereditary disorder characterised by involuntary bodily movements due to the degeneration of neurons in the basal ganglia. When asked to complete the mirror tracing task, patients with Huntington's disease have significant difficulties but are unimpaired on verbal learning tasks involving long-term explicit memory.

In contrast, patients with damage to the hippocampus, amygdala or other medial temporal lobe structures can learn the mirror tracing task and improve with each training session, indicating that implicit procedural memory for motor skills does not rely on these brain areas.

The findings about the role of the basal ganglia in implicit memories of motor skills associated with voluntary movements have been supported by the results of neuroimaging studies with healthy research participants. These show that damage to the cerebellum also affects motor skill memory, highlighting the fact that memory mostly involves different brain areas and a complex set of interacting neural networks (Hazeltine et al., 1997; Spampinato & Celnik, 2018; Kolb & Whishaw, 2020).

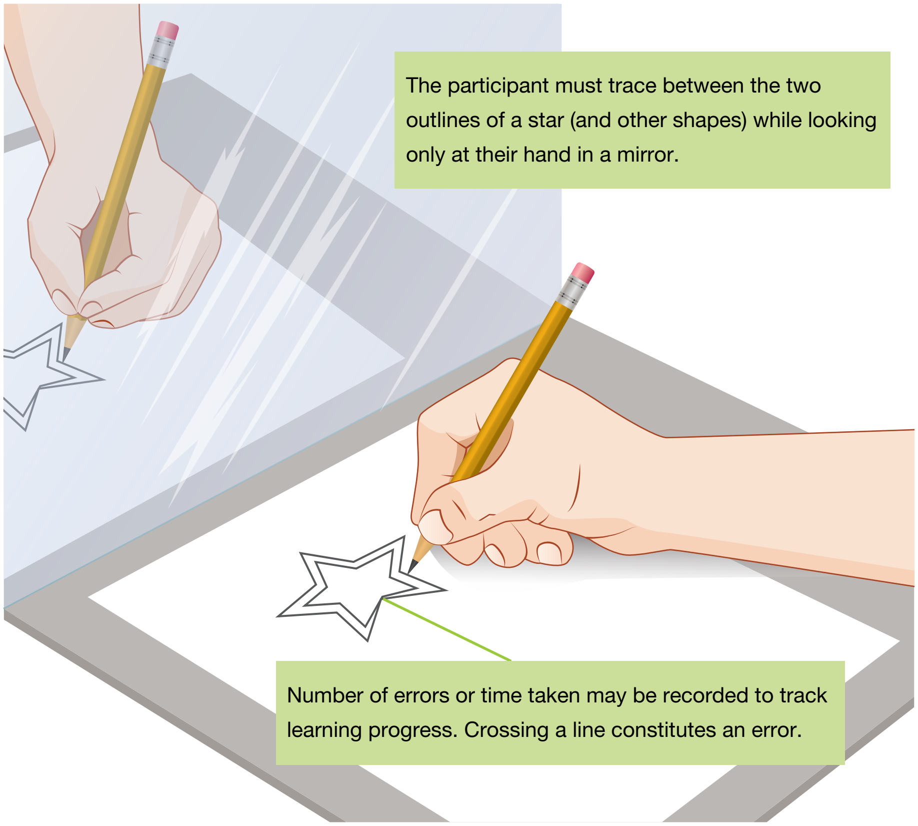

Figure 5.29 This mirror tracing task involves sensori-motor skills. Patients with Parkinson's disease and Huntington's disease, both of which involve damage to the basal ganglia, have impairments in learning and remembering this task, showing little or no improvement with each training session (so implicit procedural memory for motor skills is impaired). However, they do not have impairments on a verbal recognition task for which they have to identify and name objects (so long-term explicit memory is not impaired).

Research studies with both animals and humans have found that the basal ganglia is also involved with habituation and the associated memories. **Habituation**, or *habituation learning* as it is sometimes called, is the process of growing accustomed to a situation or stimulus. It involves a decrease in responsiveness following repeated exposure to a stimulus.

For example, a sudden, unexpected noise usually startles us and causes an orienting response. When the orienting response occurs, we become alert and turn our head towards the source of the sound. However, if the same noise occurs over and over again, we gradually cease to respond to it until we ignore it altogether. This is an example of habituation — learning to not respond to a stimulus that occurs repeatedly.

With habituation, the response to an unchanging stimulus weakens or decreases over time. Consequently, it is often described as a type of 'non-associative' learning because it does not involve the association of two stimuli to produce behaviour change. Furthermore, it usually occurs involuntarily or without any intention to learn.

Figure 5.30 These tourists have habituated to the roaring sound of low-flying aeroplanes that take off and land each hour at a nearby airport. Initially, an orienting response towards the source of the sound was unavoidable but they soon learn to ignore and not to respond to the planes as they fly overhead.

Habituation may occur with all our senses and is evident for many everyday events. For example, people living near main roads in the Melbourne suburbs become habituated to the noise of passing traffic but can be woken early in the morning by the sounds of birds when they take a holiday in the country. Similarly, when you first put on a shoe, you 'feel' it on your foot, but very shortly it is as if the shoe is no longer there and you ignore the sensation of pressure on your foot. However, you do not develop an 'insensitivity' to the sensation. You stop noticing the 'feel' of the shoe and habituate to it. If later in the day someone steps on your foot, you will still feel the pressure.

Habituation typically occurs without conscious awareness and therefore also involves memories that we can recall without conscious awareness. Consequently, memories based on this simple form of learning are considered to be implicit memories (Thompson, 2009; Squire, 2009; Foerde, & Shohamy, 2011).

5.3.5 Cerebellum

Located at the base of the brain and at the rear, the cauliflower-shaped **cerebellum** that looks like a mini brain contains more neurons than the rest of the brain combined, even though it accounts for only 10% of the brain's total volume.

The cerebellum, like many other brain structures, has multiple roles. For example, it coordinates fine muscle movements, regulates posture and balance, and contributes to various perceptual and cognitive processes.

It is probably best known for its involvement in activities requiring a skilled sequence of movements that require timing and are made with speed, ease and fluency, such as when touch-typing or playing the piano competently. However, it also plays important roles in everyday voluntary, purposeful

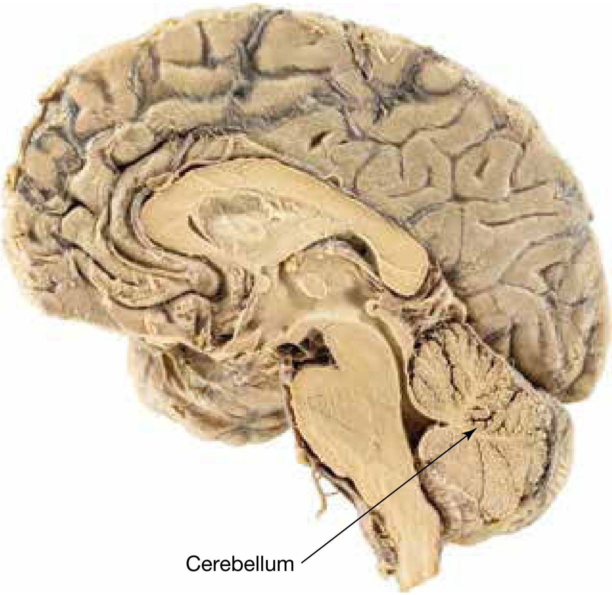

Figure 5.31 Location of the cerebellum

movements, such as when reaching to pick up a cup of coffee, so that your arm and hand make one continuous movement. Consequently, damage to the cerebellum makes it difficult to time and coordinate muscle control for everyday activities like talking, reaching, walking, brushing teeth or throwing a ball.

There is considerable research evidence that the cerebellum is directly involved in the encoding and temporary storage of implicit procedural memories for these and numerous other motor skills. It is crucial for motor learning and the execution of voluntary movements, but not their long-term storage because well-learned motor responses are believed to be stored in the neocortex like many other memories.

However, the cerebellum does form and store implicit memories of simple reflexes acquired through classical conditioning; for example, associating a sound with an impending puff of air and consequently blinking in anticipation of the puff, and a leg movement or head turn in response to a conditioned stimulus.

This was discovered by American psychologist Richard Thompson when investigating the roles of the cerebellum. Thompson conditioned rabbits to blink in response to a beep that had been associated with a puff of air. When the relevant area of the cerebellum was surgically removed, the rabbit's memory of the learned response disappeared. It no longer blinked when the beep was sounded (the CS). But when the puff of air was re-introduced, the rabbit blinked, indicating it could it normally so this reflex had not been destroyed. However, the conditioned response could not be learned again (Thompson, 2000).

Further research by Thompson and others confirmed the results and obtained evidence that classically conditioned learning and memory of very specific reflexive movements critically involves the cerebellum.

These findings are also believed to apply to people because individuals with damage to that very same area of the cerebellum have been found to be unable to store a LTM of a conditioned eye blink and other simple conditioned reflexes. All components of the conditioned response to the CS are abolished but there is no effect on the reflex itself (Thompson, 2000).

There are rare cases of people who have been born without a cerebellum and a small number of cases who have had it surgically removed because of a malignant tumour or some other life-threatening disorder. These individuals cannot acquire a classically conditioned reflex response such as the eye blink response, but do remember the experiences of hearing sounds and feeling puffs of air to the eye during the conditioning procedure (Silveri & Misciagna, 2000; Thompson, 2000; Boyd, 2009).

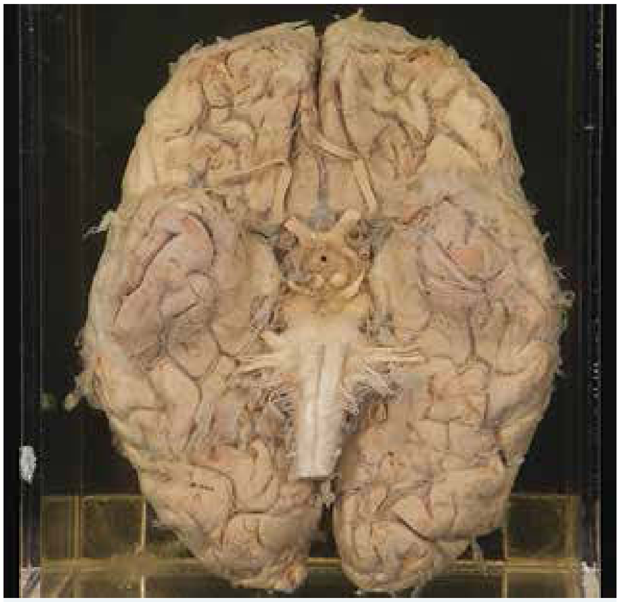

Figure 5.32 A human brain without a cerebellum. Case studies of people born without some or all of their cerebellum, a condition called cerebellar agenesis, provide valuable insights on the role of the cerebellum in memory.

A spatial function of the cerebellum has also been clearly demonstrated in a variety of experiments with small mammals. The cerebellum has two hemispheres and surgical removal of either of these results in severely impaired spatial learning and memory.

However, the exact role of the cerebellum in spatial functions remains unclear, especially its role in relation to the hippocampus. Its role is believed to be more related to assisting with visual sensori-motor coordination and the ability to organise and execute complex and effective exploration behaviours (the implicit procedural component of navigation) rather than formation of an internal map of the environment (the explicit semantic component of navigation) (Colombel et al., 2003; Passot et al., 2012; Rochefort et al., 2013; Tomlinson et al., 2014).

Although the cerebellum plays a key role in motor learning and is the permanent storage site for a range of conditioned reflexes, other brain areas and structures such as the basal ganglia and motor areas of the neocortex also play crucial roles in the learning and memory of simple and complex motor skills.

5.3 LEARNING ACTIVITY 1

Review

Complete the following table to summarise the roles of different brain regions in long-term implicit and explicit memories.

	Explicit memory		Implicit memory	
Brain area	**Semantic**	**Episodic**	**Procedural**	**Classical conditioning**
hippocampus				
amygdala				
neocortex				
basal ganglia				
cerebellum				

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

5.3 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.23; ©VCAA

Urbach-Wiethe disease is a rare genetic disorder. Some patients who suffer from Urbach-Wiethe disease may experience lack of fear and may reach out to touch a venomous snake despite remembering that it is dangerous to do so. Which region(s) of the brain is likely to be affected by Urbach-Wiethe disease?

A. amygdala
B. cerebellum
C. hippocampus
D. hippocampus and amygdala

Question 2 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.48; ©VCAA

Tuan migrated to Australia to undertake a university degree and lived in a share house with other students. He managed his money according to methods used in his birthplace, but he found it difficult to pay his bills on time. When his housemate asked for Tuan's rent money, Tuan's heart felt like it was pounding. Whenever he saw his housemate afterwards, Tuan would experience the same physiological sensation. When he started working, Tuan found he experienced an upset stomach and a pounding heart if someone at work suggested a different approach to his. He even started to experience these symptoms when he was in new social situations with friends. It was not long until he began to lie awake at night thinking about all of the things that were likely to go wrong the next day. While discussing his symptoms with his doctor, the doctor suggested Tuan had a mental health problem.

Tuan's memory of a conversation with his housemate about managing money is a very vivid memory for him. A physiological explanation for this is

A. the presence of his housemate was accompanied by strong emotions.
B. the hippocampus released noradrenaline in the consolidation of this event.
C. his heart was pounding, thus increasing the vividness of his memory of this event.
D. the amygdala was activated by adrenaline in the processing of his memory of this event.

Question 3 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.20 (adapted); ©VCAA

Research indicates that the brain area that is involved in enabling intense, emotionally significant experiences to be well remembered is the

A. amygdala.
B. basal ganglia.
C. neocortex.
D. cerebellum.

Question 4 (1 mark)

Source: VCAA 2012 Psychology 1, Section A, Q.23; ©VCAA

Dr Baressi is a very experienced medical practitioner. He works in the emergency department of a hospital where patients frequently arrive with head injuries.

One of Dr Baressi's patients had damage to the medial temporal lobes in both hemispheres, including both hippocampi.

Despite the damage, this person should be able to continue to form new

A. neocortex.
B. basal ganglia.
C. cerebellum.
D. episodic and procedural memories.

Question 5 (1 mark)

Source: VCAA 2011 Psychology 1, Section A, Q.27; ©VCAA

David, a 23-year-old university student, suffered from a brain injury and sustained damage to his amygdala. David is most likely to experience difficulty with

A. implicit memory.
B. explicit memory.
C. semantic memory.
D. sensory memory.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

5.3 LEARNING ACTIVITY 3

Analysis and evaluation of research on the role of the amygdala in the acquisition of a classically conditioned fear response

One of the best-known studies with human participants on the role of the amygdala in implicit classically conditioned memories involving fear responses was conducted by American psychologist Antoine Bechara and his colleagues (1995). The study involved three participants, each with significant brain damage:

- S.M., who had a damaged amygdala in each temporal lobe (called *bilateral amygdala damage*) but no damage to either hippocampus
- W.C., who had a damaged hippocampus in each temporal lobe (*bilateral hippocampal damage*) but no damage to either amygdala
- R.H., who had damage to each amygdala and each hippocampus (*bilateral amygdala and hippocampal damage*).

All three participants were shown a series of coloured lights and each time a blue light was presented a loud, startling boat horn was sounded. After several presentations (i.e. trials), the blue light was presented alone and each participant's 'skin conductance response' was measured as an indicator of their level of conditioned fear.

The results are shown in the table. When all participants were asked to report contextual information about what had happened during the experiment, only participant S.M., with amygdala damage, could accurately report details such as 'A light comes on, followed by the horn'. However, S.M. failed to show a conditioned fear response when the blue light was presented alone, indicating that he had not acquired this type of response. In contrast, participant W.C., with hippocampal damage, showed a conditioned fear response to the blue light but could not remember and therefore report any details of the experiment. Finally, participant R.H., with both amygdala and hippocampal damage, showed neither a conditioned fear response nor any recollection of the trials.

These results indicate that damage to the amygdala interferes with the acquisition of a conditioned fear response, providing evidence for the crucial role of the amygdala (but not the hippocampus) in acquiring and expressing a conditioned fear response (LeDoux, 2007).

Results of experiment on conditioned fear response and recollection in participants with brain damage

Participant	**Conditioned fear response (implicit memory)**	**Conscious recollection of experiment (explicit memory)**
S.M. (bilateral amygdala damage)	–	+
W.C. (bilateral hippocampal damage)	+	–
R.H. (bilateral amygdala and hippocampal damage)	–	–

a. **i.** Identify the experimental research design.
  ii. Why was this design most likely used rather than another type?
b. Identify the independent and dependent variables for the experiment.
c. Formulate a research hypothesis that would be supported by the results obtained for the experiment.
d. Explain whether sample size for this experiment enables valid generalisations to be made from the results.
e. Identify the NS, UCS, CS, UCR and CR.
f. Callie was terrified by her neighbour's dog yesterday. Describe what is likely to happen if Callie saw the dog today under each of the following conditions:
  i. no amygdala or hippocampal damage
  ii. bilateral amygdala damage
  iii. bilateral hippocampal damage.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

5.4 Role of episodic and semantic memory in retrieving autobiographical events and in constructing possible imagined futures

Autobiographical events are experiences that have occurred at some time in our own lives. These are stored in episodic memory. In order to retrieve and become consciously aware of an autobiographical event in episodic memory, we have to engage in 'mental time travel' and place ourselves in the context of the event. The ability to travel mentally through time, to remember thoughts and feelings from the recent or distant past is unique to episodic memory.

According to Tulving (2003), semantic memory is not time-related so it does not require mental time travel. For example, we don't need mental time travel to remember that grass is green or that a bird can fly. We can know a lot of things without mental time travel, but we can't remember events from your past.

Episodic memory allows us to not only mentally travel backward in time to recall past events, but also into the future. Tulving used the term 'mental time travel' to emphasise the way episodic memory allows us to 'relive' the past and use past experiences to imagine the future and plan future actions.

Consider the example of the text message from a friend that their dog was hit by a car. Mental time travel would allow you to recollect and 'relive' the experience of receiving the text from your friend about their dog's serious injury, and to use that information to construct a possible **imagined future** in which your friend's dog dies and you visit to convey your condolences and give your support.

Researchers have found similarities between the processes of remembering the past and imagining the future. For example, studies of people with Alzheimer's disease show that a common brain network underlies both memory and imagination, and the use of mental imagery to create and 'see' a 'picture' of an object or event at some time in the future (Schacter et al., 2012).

5.4.1 Alzheimer's disease

Alzheimer's disease is a neurodegenerative disorder characterised by the gradual widespread degeneration of brain neurons, progressively causing memory decline, deterioration of cognitive and social skills, and personality changes. It is age-related, but not a normal part of the ageing process.

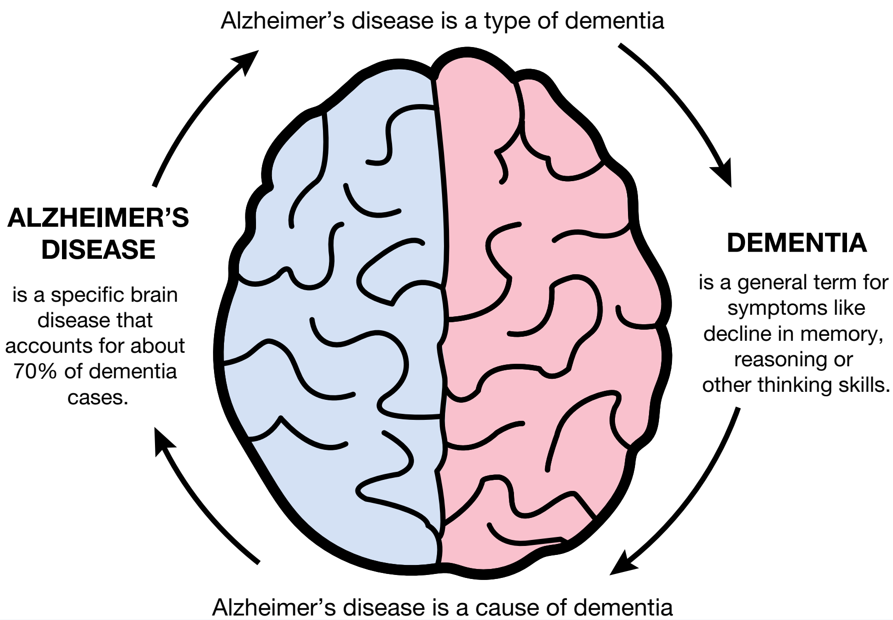

Figure 5.33 Alzheimer's disease vs dementia

The disease is believed to start when abnormal protein builds up within and between neurons, thereby disrupting their function and ultimately destroying them. As the neurons die, affected brain areas begin to shrink and waste away. By the final stages of the disease, brain lesions are widespread. As shown in Figure 5.34, there is significant damage to the normal structure of the brain.

Cortical areas tend to be damaged first, which disrupts STM. As the disease progresses to deeper parts of the brain such as the hippocampus and surrounding medial temporal lobe areas, LTM is increasingly impaired. Explicit episodic and semantic memories are primarily affected. Implicit memories tend to remain intact or are less severely affected, although this depends on the brain areas that have been damaged and the extent of the damage. Post-mortem studies typically show extensive brain shrinkage and damage. In some cases, the disease may start in or around the hippocampus and progress outwardly from there (Genova, 2021; Dementia Australia, 2022; Florey Institute, 2022).

Studies of patients with Alzheimer's disease with known hippocampal damage have found significant impairments when they are asked to imagine novel experiences; for example, when asked to imagine the future by mentally constructing a hypothetical event or scenario.

In one study, patients with a well-established deficit in remembering their past experiences could not construct new imagined experiences in response to short verbal cues that outlined a range of simple commonplace scenarios. They were encouraged to 'see the situation and setting in their mind's eye' as if they themselves were physically present and to describe as many sensory and personal details about the situation as they could. Their responses were found to be significantly impaired when compared to those of control group participants of the same sex, and of similar age and IQ. Examples of responses to one of the scenarios involving a beach are shown in Table 5.3 below.

Table 5.3 Examples of imagined experiences with the cue at the top followed by an excerpt from the response by a patient with Alzheimer's disease with damage to both hippocampi, followed by that of a control group participant matched for age, sex and IQ.

Cue:	***Imagine you are lying on a white sandy beach in a beautiful tropical bay***
Patient:	As for seeing I can't really, apart from just sky. I can hear the sound of seagulls and of the sea… um… I can feel the grains of sand between my fingers… um… I can hear one of those ship's hooters [laughter]… um… that's about it.
Researcher:	*Are you actually seeing this in your mind's eye?*
Patient:	No, the only thing I can see is blue.
Researcher:	*So if you look around what can you see?*
Patient:	Really all I can see is the colour of the blue sky and the white sand, the rest of it, the sounds and things, obviously I'm just hearing.
Researcher:	*Can you see anything else?*
Patient:	No, it's like I'm kind of floating…
Control:	It's very hot and the sun is beating down on me. The sand underneath me is almost unbearably hot. I can hear the sounds of small wavelets lapping on the beach. The sea is a gorgeous aquamarine colour. Behind me is a row of palm trees and I can hear rustling every so often in the soft breeze. To my left the beach curves round and becomes a point. And on the point there are a couple of buildings, wooden buildings, maybe someone's hut or a bar of some sort. The other end of the beach, looking the other way, ends in big brown rocks. There's no one else around. Out to sea is a fishing boat. It's quite an old creaking looking boat, chugging past on its small engine. It has a cabin in the middle and piles of nets in the back of the boat. There's a guy in the front and I wave at him and he waves back…[continues]…

Source: Hassabis et. al., (2007). Patients with hippocampal amnesia cannot imagine new experiences. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(5), 1726–1731.

The researchers then assessed the patient's abilities for 'episodic future thinking' using scenarios 'that were explicitly self-relevant and potentially plausible in the future. These scenarios included a possible Christmas event, a possible event over next weekend, and a possible future meeting with a friend. Their performance on this task was also significantly impaired when compared to the control group.

On the basis of their results, the researchers concluded that 'the role of the hippocampus extends beyond reliving past experiences' that are stored in episodic memory. Its role encompasses 'not only imagining plausible self-relevant future events, but also more generally the construction of fictitious experiences' (Hassabis et al., 2007).

When asked to perform similar imaged future tasks while their brain is being scanned, brain imaging studies of people with Alzheimer's disease have found a significant overlap in the brain activity associated with remembering actual past experiences and imagining possible future experiences. In one fMRI study, comparable levels of activity were observed in the medial temporal lobe and surrounding areas during both remembering and imagining.

Scans have also shown that both episodic and semantic memory play key roles in imagining the future. Episodic and semantic memories are supported by different neural systems and partially distinct brain areas, but there is overlap (Schacter et al., 2012; Delage et al., 2021).

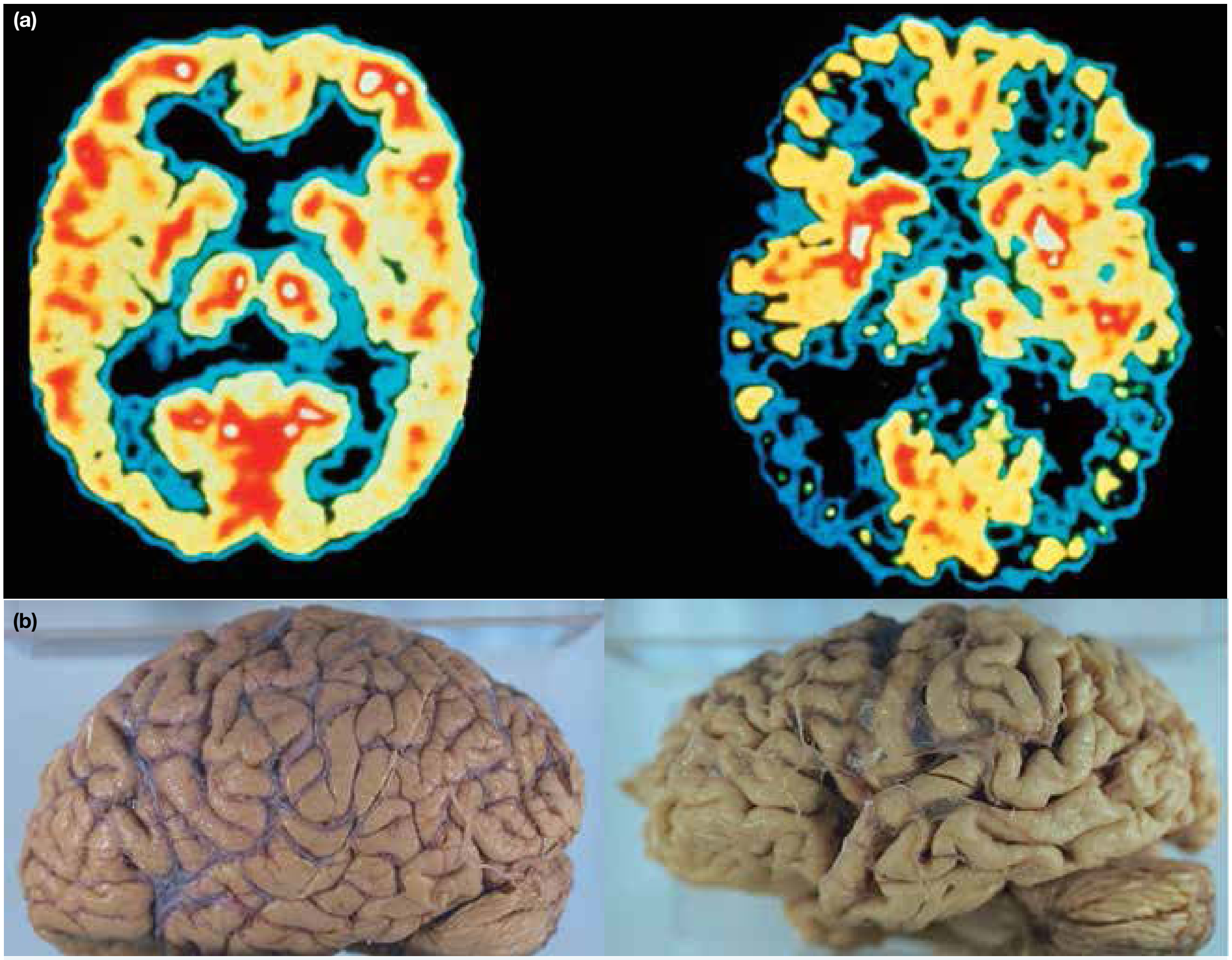

Figure 5.34 (a) A PET scan of a normal brain is shown on the left. High levels of brain activity are indicated by the red and yellow areas. The PET scan on the right shows a brain with Alzheimer's disease. Note the reduced areas of activity through neuronal loss compared to the scan of the normal brain. The lack of activity is most significant in the temporal and parietal lobes. (b) The brain on the left is a healthy one. Compare it to the brain on the right, which is affected by Alzheimer's disease. Post-mortems of people who died with the disease reveal a brain that looks shrivelled and shrunken. Note the gaps and shrinkage showing brain lesions, that is, damage to its normal structure associated with the widespread death of neurons.

learnON

learnMORE | Brain lesions associated with Alzheimer's disease

Access learnON for a description of abnormalities involving plaques and tangles that contribute to the brain lesions.

5.4.2 Aphantasia

There is a small proportion of otherwise healthy people who report that they cannot form mental images. They have no visual experience at all when asked, for example, to form an image of an apple or a face they're familiar with. They cannot picture the hot dog they ate at lunchtime or where they stayed during their last holiday. They report that they have never been able to 'see' anything in their 'mind's eye' however hard they have tried.

Although psychologists have known for many years that people vary in their ability to visualise, it was not until 2015 that the term **aphantasia** was coined by British psychologist Adam Zeman to describe the absence of visual imagery.

Zeman first became aware of the problem when a 65-year-old patient presented with a complaint that he had lost his visual imagery after a minor cardiac procedure. When he closed his eyes and tried to visualise something, all was darkness.

The patient, called M.X., was a building surveyor and reported that he had always had a talent for vividly picturing things in his mind. This was useful in his work, allowing him to recall and visualise details of the buildings he inspected. At night, just before drifting off to sleep, he usually reflected on recent events, picturing his family and friends as if watching a movie that was playing in his mind. However, he could no longer experience these memories as he previously did. When reading a novel, he used to enter a visual world, picturing characters and scenes in his 'mind's eye'. That was no longer possible either.

When asked to imagine and describe common, everyday objects or landmarks with which he was familiar, M.X. could do so in considerable detail, rattling off all kinds of facts and visual details about them. But he reported what he already knew and could remember. He was unable to experience any sort of mental image to accompany this knowledge. For example, when asked to visualise a beach, he would report that there was sand, water and various other features ordinarily found at a beach. But he couldn't create an image of a beach in his mind and mentally visit it to report what he could 'see'.

Numerous other tests were conducted to assess M.X. to find out whether his loss of visual imagery caused other problems or was a symptom of another disorder. These revealed that M.X. was, for the most part, much like the others with a similar background.

He had a high IQ and a reliable memory. His sight was normal, and he could easily put names to the faces of famous people shown to him. His visual perception and memory also appeared normal.

This was confirmed by brain scans that revealed normal functioning with visual processing in the visual cortex, but some differences when trying to use visual imagery. For example, functional neuroimaging suggested he couldn't access visual processing areas when he tried to imagine or remember images (Zeman et al., 2010; Zeman et al., 2015; Maddox, 2019).

Research shows that visual imagery involves a network of brain activity spanning from the visual

Figure 5.35 Aphantasia involves not being able to use visual imagery to picture something in your mind's eye.

cortex areas at the back of the brain to cortex involved with attention and decision-making in the frontal lobes. And in people with aphantasia, the connection between these two areas tends to be weaker, thereby disrupting access to visual processing areas. In addition, the pattern of activity in visual cortex areas is correlated with the vividness of the mental images (Keogh & Pearson, 2017; Keogh, 2021).

After the details of the M.X.'s case study were reported in an online science magazine in 2010, Zeman received over 14 000 emails from individuals, the majority describing lifelong aphantasia, but many also reporting its opposite, lifelong *hyperphantasia*, a condition involving an overabundance of visual imagery.

Zeman and many others have since conducted further research on these recently identified variations of human experience. For example, in one study, Zeman sent questionnaires to over 2000 participants who had contacted him to report that they had aphantasia and 200 with hyperphantasia. There were also control group participants who experienced visual imagery as most people do.

Participants with aphantasia reported significant difficulty with face recognition and that their autobiographical memories were less vivid and detailed than people with visual imagery, whereas a significant number of participants with hyperphantasia reported that they experienced synaesthesia — a condition in which stimulation of one sense generates a simultaneous sensation in another. It was also found that aphantasia is associated with scientific and mathematical occupations, whereas hyperphantasia is associated with creative professions such as art and design (Zeman et al., 2020).

Other researchers have obtained similar results, along with results showing difficulties imagining future events for those with aphantasia. Yet not all experiences of aphantasia are alike. Many people have had aphantasia since birth, but others have acquired it following a brain injury, or sometimes after periods of depression or psychosis. Some individuals don't dream in images, like M.X., but others can, even though they are unable to visualise while they're awake. Others say their dreams are non-visual — made up of conceptual or emotional content (Maddox, 2019; Pounder, 2021).

Although there is a trend for people with aphantasia to work in academic and computer-related careers, and for those at the other end of the spectrum to work creatively, there are artists with aphantasia who either depict objects they are looking at or use their knowledge of what things look like to steer their hand accordingly. This shows that it's possible to be creative and imaginative without visualisation (Maddox, 2019, MacKisack, 2021).

For most of us, visual imagery is used in many everyday tasks without actively trying to. For example, visual imagery is involved when we recognise faces, remember past events, plan future actions, and navigate our way between locations. It also has a prominent role in our subjective experience of dreaming, both daydreams and nightly dreams. It can influence perception and our emotions, and has been implicated in creativity and various other cognitive processes (Keogh & Pearson, 2017; Zeman et al., 2020; Milton et al., 2021).

However, one reason aphantasia may have gone nameless and unstudied for so long is because it isn't necessarily a problem. For instance, psychologists do not think that aphantasia is a disorder or a condition that needs diagnosis and treatment. Instead, it is considered a normal variation in human experience. Although many people with aphantasia may not be aware they experience the world differently, it is evident that they can live full and professional lives.

This doesn't mean that aphantasia might not have an effect on different aspects of one's life. While it makes drawing objects from imagination impossible, and visualisation strategies cannot be used for memorising and various other tasks, there are other ways to mentally represent information. Some people with aphantasia use words or symbols, others report having a good 'mind's ear' or 'mind's nose' instead of a 'mind's eye', or say that they have kinaesthetic (movement-based) imagery.

Estimates of the number of people with aphantasia vary from 1–5% of the population, including about 1–3% who have had it lifelong. The presence of a previously hidden aphantasic community reveals that many of our mental experiences are not experienced universally. Having aphantasia is part of the normal variation of mental experience found within any group or society in general. Aphantasia also shows how it is possible for many of us to be seeing the world differently without even realising it (Maddox, 2019; Pounder, 2021).

Resources

Weblinks Video: Can You Visualise This? (Aphantasia Explained) 5 m 26 s
TEDx presentation by a neuroscientist with the disorder 8 m 27 s

5.4 LEARNING ACTIVITY

Multiple-choice questions

Question 1

Mental time travel is a feature of _____ memory.

A. working
B. episodic
C. semantic
D. procedural

Question 2

Source: VCAA 2013 Psychology, Section A, Q*.17; ©VCAA*

Alzheimer's disease is

A. a form of dementia from which every person will eventually suffer.
B. a disease that progressively destroys neurons in the brain, causing memory loss.
C. caused by excessive consumption of alcohol and a diet that is deficient in vitamins.
D. a form of dementia that is characterised by irregular involuntary movements of the body and rapid intellectual deterioration.

Question 3

Source: VCAA 2014 Psychology, Section A, Q*.25; ©VCAA*

Dr Lewis is treating John, whose memory has declined significantly over the past 12 months.

Dr Lewis is not able to make a conclusive diagnosis of Alzheimer's disease because

A. John's memory for semantic information is still good.
B. Alzheimer's disease can only be confirmed via an autopsy.
C. John is only 45 years old and Alzheimer's disease occurs only in elderly people.
D. John is still able to do everyday activities, such as dressing, cooking and cleaning his house.

Question 4

The ability to construct a possible imagined future is most reliant on _____ memory.

A. working
B. episodic
C. semantic
D. procedural

Question 5

Which of the following statements is likely to be made by someone with aphantasia?

A. 'I cannot recall autobiographical events'.
B. 'I cannot think about the future'.
C. 'I can remember visual details when I think about an object, but I can't see them in my mind's eye'.
D. 'I can see the visual details when I look at a familiar object, but I can rarely remember what it's called'.

Question 6

The initial description of aphantasia is based on a

A. case study.
B. correlational study.
C. simulation study.
D. post-mortem study.

Question 7

A brain lesion is

A. a type of brain surgery.
B. any type of growth in or on the brain.
C. any disruption of or damage to the brain's normal structure.
D. a treatment for Alzheimer's disease.

Question 8

Autobiographical events are stored in _____ memory.

A. working
B. episodic
C. semantic
D. procedural

Question 9

What is the name of the condition primarily characterised by absence of visual imagery?

A. aphantasia
B. hyperphantasia
C. dementia
D. Alzheimer's disease

Question 10

Mental time travel may be used to

A. personally experience events.
B. travel mentally through time to recall a teacher's name.
C. travel mentally through time to retrieve knowledge of the world.
D. 'relive' the past and use that information to imagine the future.

Question 11

Which one of the following is a typical characteristic of Alzheimer's disease?

A. caused by ageing
B. caused by dementia
C. strong correlation with brain lesions
D. initially affects LTM more than STM

Question 12

A researcher asks participants with non-congenital aphantasia to draw a local landmark that cannot be seen. The participants would probably be able to draw the landmark quite well if they

A. are told where the landmark is located.
B. access their semantic memory for the landmark.
C. generate a mental image of the landmark.
D. know or remember what the landmark looks like.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

5.5 Comparing use of mnemonics by written and oral cultures

Some day we might be able to effortlessly encode, store and retrieve information by taking some kind of memory pill, or by hooking up through a direct electrical link from our brains to a wrist band, phone app or some other device. In the meantime, however, those of us who want to improve our memories must rely on specific mental strategies.

Of course, some things are very easy to remember. If you arrived at school one day and saw the principal sitting on top of the flagpole you would not have to rehearse this information to remember it. Observing such an unusual event would be enough to ensure that the scene remained with you always. Similarly, you would probably easily learn and remember the name of the next prime minister of Australia when they were elected.

But often we must learn and remember information that is much more difficult. This requires conscious effort. Mere exposure, even very frequent exposure, to information is often insufficient to produce effective encoding and efficient retrieval.

To make sure that information goes beyond sensory memory, attention must be given to it. It must also be organised and integrated into the information already stored in LTM. While this may sound like a tedious process, improving or enhancing your memory is not very difficult.

Any technique used to assist memory is known as a **mnemonic** (from the Greek word Mnemosyne, the goddess of memory). They can be as basic as an abbreviation or complicated strategies that themselves take considerable time to learn.

Figure 5.36 Memory when studying for an exam can be improved through the use of mnemonics.

Many of these techniques were developed in ancient times by scholars, politicians, orators, actors and priests when written records were scarce or non-existent. It is only in relatively recent times that psychologists have examined them and recognised their value in improving memory. In particular, it has been recognised that Aboriginal and Torres Strait Islander peoples have been using mnemonics for more than 50 000 years, long before 'ancient times' and the advent of alphabetic writing (Kelly, 2016; Korff, 2020).

Mnemonics use information that is already stored in LTM by forging a link or association between the new information to be remembered and information previously encoded. For example, the numbers in a password might be remembered by associating them with familiar birth dates or street addresses in your neighbourhood.

The techniques do not simplify information; they actually make it more elaborate. More information is stored, not less. However, it is believed that the additional information tends to more richly encode the material and make it easier to locate and retrieve because it has enhanced organisation in LTM. Mnemonics tend to organise new information into a cohesive whole, so that retrieval of part of the information generally assists retrieval of the rest of it.

This suggests that the ease or difficulty with which we learn new information depends not on *how much* we must learn, but on *how well it fits with what we already know*. Generally, the better it fits, the easier it is to retrieve.

Numerous mnemonics have been described. All emphasise the logical organisation of information to be remembered, and use a particular structure to facilitate this. In this section, we examine several examples that vary in degree of complexity.

5.5.1 Acronyms

Acronyms are pronounceable words formed from the first letters of a group of words. The acronym doesn't have to be a real word. An acronym is often a pronounceable abbreviation that isn't actually a 'dictionary' word. The letters of the acronym act as retrieval cues to prompt recall of the associated information.

Acronyms are formed using a type of 'chunking' or grouping procedure. ANZAC, for example, is an abbreviation of 'Australian and New Zealand Army Corps', PIN is an abbreviation of 'Personal Identification Number', and FOMO is an abbreviation of 'fear of missing out'. For all three examples, the abbreviations can be pronounced as words. Similarly, a large number of organisations are known by their acronyms rather than by their names; for example, ASIO, WHO, NASA, UNESCO and so on.

Most acronyms consist of capital letters without full stops between them. Over time, however, some may be written as words, retaining only the first capital letter. For example, Anzac and Qantas have been transformed into words in many contexts.

Acronyms can also be used for remembering other types of information. For example, the colours in the rainbow or visual colour spectrum can be remembered by relating them to the pronounceable name 'Roy G. Biv' (red, orange, yellow, green, blue, indigo, violet). Similarly, in maths, BODMAS is an acronym that represents the order of mathematical operations. When a sum contains multiple numbers and operations, you need to know which part to solve first in order to solve it in the correct order. If you don't, you'll get an incorrect answer. BODMAS stands for:

- **B**rackets (any part contained in brackets comes first)
- **O**rder (operations containing powers or square roots)
- **D**ivision
- **M**ultiplication
- **A**ddition
- **S**ubtraction.

There are other common abbreviations that are made up from the first letter of a group of words. For example, the abbreviations VIP (very important person) and ATM (Automated Teller Machine) fit this category. So do most abbreviations that are used when texting or messaging, such as LOL (laughing out loud) and OMG (Oh my God). These are called initialisms. *Initialisms* are abbreviations that are pronounced by saying each letter of the word individually. They cannot be pronounced in the way that words can. However, an acronym is often described as a blanket term that can also encompass initialisms.

Figure 5.37 Heart health organisations and medical professionals promote the acronym FAST to help people learn and remember the most common signs of stroke.

5.5.2 Acrostics

An acrostic uses the same concept as the acronym except that instead of forming a new word, it generates a sentence that helps you remember the information. **Acrostics** involve making verbal associations for items to be remembered by constructing sentences (or phrases) using the first letters of the information to be remembered. The first letter of each word in the sentence then acts as a retrieval cue, which assists recall of the relevant information.

For example, in a music class you may have learned a phrase such as '**E**very **G**ood **B**oy **D**eserves **F**ruit'. The first letters of these words are the same as the names of the musical notes on the lines of the treble clef (E, G, B, D, F), in order from highest to lowest.

Similarly, in biology, living things are organised under different categories based on similarities in a hierarchical classification system called a taxonomy. The order in the taxonomy, from largest group to smallest, is kingdom, phylum, class, order, family, genus, species. Biology students may use a phrase such as **k**ids **p**refer **c**heese **o**ver **f**ried **g**reen **s**pinach to remember the order.

Acrostics can also be useful when you have to remember information in sequential order. This can include sets of points for an essay or presentation. For example, if you wanted to remember several reasons for the colonisation of Australia you could choose key words (e.g. *convicts, staple, imperialism*) and organise them into a sentence. You could then recall the sentence and each word in the sentence would act as a retrieval cue for the recall of specific related information.

5.5.3 Method of loci

One of the oldest mnemonics was used by Ancient Greek and Roman public speakers who, without the benefit of paper, had to learn and recall their long speeches or poems. The technique, called the method of loci (loci means 'place' in Latin), uses a well-learned sequence of locations as a series of retrieval cues for the information to be recalled.

Also known as the *memory palace* or *mind palace*, the **method of loci** is a mnemonic device for which the items to be remembered are converted into mental images and associated with specific positions or locations. For instance, to remember a shopping list, each product could be imagined at a different location along a familiar street.

When the orators used this method, they would associate the parts of their speeches with landmarks in a familiar place or a part of a building. For example, if an opening point of a speech was about 'love', they might visualise a couple embracing at the entry of a temple to remind them of this point. As they mentally 'walked' around the temple, just as you could make a mental tour of your house to count the windows, they would come across each of the points to be made in their speech in the appropriate order.

The method of loci is particularly useful when you want to remember a list of items in a particular order; for example, if you had to remember the sequence of a number of historical events in chronological order or the sequence of steps in a particular process.

The first step involved in the method of loci is to learn, in their naturally occurring sequential order, some locations that are easily distinguishable and well known to you. For example, the layout of your home or backyard, the route you take between home and school, or parts of your body from head to toe. The number of locations in the sequence should correspond with the number of items of information to be remembered. It should also be possible to mentally 'move' through the locations sequentially without difficulty.

The second step is to associate a visual image of each item to be remembered with a location in the sequence. This involves creating a mental image of the items to be remembered and visually linking them with a particular location. For example, if the location is your backyard and the first item to be remembered is the planet Mars you might imagine a chocolate Mars bar resting on the handle of the back door. If the second item is a space vehicle, you might imagine this hovering over the first pot plant you come to after you walk out your back door.

If any item is an abstract or unusual concept that is hard to visualise, it must be changed into an object that can be visualised instead; for example, a courtroom might be a good substitute for the concept of 'justice'. When you need to remember the material, you mentally revisit each place in the sequence in its predetermined order, retrieving from each place the image associated with it.

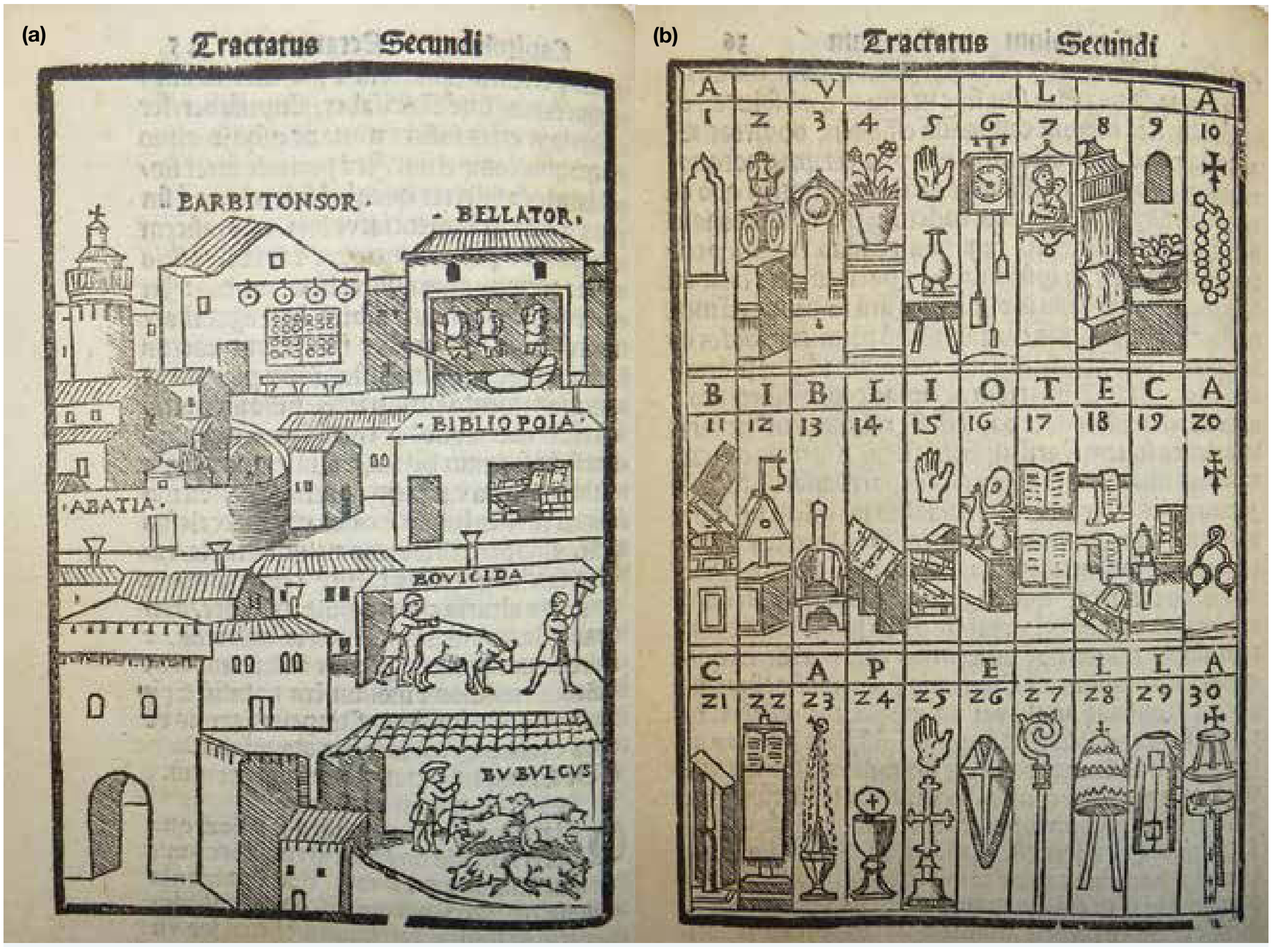

Figure 5.38 This illustration by a Dominican monk in the sixteenth century shows how the method of loci is applied. On the left is the abbey and the surrounding buildings through which the speaker will mentally walk, placing the ideas (illustrated on the right) to be recalled.

Although this method may seem an unusual strategy to enhance memory, experimental research findings indicate that it can improve memory by a factor of two to three times over recall without the use of a mnemonic. Furthermore, the method of loci is used by numerous participants in memory competitions throughout the world to enhance encoding and recall.

Many of these techniques were developed in ancient times by scholars, politicians, orators, actors and priests when written records were scarce or non-existent. It is only in relatively recent times that psychologists have examined them and recognised their value in improving memory. In particular, it has been recognised that Aboriginal and Torres Strait Islander people have been using mnemonics for over 50 000 years, long before 'ancient times' and the advent of alphabetic writing (Kelly, 2016; Korff, 2020).

5.5.4 Aboriginal peoples' use of songlines

Aboriginal and Torres Strait Islander languages, cultural practices and spiritual beliefs have survived for many thousands of years without the need for written, 'alphabetic' communication of knowledge and practical skills.

Written records have not been kept. Instead, First Australians have primarily used oral memory systems (mnemonics) to memorise massive amounts of essential information and preserve it by passing it down through numerous generations.

Each nation and language group has its own established stories, which contain vital cultural knowledge. The vast encyclopaedia stored in memory includes customary law, personal rights and responsibilities, land use, astronomical and navigational information. Extensive environmental knowledge must also be memorised, including seasonal indicators and weather conditions.

Stories aid encoding of numerous details about the habitat and properties of hundreds of plants available locally and through trade for food, building, making objects and weapons as well as for medicine. Every one of numerous animals is known as well, not just the big mammals, fish and birds. The reclusive reptiles and invertebrates must also be fully understood, for their potential both as a food source, possible dangers, and as metaphors for stories about human behaviour.

Songlines are used as mnemonics to memorise and communicate the information. They involve the pairing of place and information, like the method of loci, but are deeply tied to the landscape and much more elaborate.

A **songline**, sometimes called a *dreaming track*, is a navigational route comprising a sequence of locations. It assists navigation, but it is more than that. The locations often include significant landscape features that incorporate vital information. In addition, at each location, a story, song, dance or ceremony is performed that is associated with that particular location.

Like the method of loci, songlines link information with a physical location. Among Aboriginal and Torres Strait Islander **oral cultures**, this is almost always done when out 'on Country'.

Encoding, storage and retrieval of knowledge communicated at different locations are enhanced through stories with vivid characters. For example, human and non-human characters might be vulnerable or evil, highly intelligent or very silly and often possess magical skills such as ability to morph between human and animal forms. They may fall desperately in love or be killed violently, escape from danger or be completely engulfed by it. The stories contain all the elements of a highly memorable narrative.

The version of the knowledge performed will depend on the initiation and gender status of the audience. Teaching continues into adulthood as Elders share their knowledge with those who have sufficient knowledge to receive it. By restricting the 'secret business' to situations where accurate retelling can be assured, critical information has not become corrupted despite the passage of tens of thousands of years.

Locations within a songline might, for example, include the rocks that provide the best materials for hunting tools or be the site of a waterhole. Or, a songline may lead to a significant tree or hill, the site of a sacred Dreamtime event or a cave with rock art incorporating information about a ritual or food source. A songline story told at one of the locations may, for example, offer rich explanations of a land formation at the site, animal behaviour that should be known when hunting, or plants that can be used for medicinal purposes. It may describe laws of the land declared during the Dreamtime and how people must behave towards one another, or it may describe the customs that are followed for food supply and distribution, the rituals of initiation, the laws of marriage or the ceremonies of death that must be performed (Kelly, 2017; Reser et al., 2021).

Knowledge accumulated over many thousands of years is attached to numerous songlines throughout Australia. In particular, dreaming stories associated with the route or a particular location incorporate crucial information and are in themselves a significant means of intergenerational knowledge transmission (Nicholls, 2014).

Stories and songs in a songline may include the use of portable objects, such as message sticks, food carrying dishes, knotted cords, boards and stones. Information of cultural significance is carved, painted or woven into these and other objects such as bark and animal skins. Using these devices, in combination with the landscape, song, dance and performance provides time, place and elaborate, multi-sensory information for deep encoding, long-lasting memories and efficient retrieval (Kelly, 2016).

Figure 5.39 First Nations Australians have primarily used oral, memory code systems (mnemonics) to memorise massive amounts of vital information.

Similarly, singing the information in songs, focusing on its meaning and telling stories; for example, about plants with vivid descriptions of their characteristics, seasonal behaviour and relationship with the local area, is more likely to be remembered than a list of isolated facts.

Numerous research studies have found that when we relate new information to personal experiences and our personal situation in some way, we are more likely to remember it. Doing so involves a deeper level of information-processing that enhances encoding and consolidation for long-term storage. Attaching spiritual or emotional significance to the information, along with its repetition in elaborate, ceremonial or ritualistic ways, further enhances encoding and helps ensure the memory is long lasting.

There is an extensive network of songlines throughout Australia. Some criss-cross for hundreds of kilometres through the lands of different clans. Because they cross different language boundaries, stories and songs are also in multiple languages which change when the traveller crosses into new 'Country'. However, the information remains unchanged.

Some indigenous cultures also use the skyscape as songlines, with landscape features, songs and stories tied to stars, planets and dark spaces. In many cases, songlines in the landscape are mirrored by the songlines in the sky. A pattern of stars (a 'star map') may be used to teach a route to others, while also serving as mnemonic to remember the songline and its directions and stories on the ground.

The songline stories are ancient, exhibit little variation over long periods of time, and are carefully learned and guarded by the Elders who are the custodians. They are, however, adaptable as information may be changed or added when required (Norris & Harney, 2014; Fuller, 2016; Kelly, 2016; Reser et al., 2021).

Figure 5.40 Songlines are deeply tied to the landscape and serve as a knowledge system for the traditional, non-text-based culture of First Nations Australians. Linking meaningful information in stories and songs with locations and personal experience almost guarantees that it will be retained and accessed when needed. This image shows the Tjapini Desert Weavers letting their weavings of the Seven Sisters fly.

learnon

learnMORE | Songline activity

Access learnON for a description of the Seven Sisters Songline and instructions for how to create a useful songline for recalling psychology terms by Lynne Kelly, who has researched and written about the use of songlines and other mnemonics by indigenous peoples throughout the world.

learnON

learnMORE | Maintenance versus elaborative rehearsal for encoding, storage and retrieval

Access learnON to learn about the relative effectiveness of different types of rehearsal for encoding, storing and retrieving information

5.5 LEARNING ACTIVITY 1

Review

1. Complete the following table to summarise the mnemonics described in this topic.

Name of device	How it is used	Example of its use to assist memory
method of loci		
acronym		
acrostic		
songline		

2. How do mnemonics assist memory?

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

5.5 LEARNING ACTIVITY 2

VCAA exam questions

The following information relates to questions 1 and 2.

Simone started a new job at a local cafe. One of the cafe's most popular sandwiches is called 'The Lot'. The ingredients for 'The Lot' had to be placed into the sandwich in a specific order: a slice of cheese, then a slice of ham, followed by some anchovies, then salami and finally some egg.

Question 1 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.49; ©VCAA

Simone decided to use an acrostic to help her remember the order of the ingredients for 'The Lot'.

A possible example of her acrostic is
A. CHASE.
B. Criminals Hate Any Smelly Escapes.
C. one-cheese, two-ham, three-anchovies, four-salami and five-egg.
D. 'The cheese said to the ham and anchovies, "Why is the salami kissing the egg?"'

Question 2 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.50; ©VCAA

One of the other chefs suggested that he would find an acronym more effective to remember the order of the ingredients.

A possible acronym for the ingredients would be
A. CHASE.
B. Criminals Hate Any Smelly Escapes.
C. one-cheese, two-ham, three-anchovies, four-salami and five-egg.
D. 'The cheese said to the ham and anchovies, "Why is the salami kissing the egg?"'

Question 3 (1 mark)

Source: VCAA 2011 Psychology 1, Section A, Q.41 (adapted); ©VCAA

Frank was concerned about remembering, in the correct order, all the items he had to discuss during his work presentation.

He made up a short and funny story which included each key word in order and then used this to assist recall when he presented the speech.

The mnemonic device used by Frank would have assisted his memory by

A. allowing him to rehearse information in short-term memory.
B. adding a songline to the material to be learned and retrieved.
C. decreasing the amount and complexity of information to be learned and retrieved.
D. elaborating the information and enhancing its organisation in long-term memory.

Question 4 (1 mark)

Source: VCAA 2011 Psychology 1, Section A, Q.43 (adapted); ©VCAA

'ANZAC' helps us remember the Australian and New Zealand Army Corps, whereas 'every good boy deserves fruit' helps us to remember the musical notes E, G, B, D, F in their correct order.

These two mnemonic devices are an

A. acronym and acrostic.
B. acrostic and method of loci.
C. acrostic and sung narrative.
D. acronym and songline.

Question 5 (1 mark)

Source: VCAA 2008 Psychology 2, Section A, Q.20 (adapted); ©VCAA

George taught his class how to remember key people in Australian history by visually associating each person with a landmark in the classroom.

This mnemonic technique is known as

A. sung narrative.
B. an acronym.
C. method of loci.
D. acrostic.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

5.6 Review

Topic summary

- **Atkinson–Shiffrin multistore model of memory**
  - Sensory memory
    - Iconic memory
    - Echoic memory
  - Short-term memory (STM)
    - Duration of STM
    - Capacity of STM
    - STM functions as working memory
  - Long-term memory (LTM)
    - Explicit memory
      - Episodic memory
      - Semantic memory
    - Implicit memory
      - Procedural memory
      - Classically conditioned memory
- **Brain areas involved in long-term implicit and explicit memories**
  - Hippocampus
  - Amygdala
  - Neocortex
  - Basal ganglia
  - Cerebellum
- **Role of episodic and semantic memory in retrieving autobiographical events and in constructing possible imagined futures**
  - Alzheimer's disease
  - Aphantasia
- **Comparing use of mnemonics by written and oral cultures**
  - Acronyms
  - Acrostics
  - Method of loci
  - Aboriginal peoples' use of songlines

Key terms

acronym p. 368
acrostic p. 369
Alzheimer's disease p. 360
amygdala p. 348
aphantasia p. 363
Atkinson–Shiffrin multi-store model p. 328
autobiographical event p. 356
basal ganglia p. 353
brain lesion p. 362
cerebellum p. 355
classically conditioned memory p. 339
consolidation p. 346
dementia p. 356
echoic memory p. 331
encoding p. 327
episodic memory p. 340
explicit memory p. 340
habituation p. 355
hippocampus p. 346
iconic memory p. 331
imagined future p. 360
implicit memory p. 341
long-term memory (LTM) p. 339
medial temporal lobe p. 346
memory p. 327
memory reconstruction p. 352
method of loci p. 369
mnemonic p. 367
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oral culture p. 371
post-mortem study p. 362
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sensory memory p. 330
short-term memory (STM) p. 335
songline p. 371
storage p. 327
storage capacity p. 324
storage duration p. 324
sung narrative p. 372
working memory p. 333
written culture p. 367

Note: The **References** for the entire title can be accessed in learnON and are also available as a downloadable PDF.

on Resources

Digital documents Key terms glossary — Topic 5 (doc-37230)
Topic summary — Topic 5 (doc-37231)
Key diagrams PowerPoint — Topic 5 (doc-37233)

Exam question booklet Exam question booklet — (eqb-0111)

5.6 Topic 5 test

Section A: 25 marks **Section B:** 50 marks **Total:** 75 marks

Access learnON to answer the following test questions online and receive **immediate feedback**.

Section A — Multiple-choice questions

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

Memory is best described as

A. a unitary system through which information flows back and forth.
B. the storage and recovery of information acquired through learning.
C. a multi-store system in which all information is continually processed.
D. three independent systems called sensory memory, short-term memory and long-term memory.

Question 2

Which type of long-term memory is likely to be involved when a person recalls how to switch on their iPad after not having used one for some time?

A. working
B. semantic
C. episodic
D. procedural

Question 3

Which one of the following best describes Alzheimer's disease?

A. a contagious disorder
B. a hippocampal disorder
C. an old person's disorder
D. a neurodegenerative disorder

Question 4

Which of the following activities involves implicit memory?

A. distinguishing between a shark and a dolphin
B. telling a friend about how the weekend was spent
C. swimming in water using breaststroke
D. recalling a word for a crossword puzzle

Question 5

In which LTM are autobiographical events stored?

A. working
B. episodic
C. semantic
D. procedural

Question 6

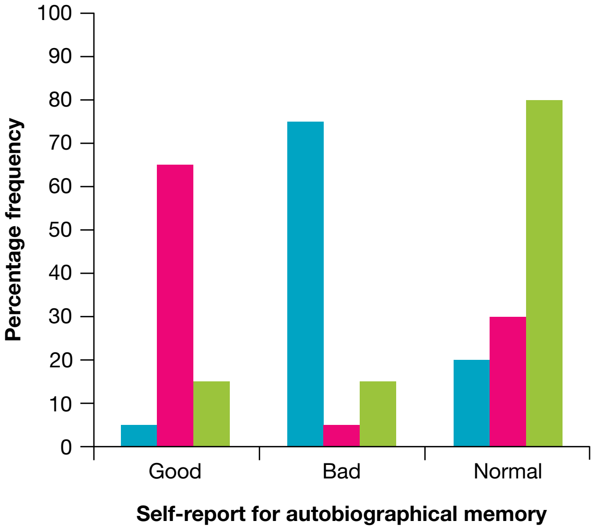
Which of the following is most likely stored in the cerebellum?

A. an episodic memory of a celebration
B. any type of sensory memory
C. a classically conditioned fear response
D. a classically conditioned patellar (knee jerk) reflex

Question 7

Consider the results in the graph below.

Participants whose results are represented by the bar shown in blue, most likely had



A. aphantasia.
B. hyperaphantasia.
C. a memory disorder affecting semantic memory.
D. a memory disorder affecting implicit memory.

Question 8

Which LTM involves mental time travel?

A. working
B. episodic
C. semantic
D. procedural

Question 9

What is required for information to be transferred from a sensory register to short-term memory?

A. attention
B. encoding
C. rehearsal
D. retrieval

Question 10

Which sub-type of LTM is likely to be involved when someone recalls their first day as a VCE student?

A. procedural
B. episodic
C. semantic
D. classically conditioned

Question 11

Which of the following statements about the hippocampus is correct?

A. The hippocampus is the permanent storage site for explicit memories.
B. The hippocampus is the permanent storage site for classically conditioned memories.
C. The hippocampus does not appear to be involved in procedural memories.
D. The medial temporal lobe is located in the hippocampus.

Question 12

You switch off a bedside alarm clock but can still hear it ringing for a couple of seconds. This is most likely due to _____ memory.

A. episodic
B. working
C. iconic
D. echoic

Question 13

Which memory system or sub-system stores information for the shortest duration?

A. short-term memory
B. sensory memory
C. echoic memory
D. iconic memory

Question 14

In which brain area is it most likely that the LTM of a visual image of an artwork is stored?

A. hippocampus
B. amygdala
C. visual cortex
D. frontal lobe

Question 15

Your ability to use language efficiently in everyday conversation is an example of

A. implicit memory.
B. explicit memory.
C. retrieval by the hippocampus.
D. classical conditioning.

Question 16

Which of the following statements is likely to be made by someone with aphantasia?

A. 'I cannot recall autobiographical events'.
B. 'I cannot think about the future'.
C. 'I cannot visualise any object'.
D. 'I can see the visual details when I look at a familiar object'.

Question 17

Most of the information that reaches sensory memory is

A. lost from the relevant sensory register.
B. immediately transferred to short-term memory.
C. encoded before transfer to short-term memory.
D. processed in some way before transfer to short-term memory.

Question 18

Which of the following shows the most likely correct order of memory processes?

A. attention → LTP → encoding → storage → retrieval → perception of stimuli
B. perception of stimuli → encoding → LTP → storage → retrieval
C. attention → perception of stimuli → LTP → encoding → storage → retrieval
D. perception of stimuli → encoding → storage → LTP → retrieval

Question 19

Sara is a proficient keyboarder. For example, when creating a Word document, she can key in a complex sentence with eyes closed, very quickly and accurately. However, when asked to name the location of the seven letters on the bottom row of a keyboard, from left to right, in their correct order, she cannot do so.

Sara's keyboarding with eyes closed relies on _____ memory, whereas correctly naming the letters relies on _____ memory.

A. explicit procedural; implicit semantic
B. implicit procedural; explicit semantic
C. implicit procedural; explicit episodic
D. implicit classically conditioned; explicit semantic

Question 20

Which brain area or structure is primarily involved in memory formation of classically conditioned fear responses?

A. cerebellum
B. hippocampus
C. cerebral cortex
D. amygdala

Question 21

Brain surgery resulting in severe damage to both amygdalae is unlikely to affect

A. retrieval of the details of an emotional memory such as where and when it was experienced.
B. acquisition of a conditioned fear response.
C. expression of a fight, flight or freeze reaction to a conditioned fear stimulus.
D. implicit, classically conditioned memory formation.

Question 22

Studies of animals and people with brain damage provide evidence that the _____ stores some relatively simple classically conditioned motor responses.

A. cerebellum
B. hippocampus
C. cerebral cortex
D. amygdala

Question 23

Songlines used as mnemonics in oral cultures are most like the mnemonic called _____ in written cultures

A. rehearsal
B. acronym
C. acrostic
D. method of loci

Question 24

Which of the following memory processes is most likely to be experienced if there is damage to the neocortex?

A. reconsolidation
B. retrieval of explicit memories
C. retrieval of classically conditioned fear responses
D. expression of classically conditioned fear responses

Question 25

Someone with aphantasia since birth will probably be able to draw a simple object if they can

A. create a visual image of the object.
B. visualise the object in their 'mind's eye'.
C. use their procedural memory of the object.
D. see the object.

Section B — Short answer questions

Question 1 (2 marks)

Long-term semantic and episodic memories are formed in the _____ and stored in the _____.

Question 2 (2 marks)

a. What is the main function of LTM? 1 mark
b. We become consciously aware of information stored in LTM by retrieving it to _____ memory. 1 mark

Question 3 (2 marks)

Source: VCAA 2002 Psychology 2, Section B, Q.5; ©VCAA
Define procedural memory. Give an example to illustrate your answer.

Question 4 (2 marks)

Identify two different types of classically conditioned memories.

Question 5 (1 mark)

Explain why short-term memory may be described as 'working memory'.

Question 6 (2 marks)

Source: VCAA 2004 Psychology 2, Section B, Q.7; ©VCAA
Give an example of an acrostic and an acronym. In each example clearly describe the material that the mnemonic device is being used to represent.

Question 7 (3 marks)

You start a new job as a casual cook in a fast-food outlet where orders are called out for you to prepare.

a. How many different items are you likely to remember in one order? 1 mark
b. Explain your answer. 1 mark
c. For about how long will you store all the items in short-term memory without any rehearsal? 1 mark

Question 8 (2 marks)

Explain the difference between encoding and retrieval in relation to LTM.

Question 9 (4 marks)

Distinguish between implicit and explicit memory with reference to an example and sub-type of each memory.

Question 10 (3 marks)

Describe the interaction between the amygdala and hippocampus in LTM formation and storage.

Question 11 (2 marks)

Source: VCAA 2004 Psychology 2, Section B, Q.4; ©VCAA

a. Describe one effect of Alzheimer's disease on the physiology of the brain. 1 mark
b. In the early stages of Alzheimer's disease what sort of information (that is, episodic and/or semantic and/or procedural) is most likely to be affected? 1 mark

Question 12 (3 marks)

Source: VCAA 2006 Psychology 2, Section B, Q.5; ©VCAA
Karlee's friend tells her the name and address of a great new music store. Karlee does not have a pen or paper to write down the information, so she repeats it over and over to herself.

a. In which memory system is the address of the music store being rehearsed? 1 mark
b. Name a mnemonic technique Karlee could use to increase her chances of being able to remember the name and address of the music store in a week's time. Explain how Karlee would apply this technique to the information. 2 marks

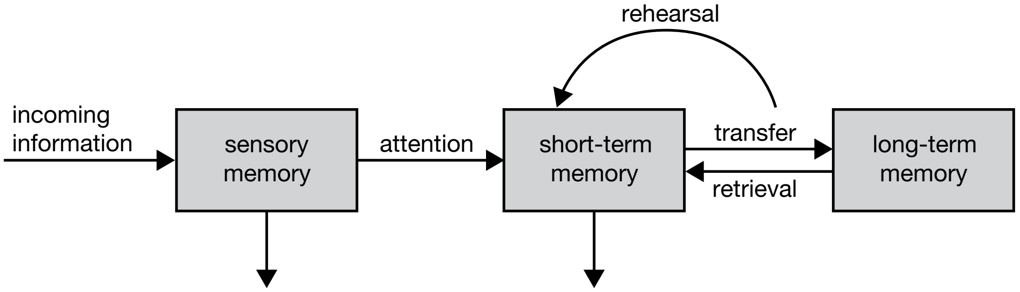
Question 13 (2 marks)

Source: VCAA 2007 Psychology 2, Section B, Q.1; ©VCAA
Tan is giving a talk to her class on endangered species of animals in Australia. She wants to ensure that she remembers all of the endangered species so she decides to use the Method of Loci to help. Describe how she could use this method to help her remember all of the endangered species.

Question 14 (10 marks)

Source: VCAA 2019 Psychology, Section B, Q.8; ©VCAA
The multi-store model of memory was first proposed by Atkinson and Shiffrin (1968). Current textbooks portray the model using a simplified diagram similar to the one above. Discuss how the Atkinson-Shiffrin multi-store model of memory and other concepts, theories and/or evidence can be used together to explain the formation and retrieval of the memories of a person's first day at secondary school.

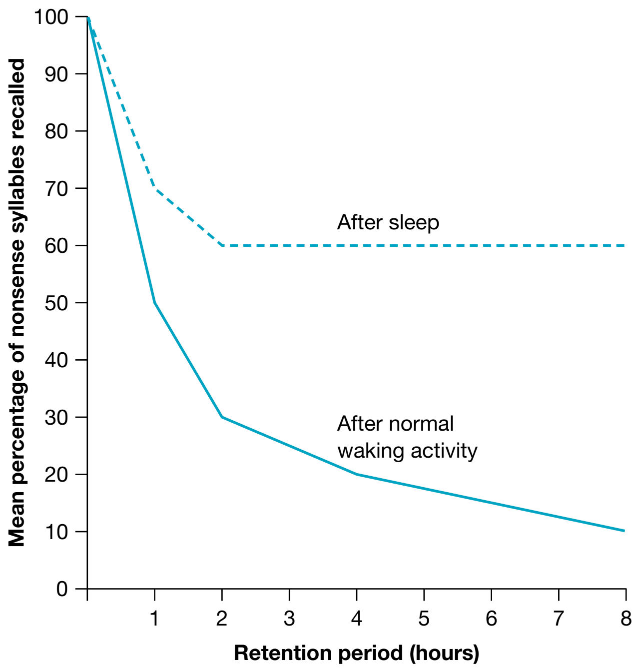
Multi-store model of memory



Source: adapted from P Shrestha, 'Types of Memory', in *Psychestudy*, 17 November 2017, <www.psychestudy.com/cognitive/memory/types>

Question 15 (10 marks)

The following graph shows the results of a pioneering study conducted on sleep and memory. The researchers were interested in finding out whether it was better for recall of newly learned information to go to sleep immediately after learning.



The researchers had two groups of first-year psychology students at their university learn a list of nonsense syllables. Immediately after the learning, Group A participants were required to go to sleep, whereas Group B participants continued with their usual activities for 30 minutes before going to sleep. When tested for recall on the nonsense syllables at different times after awakening, it was found that retrieval was lower for Group B.

a. Which data in the graph shows the results for Group B? Explain your answer. 2 marks

b. Formulate a research hypothesis of relevance to this particular experiment. 2 marks

c. Identify the independent and dependent variables. 2 marks

d. Suggest a potential extraneous or confounding variable that may not have been adequately controlled and explain your choice of the variable. 2 marks

e. Write a possible conclusion for the experiment based on the results obtained. 2 marks

on Resources

Go to learnON to access answers to the Topic 5 test. A customisable Word version of the test can also be downloaded from the **Digital documents** tab of the Resources panel.

learnMORE | The implicit memory of priming

Not all implicit memories are 'how-to' memories or conditioned responses. For example, we can learn and remember words, shapes or other objects without having a conscious memory of prior exposure to them or awareness that they may be in our memory. When the right cues are used, however, we can retrieve this information.

Priming is an improvement or change in the ability to remember something as the result of having prior experience with it. Essentially, prior exposure to a stimulus (the 'prime') influences a response to a later stimulus. For example, if you were to see a picture of bicycle handlebars drawn from an unusual angle, you would recognise them as part of a bike faster if you had previously seen a more conventional picture of a bike (the 'prime' or 'priming stimulus'). If you had not, you would find them more difficult to identify.

Priming is considered by many psychologists to be a type of implicit memory in the sense that it can occur independently of any conscious or explicit recollection of a previous encounter with a particular stimulus (Schacter, 1992; Stevens et al, 2008). Priming has mainly been studied in experiments using word completion tests. For example, participants may be exposed to a list of ten words that are rarely used in everyday conversation, such as assassin and sampan. They may be required to rate how much they like or dislike the words so that they do not focus on committing the words to memory. A week or so later, when given a test of explicit memory, the participants had no idea whether any of the words were on the list. However, when given a word fragment such as a _ _ a _ _ in and s _ m _ _ n then asked to complete it with the first appropriate word that comes to mind, they are more likely to complete the words assassin and sampan than control group participants.

Similarly, participants who are shown an entire word such as 'bird' or 'elephant' will respond more quickly to later presentations of these words than to words they had not previously seen, even though they do not remember having seen the words 'bird' or 'elephant' earlier.

This priming effect seems to rely on prior exposure to a stimulus even though the person is unaware of the experience. The effect, although sometimes reduced, has been observed in people both with and without amnesia, using different types of words (e.g. meaningful-nonmeaningful; familiar-unfamiliar; short-long) and different types of presentations (e.g. visual-auditory; short-long exposure time) (Schacter, 1987; Schacter & Buckner, 1998).

Have you noticed how your fears are heightened during and after watching a horror film? Prior experience has primed you to notice and recall related instances more easily.

learnMORE | The hippocampus and memory consolidation

Early evidence for the role of the hippocampus in memory consolidation

Consolidation is the neurobiological process of making a newly formed memory stable and long-lasting after learning. Time is required after learning takes place to enable the new information to consolidate ('set') as a durable long-term memory (LTM).

New incoming information is temporarily stored in short-term memory (STM) before its transfer to LTM. Research evidence indicates that if consolidation is disrupted, new information may not transfer from STM to LTM or will not be stored well in LTM if it does arrive there. The outcome depends on the timing of the disruption. Consolidation appears to be a gradual process, and the information being remembered tends to be particularly vulnerable to disruption for at least 30 minutes following learning.

Evidence in support of consolidation has come from studies of people who have experienced brain trauma resulting in memory failure or loss; for example, after suffering a concussion or being knocked unconscious as a result of an accident, after acquiring certain diseases affecting the brain (such as encephalitis) or after receiving electroconvulsive therapy (ECT) as part of the treatment used in some of the more serious cases of depression.

A severe blow to the head may disrupt consolidation and result in memory failure or loss.

These people are frequently unable to report any memory of the events immediately before the accident or treatment, and in many instances they cannot remember anything that occurred during a period of about 30 minutes before the brain trauma.

Other evidence for consolidation has come from research using animals. In one of the earliest and best-known studies, researchers were interested in learning whether rats that were given ECT at various intervals after learning to run a maze would be able to remember the task they had learned.

Administration of an electric shock after maze learning by rats enhanced understanding of consolidation and indicated it was a time-dependent process.

In the 1960s, American psychologist William Hudspeth and his colleagues conducted an experiment using four groups of rats. ECT was administered to the rats in Group A immediately after they had learned the task, to Group B 20 seconds after learning, to Group C 30 minutes later and to Group D 60 minutes after learning. The results showed that consolidation of the experience occurred within about 60 minutes of the rats learning the task. None of the rats in Group A remembered the task they had learned. Those in Groups B and C showed partial retention (but Group C's retention was on average greater than that of Group B). All the rats in Group D remembered the task completely (Hudspeth, McGaugh & Thomson, 1964).

The hippocampus has a crucial role in the consolidation of most of our memories. Once consolidated, memories are still not necessarily fixed. Whenever a memory is retrieved, it is open to further consolidation and must be 're-stabilised' through a process called *reconsolidation*. If information in the original memory is changed, which is common when we recall a memory, then the revised version is 'reconsolidated'.

learnMORE | H.M.'s brain surgery reveals the roles of the hippocampus in human memory

In 1957, the publication of a now widely cited case study drew the attention of psychologists to the importance of the medial temporal lobe area in memory and provided compelling evidence for the separation of explicit and implicit memories. The case study documented memory problems experienced by American patient H.M. who had undergone brain surgery. The patient, whose real name was Henry Molaison, subsequently participated in hundreds of research studies on memory until he died in 2008 at age 82. However, until his death, he was known only by the initials H.M. to protect his privacy.

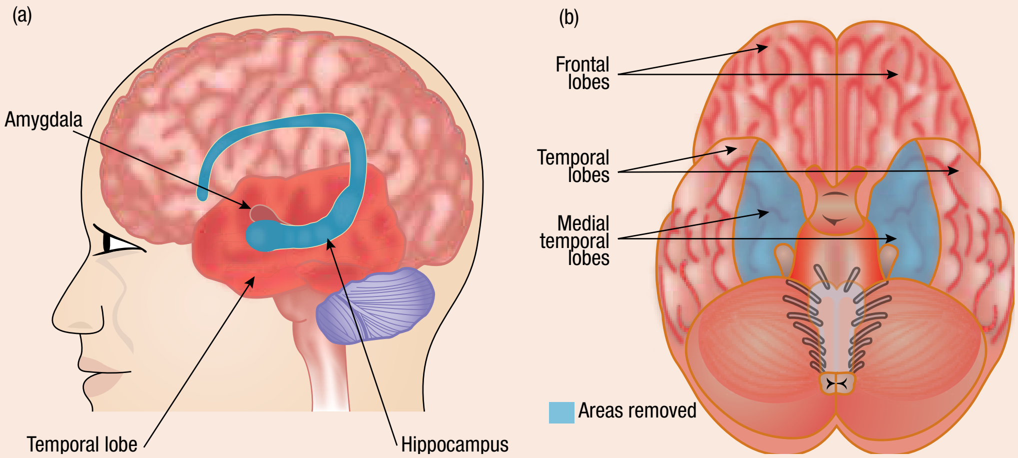
In 1953, when Molaison was 27 years old, he agreed to brain surgery to treat his severe epilepsy from which he had been suffering since the age of ten. Molaison's epilepsy was unresponsive to anticonvulsant medications and other treatments. It was also extremely debilitating, and he had difficulty holding even a simple job. At the time, doctors knew that in many patients with epilepsy, seizures started in either the right or left hemisphere, usually in the medial temporal lobe (Scoville & Milner, 1957).

Because Molaison's seizures were so severe, and because their precise origin could not be determined, his neurosurgeon decided to remove the medial temporal lobe area from each hemisphere. Altogether, over 5 centimetres of tissue was 'sucked out' from each lobe. This included about two-thirds of each hippocampus, most of each amygdala, and the adjacent cortex from around the hippocampus and amygdala. Although some of the hippocampus and amygdala remained in each lobe, these structures and surrounding neural tissue were so damaged ('lesioned') that what was left was believed to be useless (Milner & Corkin, 2010).

Medically, the surgery was successful in terms of its goals. Molaison's seizures declined in their frequency and severity and could also be controlled with medication. His personality was basically unchanged and almost all cognitive functions remained unaffected. Molaison could conduct a conversation as normally as most people, as long as he was not distracted. He had a good vocabulary, normal language skills and slightly above-average intelligence. However, there was a huge cost. The surgery left him with serious memory problems.

Molaison could not remember things that happened in the period leading up to his operation. This memory loss was virtually 'total' for about 2 years pre-surgery and 'partial' back to about 10 years pre-surgery. Overall, in relation to episodic memories, he could not remember any event that happened at a specific time and place, but he had retained the essence of personal experiences. He could describe his life up until his operation in a general way. He could talk about experiences, but could not report specific details.

This photo of Henry Molaison, or H.M. (1926–2008), was taken shortly before he underwent the surgery that left him with serious memory problems.

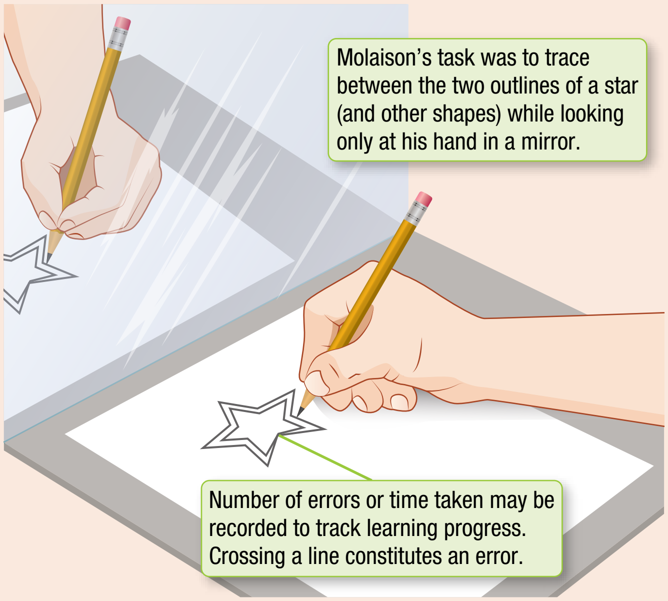


(a) Location of the hippocampus and amygdala in the medial temporal lobe area. (b) Molaison had the hippocampus, amygdala and surrounding cortex in the medial temporal lobe area of each hemisphere surgically removed to treat his epileptic seizures. As a result, he lost certain episodic memories and was incapable of forming new long-term explicit memories — both episodic and semantic memories.

More significantly, Molaison had anterograde amnesia and was therefore incapable of forming new episodic or semantic memories. For example, Molaison could no longer remember what he had eaten for breakfast when asked shortly afterwards, or why he was in hospital. He had to be reintroduced to his doctors every time he visited them, including Brenda Milner, his neuropsychologist who tested him regularly for some 50 years. Molaison had almost no knowledge of current events because he forgot the news almost as soon as he had seen or heard something. He had no idea what time of day it was unless he had just looked at a clock, and each time he was told his uncle died he reacted with surprise but could never actually experience sadness.

However, Molaison's short-term 'working' memory was relatively normal. For example, he could amuse himself by doing crossword puzzles. And, if given a series of numbers to learn during psychological testing, he could recall about seven numbers like most people. As long as he paid attention to a task and thought about or actively repeated it aloud, he could retain information in short-term memory (and therefore conscious awareness) for as long as required. However, as soon as he was distracted and his attention was consequently diverted to something else, he immediately forgot about it. The information vanished without a trace and could not be recalled thereafter (Ogden & Corkin, 1991).

Furthermore, Molaison could also learn and retain new motor skills, so the formation of these types of procedural memories was also relatively normal. For example, he learned a new motor skill involving 'mirror tracing' for which he had to trace around a shape such as a star that could only be seen in a mirror (see the figure below). He progressively improved with practice on this and other motor learning tasks over a period of three days. However, he could never recall having seen and therefore being exposed to the test materials or engaging in practice on the task at any previous time.



Despite surgical removal of the hippocampus in each hemisphere, Molaison could learn mirror tracing and improve with each training session (so procedural memory for motor skills was intact). However, he could never recall ever having seen the materials (so the formation of new explicit memories was impaired).

Roles of the hippocampus

Molaison's case illustrates that removal of (or damage to) the hippocampus in each hemisphere disrupts identifiable memory processes. It does not seem to affect the formation, storage or retrieval of procedural memories, but the formation of semantic and episodic memories and their transfer to the cortex for storage may be affected. For example, a person can still learn how to serve in tennis or use an elevator but will not remember any aspect of the learning experience such as when, where or how the learning occurred.

The removal of H.M.'s hippocampi is likely to have impaired the consolidation process, which probably accounts for why Molaison was incapable of forming new long-term episodic or semantic memories. Consolidation was unable to occur due to the lack of structures that undertake the process – not only through the loss of most of the hippocampus in each hemisphere, but also through other medial temporal lobe areas and synaptic connections that may be involved in the formation and transfer of explicit memories.

Other studies have also provided evidence that supports this. For example, monkeys and people who lose both hippocampi to surgery or disease also lose most of their explicit memories of whatever they learned during the preceding month, though their older memories tend to remain intact. This includes the explicit content of emotional memories formed when highly aroused (but not the expression of the emotional qualities or reactions, such as an elevated heart rate if fearful). The longer both hippocampi and their pathways to the cortex are left intact after learning, the smaller the memory loss, most likely because of the time available for consolidation and transfer to the cortex. Removal of one hippocampus — either one — does not seem to cause much memory impairment. It is only when both are removed or severely damaged that profound difficulties are experienced in forming new memories. The greater the loss or damage, the greater the impairment (Di Gennaro et al, 2006; Gluck et al, 2008; Schacter et al, 2009).

The fact that H.M. was able to learn the hand–eye coordination skills required for mirror drawing, despite having absolutely no memory of having practised the task before, also provides evidence of the existence of explicit and implicit memories and that they are distinctively different from each other. In addition, H.M. had retained many previously stored long-term memories suggesting that the hippocampus is not entirely responsible for their retrieval.

Although H.M. was unable to remember anything that left STM, his STM was still functional. Given that hippocampal removal did not affect H.M.'s STM in any significant way, this provides evidence that STM is different from LTM, and that the hippocampus is not involved in STM encoding, storing or functioning, other than possibly the transfer of information about facts and events from STM to LTM.

Loss of or damage to the left or right hippocampus seems to produce different results. People (and animals) without the right hippocampus tend to have difficulties learning and remembering the location of objects or places. This provides evidence for the crucial role of the right hippocampus in spatial learning and memory. Studies have also found that people without the left hippocampus tend to experience difficulty remembering verbal information (e.g. words), but they have little or no difficulty recalling visual designs (or locations). This provides evidence for the crucial role of the left hippocampus in verbal learning and memory. The reverse applies to those without the right hippocampus (Schacter, 1996).

Destruction or absence of either or both hippocampi appears to have little or no effect on the acquisition or retention of conditioned eye-blinks and other simple reflexive responses through conventional classical conditioning procedures. Therefore, it seems that the hippocampus is not required for classical conditioning or storage of these simple motor responses (Breedlove & Watson, 2020).

Although surgery to remove both medial temporal lobes is no longer performed as a treatment for epilepsy, case studies of patients with injury or disease to hippocampi in both lobes indicate that they experience similar difficulties to those of H.M., although often not as severe. Removal of the hippocampus in the temporal lobes of other mammals such as rats, rabbits and monkeys also results in the same types of memory problems (Zola-Morgan & Squire, 1993; Gluck et al., 2008).

learnMORE | Brain lesions associated with Alzheimer's disease

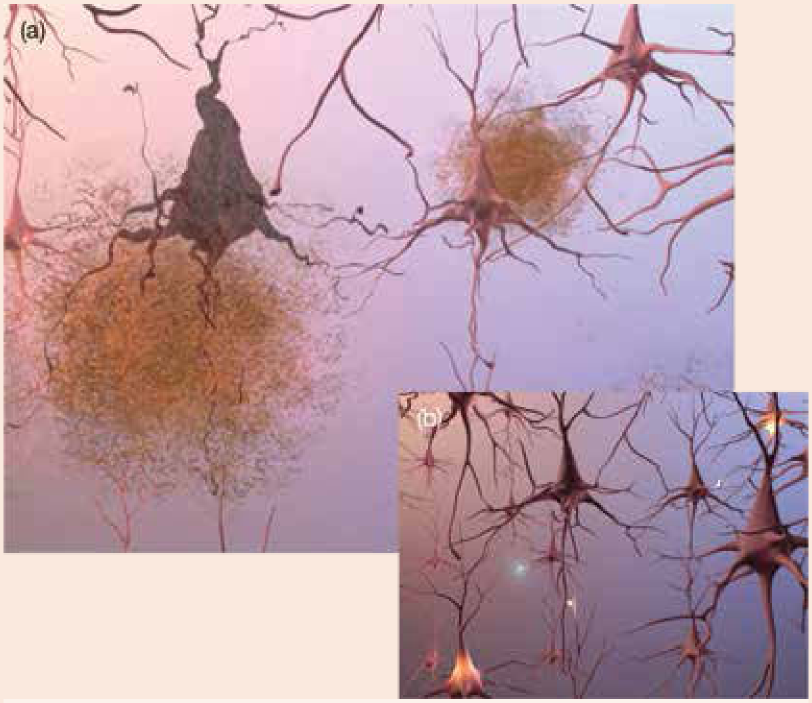
Post-mortems (autopsies) of people who died with Alzheimer's disease expose a brain with cortical and sub-cortical areas that look shrivelled and shrunken due to the widespread death of neurons. The area of the brain that appears most affected is the medial temporal lobe, particularly the hippocampus. Autopsies have revealed that up to three-quarters of the neurons in this area may be lost in Alzheimer's patients, and the remaining neurons are often damaged. This makes shrinkage in the hippocampal area especially severe.

Microscopic examination of neural tissue in a brain with Alzheimer's disease usually reveals high levels of abnormal structures that interfere with neural communication within and between neurons, and therefore impair normal brain function. These abnormalities involve plaques and tangles.

The *plaques* are fragments of the protein called beta amyloid that the body produces normally. In a healthy brain, these are broken down and eliminated from the brain naturally. In a brain with Alzheimer's disease, the fragments accumulate over time to form clumps of hard, insoluble plaques outside and around the neurons, thereby impairing synapses and inhibiting communication between neurons.

Within the neurons, another protein called *tau* also accumulates in an insoluble form. Gradually, the tau deposits form another type of abnormal structure called *neurofibrillary tangles*. These look like twisted fibres and inhibit transport of essential substances throughout the neuron. This failure of the transport system is believed to eventually kill the neurons.

Both amyloid plaques and neurofibrillary tangles can occur as part of the normal ageing process of the brain, but they are much more abundant in individuals with symptoms of Alzheimer's disease. It remains unclear whether the build up of plaques and tangles causes Alzheimer's disease or results from the disease process (Dementia Australia, 2022).



Amyloid plaques and neurofibrillary tangles associated with Alzheimer's disease that interfere with neural communication within and between neurons. (a) Neural tissue in an Alzheimer's-affected brain contains fewer neurons and synapses than (b) neural tissue in a healthy brain.

learnMORE | Maintenance vs elaborative rehearsal for encoding, storage and retrieval

Information can be kept in STM (or 'working memory') for longer than the usual maximum of about 18 to 20 seconds if it is rehearsed in some way. In the study of memory, **rehearsal** is the process of consciously manipulating information to keep it in STM, to transfer it to LTM or to aid storage and retrieval. The two main types of rehearsal are called maintenance rehearsal and elaborative rehearsal.

Maintenance rehearsal

Maintenance rehearsal involves repeating the information being remembered over and over again so that it can be retained (or 'maintained') in STM. When you hear something for the first time and simply 'go over and over it' so that you don't forget it, you are using maintenance rehearsal.

Maintenance rehearsal not only involves simple *repetition* of words or auditory information such as the sounds of words, but can also involve visual or spatial information such as images or 'mental maps'. When the information involves words and sounds, maintenance rehearsal can occur *vocally*, by repeating the information aloud over and over again, or *sub-vocally*, by silently repeating the words or a tune 'in your head'.

When the information is visual and/or spatial, maintenance rehearsal involves using something like an 'inner eye' to maintain the image of the object or scene in STM for a period after you first see it. Whether maintenance rehearsal involves words or auditory, visual or spatial information, provided it is not interrupted, the information can be retained indefinitely in STM.

Although maintenance rehearsal can be very effective for retaining information in STM, it does not always lead to long-term retention. In one experiment, participants were asked to memorise pairs of numbers; for example, 295–417, 381–620 and 749–836. After the presentation of each pair, participants were told to repeat one word per second, out loud, to prevent rehearsal of the numbers. However, unexpectedly for the participants, the memory test given at the end of the paired number presentations involved recalling the words they thought were distractions, and not the numbers. The results showed that merely repeating the words did not guarantee retention. Furthermore, the number of times a person rehearsed a word — four, eight or 12 times — did not affect the ability to recall that word (Rundas, 1977).

Nonetheless, maintenance rehearsal is a useful technique for coping with the limited duration of STM. A limitation of maintenance rehearsal, however, is that when information is continually renewed and therefore retained in STM through the rehearsal process, the amount of new information that can enter is restricted because of the limited storage capacity of STM.

To transfer information to LTM, where it may be stored indefinitely, it is more effective to use elaborative rehearsal as the information will be more 'deeply' processed (and encoded).

When a teacher gives verbal feedback on coursework during a lesson, maintenance rehearsal can be used to keep the information in STM until the advice can be written down or implemented.

Elaborative rehearsal

Unlike maintenance rehearsal, elaborative rehearsal involves focusing on the meaning of the information. More specifically, **elaborative rehearsal** is the process of linking new information in a meaningful way with other new information or information already stored in LTM to aid in its storage and future retrieval from LTM. For example, rather than 'memorising' a definition of memory for the end-of-year exam by repeating the definition aloud or writing it down over and over again, your ability to recall an appropriate definition will be more enhanced if you link it to learning and think about the nature of its relationship to learning, biologically and psychologically. You might note that learning comes before memory (as does the *l* in learning and the *m* for memory), or that memory is an expression of learning. You might also think about key processes of memory such as encoding, storage and retrieval. You might analyse a personal example of when you successfully and unsuccessfully stored and retrieved important information. The more you elaborate, or 'flesh out', the various features of the concept and link it to your own experience, the more likely you are to remember it.

When we relate new information to personal experiences and our personal situation in some way, we are more likely to remember it. This is called the *self-reference effect*. For example, if the word 'win' is on a list of words to remember, you might link it to the last time you won something, or if the word 'cook' appears, you might link it to the last time you cooked a meal (Matlin, 2002; Rogers, et al., 1977).

Elaborative rehearsal is a more active and effortful process than maintenance rehearsal. It is also more effective than maintenance rehearsal for remembering new information because it helps to ensure that information is encoded well. Consequently, it is much better to process material that you want to store for long periods in a meaningful way, rather than memorise it in a meaningless, repetitive, rote way. Why is elaborative rehearsal a more effective way of encoding new information than maintenance rehearsal?

The most common explanation emphasises that elaborative rehearsal involves a deeper level of information-processing that enhances encoding and consolidation for long-term storage. Depending on the strategy used, it may also help enhance organisation of information in LTM in a way that aids retrieval. For example, mnemonics typically involve some kind of elaborative rehearsal that simplifies organisation, reduces memory load and/or provides retrieval cues, all of which can aid retrieval.

Elaborative rehearsal enables more effective encoding, thereby enhancing LTM storage and retrieval. The more associations (and therefore neural connections or activation of connections) made between new information and information already in memory, the more likely the new information will be retained and accessed.

learnMORE | Songline activity

The Seven Sisters Songline

One of the best-known Aboriginal songlines tells the epic story of the Seven Sisters. The songline tracks the adventures of seven sisters across three states of Australia, covering about 7000 kilometres through Anangu Pitjantjatjara Yankunytjatjara lands and Ngaanyatjarra and Martu lands.

An Ancestral Being in the form of a man pursues the sisters to take possession of them. By shape shifting into things that women need, such as water, food or shade, the story encodes critical survival information in a highly memorable form.

Numerous physical features were created during their relentless Ancestral travel during the Dreaming. Re-enactments at those locations, or mentally visiting them, constantly revives the sacred locations and the knowledge encoded there. As well as survival information, the compelling story engages with moral issues of kinship, marriage and many aspects of appropriate behaviour.

The sisters flee their enemy across Country, sometimes diving beneath the earth through caves. Finally, they leap into the night sky and become the Pleiades star cluster. Their pursuer follows and becomes the 'belt' of Orion (Neale & Kelly, 2020).

A 'Songline' for the brain regions used in long-term memory

Although we can only glimpse the way Songlines work for Aboriginal and Torres Strait Islander peoples, even that brief experience will start you on a journey to understanding and give you an invaluable skill. The more you act out stories, the stronger your memories will be.

1. ***Long-term memory***. Go into the school grounds and plan a *long* path for *long*-term memory, preferably in a group.
2. ***Hippocampus***. Choose a starting point where you can imagine hippocampi camping. Act out your reaction. These are dangerous creatures. You need to be explicitly aware of them or you will die.
3. ***Amygdala***. Move along your Songline to the next significant feature. There is Amy! She is very emotional. Tell Amy that you will bring in the army to remind yourself of the pronunciation of amygdala.
4. ***Neocortex***. Add the neocortex to the next location. What pun or connection can you and your companions make?
5. ***Basal Ganglia*** and ***cerebellum***. You'll need your *imp* to join in now, to remind you that these two features are linked to *implicit* memory. Maybe even the *base* for a *gang* of imps at the next location and some kind of *ceremony* with *bells* at the last position.
6. ***Sung path***. Try making up a song to link the five words: hippocampus, amygdala, neocortex, basal ganglia and cerebellum and all sing it loudly and often!

Conclusion

You will now have a start to the story for each location in your memory palace or Songline. To add more information, just keep imagining more of the relevant story while acting, singing and linking the ideas to physical details at the specific location.

6 The demand for sleep

TOPIC CONTENT

6.1 Overview

KEY KNOWLEDGE

- sleep as a psychological construct that is broadly categorised as a naturally occurring altered state of consciousness and is further categorised into REM and NREM sleep, and the measurement of physiological responses associated with sleep, through electroencephalography (EEG), electromyography (EMG), electro-oculography (EOG), sleep diaries and video monitoring
- regulation of sleep-wake patterns by internal biological mechanisms, with reference to circadian rhythm, ultradian rhythms of REM and NREM Stages 1–3, the suprachiasmatic nucleus and melatonin
- differences in, and explanations for, the demands for sleep across the life span, with reference to total amount of sleep and changes in a typical pattern of sleep (proportion of REM and NREM)

Source: © VCAA, *VCE Psychology Study Design: 2023–2027*. p.39.

Stop for a moment and focus your attention on your thoughts and feelings right now. Are you thinking about the words in this paragraph, something a friend said to you, how hungry you are, what someone else in the room is saying, or something completely different? Now focus your attention on how you feel. Do you feel tired, bored, happy or even curious? Next, switch your attention to the sounds around you. Try to identify the different sounds you can hear. Now change the focus of your attention to what you can see, or the texture of your clothes against your skin. Try to become aware of the rhythm of your breathing and any aches, itches or pressure you may feel. Before your attention was directed to any of these things, were you actually aware or conscious of them or did they just exist without your awareness? The answer lies in your understanding of consciousness.

Consciousness refers to our awareness of something either internal or external to yourself. This includes our awareness of all objects and events in the external world, and our sensations, mental experiences and our own existence at any given moment. If we are unaware of something, then it is not a part of our immediate conscious experience.

However, consciousness is usually not an 'all-or-nothing' experience in terms of awareness. The contents of your consciousness constantly change as you continually shift your focus of attention. We also experience variations in the extent or degree of overall awareness at different times throughout each day. At times, we are highly focused and acutely aware; for example, when we are concentrating on learning how to use a new phone app or lining up to shoot a goal. At other times, we experience a medium level of awareness, such as when we are daydreaming. There are still other times, such as when we are in deep, dreamless sleep, when our overall level of awareness is very low.

Psychologists have therefore described consciousness as varying along a *continuum of awareness* with two distinctive extremes — total awareness (e.g. sustained attention) and complete lack of awareness (e.g. unconscious in a deep coma or a vegetative state). In between are other states involving more or less overall awareness.

The different states of awareness that we experience are commonly referred to as **states of consciousness**. These are primarily distinguished by their level of awareness and each is also associated with other distinguishable psychological and physiological characteristics. Such variations of consciousness may occur, for example, when people are in a fight-or-flight-or-freeze mode, fatigued, drowsy, daydreaming, asleep, in a meditative state or under the influence of alcohol, medication or an illegal drug.

In the course of a typical day we experience many different states of consciousness and therefore many levels of overall awareness, with each state having its own specific qualities of awareness. While it is sometimes difficult to distinguish between different states, psychologists generally agree on a broadly based distinction in terms of normal waking consciousness and altered states of consciousness.

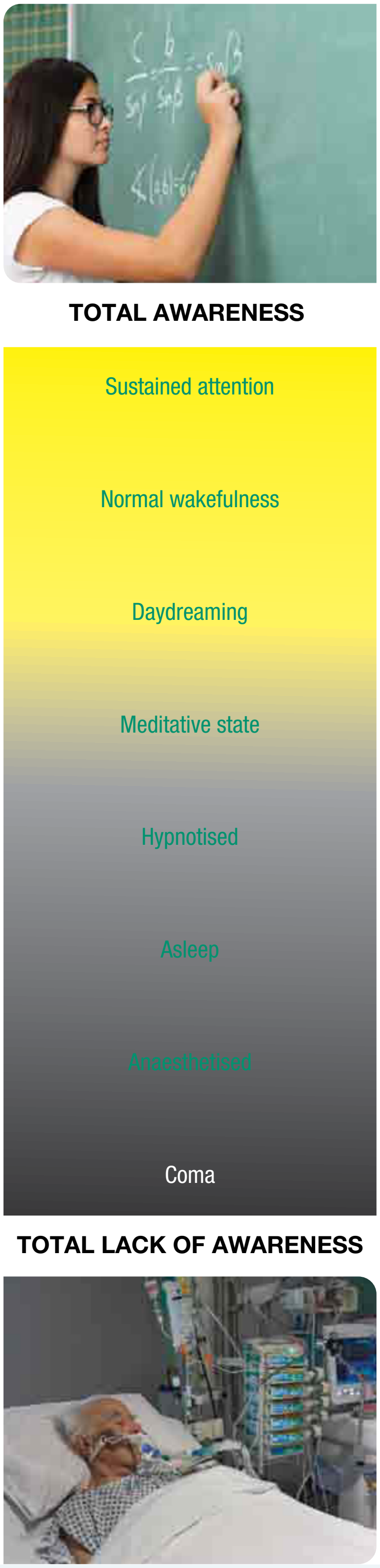


Figure 6.1 Consciousness involves our awareness of internal and external stimuli at any given moment, including our self-awareness. It is often described in terms of different states along a continuum of awareness that ranges from total awareness to a complete lack of awareness.

Normal waking consciousness, sometimes called *ordinary consciousness*, refers to the state of consciousness associated with being awake and aware of objects and events in the external world, and of one's sensations, mental experiences and own existence. Although it is a constantly changing experience, our perceptions and thoughts continue to be organised and clear, and we remain aware of our personal identity — who we are. We also perceive the world as real and we maintain a sense of time and place.

Normal waking consciousness is not considered one single state, as there are varying levels of awareness when we are awake. Generally, it includes all states of consciousness that involve heightened awareness. This does not mean, however, that all our waking time is spent in the same state of consciousness. We continually shift between different states, and therefore levels of awareness, within normal waking consciousness.

Most people spend about two-thirds of each day in normal waking consciousness during which there are variations in conscious experience as information flows in and out of awareness. Arbitrary dividing lines cannot be drawn between different waking states to clearly indicate when one state starts and ends. However, when changes in mental awareness occur to the extent that you can notice differences in alertness and your responsiveness to internal and external stimuli, you may have entered an altered state of consciousness (Glicksohn, 1991).

The term **altered state of consciousness (ASC)** is used to describe any state of consciousness that is significantly different from normal waking consciousness or any waking state in terms of level of awareness and experience. In an ASC, mental processing of internal and external stimuli shows distinguishable, measurable changes. For example, wakefulness, self-awareness, emotional awareness and perceptions of time, place and one's surroundings may change. In addition, normal inhibitions or self-control may weaken (Reisberg, 2013; APA, 2022).

Psychologists also distinguish between naturally occurring and induced altered states of consciousness. Some ASCs, such as sleep, dreaming during sleep and daydreaming when awake, are a normal part of our lives and are **naturally occurring** in the course of our everyday activities without the need for any aid. For example, each day we experience natural changes in levels of alertness and awareness as we go through cycles of wakefulness, drowsiness and sleep.

Other ASCs do not occur naturally and are instead **induced** — they are intentionally brought on by the use of some kind of aid, for example, through meditation, hypnosis, alcohol ingestion or by taking certain medications or illegal drugs. Some altered states can also be induced unintentionally due to an accident, disease or some other disorder. For example, brain trauma from a blow to the head can produce concussion or a comatose state and a medical condition such as epilepsy produces recurring seizures that alter conscious experience.

Naturally occurring and induced ASCs are not necessarily mutually exclusive. Some naturally occurring states may be induced. For example, sleep is naturally occurring and can be purposely induced with various drugs such as tranquilisers and sedatives ('sleeping pills') that promote drowsiness.

In this topic we focus on sleep as an example of an altered state of consciousness and the different demands humans have for sleep across the life span. We compare REM and NREM sleep as examples of naturally occurring ASCs and investigate the biological mechanisms of the sleep–wake cycle in terms of the timing of sleep, what causes individuals to be sleepy at night and why individuals wake when required.

Figure 6.2 An altered state of consciousness may be (a) naturally occurring (b) induced intentionally or (c) induced unintentionally. During an ASC, wakefulness, self-awareness, emotional awareness and perceptions of time, place and our surroundings may change.

6.1 LEARNING ACTIVITY 1

Multiple-choice questions

1. Consciousness is best defined as an organism's
   - A. awareness of an internal or external stimulus.
   - B. ability to change its level or degree of awareness.
   - C. lack of awareness of internal or external stimuli.
   - D. sustained attention to a stimulus while excluding other distracting stimuli.
2. Conscious experience may be described as
   - A. varying along a continuum of awareness.
   - B. graduated changes in levels of awareness.
   - C. constant and stable unless intentionally changed.
   - D. constant and stable unless unintentionally changed.
3. A state of consciousness is
   - A. a state or condition in which we are highly focused and acutely aware.
   - B. the time when our overall level of awareness is very high.
   - C. a particular state or form of awareness with distinguishable psychological characteristics.
   - D. the time when we are awake and able to attend to internal and external stimuli.
4. An altered state of consciousness
   - A. typically involves some loss of awareness.
   - B. is a type of unconsciousness.
   - C. is the opposite of normal waking consciousness.
   - D. is significantly different from the experience of normal waking consciousness.

5. Which of the following is typically an induced ASC?
   A. sleep state
   B. anaesthetised
   C. daydreaming
   D. normal wakefulness

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

6.1 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.27 (adapted); ©VCAA

Consciousness is
A. individual and continuously changing.
B. limited by an individual's capacity to learn.
C. stored in an individual's long-term memory.
D. directly observed through the behaviours of individuals.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.28; ©VCAA

Alex was waiting at the hairdresser's for his appointment. As time passed, Alex considered the traffic conditions outside and whether he would get home in time to watch his favourite TV show, noticed the peculiar smell in the salon, and wondered whether he would have time for a run later on.

Alex's state of consciousness could best be described as
A. focused awareness.
B. normal waking consciousness.
C. an induced altered state of consciousness.
D. a naturally occurring altered state of consciousness.

Question 3 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.13; ©VCAA

Lucy and Xavier were at a bar for a friend's 21st birthday. Lucy was drinking alcohol; Xavier was not as he was the designated driver. Thomas was at home, asleep in bed.

Which of the following identifies the state of consciousness being experienced by Lucy, Xavier and Thomas?

	Lucy	Xavier	Thomas
A.	induced altered state of consciousness	naturally occurring altered state of consciousness	normal waking consciousness
B.	normal waking consciousness	naturally occurring altered state of consciousness	induced altered state of consciousness
C.	induced altered state of consciousness	normal waking consciousness	naturally occurring altered state of consciousness
D.	naturally occurring altered state of consciousness	normal waking consciousness	naturally occurring altered state of consciousness

Question 4 (1 mark)

Source: VCAA 2009 Psychology 1, Section A, Q.32 (adapted); ©VCAA

The awareness of objects and events in the external world, and of the subject's own existence and activities, is defined as
A. consciousness.
B. focused attention.
C. sustained attention.
D. an altered state of consciousness.

Question 5 (1 mark)

Source: VCAA 2007 Psychology 1, Section A, Q.32; ©VCAA

Which of the following descriptions of human consciousness is most accurate?

A. awareness of the world around us and ourselves, including thoughts and feelings
B. knowledge of events taking place in the world
C. being able to understand and express our thoughts, feelings and knowledge of the world
D. awareness of different situations that may cause an altered state of consciousness

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6.2 Sleep as a psychological construct

Just as we experience differing states of consciousness within normal waking consciousness, it is the same when we sleep. Psychologists have identified different types of sleep associated with different levels of alertness and experiences of consciousness. For example, when we dream during sleep, we experience an ASC that is distinctly different from the state of consciousness we experience when we are asleep but not dreaming.

While there is no single definition of sleep used by all psychologists, **sleep** can be described as a regularly occurring ASC that typically occurs naturally and is primarily characterised by partial or total suspension of conscious awareness. Other characteristics such as unique, sleep-related brain wave patterns, help distinguish normal sleep from a loss of consciousness due to brain injury, disease or drugs (APA, 2022).

Sleep is considered to be a fundamental human need and along with nutrition and physical exercise, one of the three pillars of good health (Zimmerman, 2019). Over a lifetime, we spend about one-third of our time asleep. If we live to around 75 years of age, we will spend about 25 years sleeping (including about five years dreaming).

Sleep may also be described as a psychological construct. Constructs are ways to describe patterns of behaviour or experiences so that they can be explored, investigated and discussed. They are a means of describing or explaining things that don't exist or occur in a physical sense, as do eye colour or height, or behaviour such as walking and talking.

Figure 6.3 Sleep is a psychological construct that is broadly categorised as a naturally occurring altered state of consciousness and is further categorised into REM and NREM sleep.

More specifically, a **psychological construct** is a concept, description or explanatory model that is 'constructed' to describe specific 'psychological' activity, or a pattern of associated activities or processes. It is based on scientifically verifiable and measurable events or processes, or on behaviours or mental processes inferred from scientifically collected data but not themselves directly observable.

A psychological construct is usually hypothesised from research (empirical) evidence so the term is sometimes used interchangeably with the term *hypothetical construct*. In the case of the construct of sleep, researchers typically rely on

- information provided by individuals and groups (e.g. self-reports), and/or
- behaviour that is demonstrated (e.g. responses by participants observed during sleep), and/or
- physiological changes that can be measured (e.g. recordings of brain wave activity).

On the basis of such information, inferences are made about sleep as an altered state of consciousness. As techniques for studying sleep have become more sophisticated, so too has the understanding of sleep and characteristics common among people of different ages.

Other psychological constructs include consciousness, altered state of consciousness, intelligence, cognition, learning, memory, emotion, emotional states, personality, personality traits, schizophrenia, self-esteem and anxiety.

6.2 LEARNING ACTIVITY

Multiple-choice questions

1. Which term may be used interchangeably with the term consciousness?
   - A. sleep
   - B. awareness
   - C. focussed
   - D. altered
2. Which of the following is a naturally occurring ASC?
   - A. concussed state
   - B. sleep state
   - C. alcohol-induced state
   - D. relaxed meditative state
3. Which of the following is not an ASC?
   - A. normal waking state
   - B. sleep state
   - C. comatose state
   - D. daydreaming
4. A psychological construct is used to describe or explain activities or processes that cannot be
   - A. researched.
   - B. measured.
   - C. directly observed.
   - D. indirectly observed.
5. A psychological construct is primarily based on
   - A. a belief.
   - B. an opinion.
   - C. common sense.
   - D. research evidence.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

6.3 Measurement of physiological responses associated with sleep

With advances in technology for detecting and recording physiological responses while people sleep, researchers have increasingly been able to understand the nature of sleep.

Most sleep research takes place in a *sleep laboratory*, also called a *sleep study centre* or *unit*, often attached to a public or private hospital. Here, people with and without a sleep problem or disorder can be studied for research purposes. Individuals with a sleep problem may also be observed, diagnosed and treated.

An individual's sleep can be affected by their surroundings and their routine before going to sleep. Consequently, a sleep laboratory has one or more small 'bedrooms', that are usually furnished and decorated to be as homelike and comfortable as possible (but also soundproof). The person is connected to an adjoining 'control room' where researchers monitor physiological responses associated with sleep throughout the night.

Research participants go to bed at their usual time to keep behaviour patterns as close to normal as is reasonably possible. They might arrive at the sleep laboratory in time for an evening meal, then sit around watching television, reading or checking social media, following their usual routine before going to sleep.

A researcher may use a variety of techniques to study a sleeping person. The most commonly used techniques can be organised in three categories: measurement of physiological responses, sleep diaries to obtain self-reports and video monitoring. These can be used independently or in combination.

Measurements of physiological responses enable researchers to obtain quantitative data on bodily processes and changes that occur as we fall asleep, during sleep itself and as we awaken from sleep. These data include information about the electrical activity of the brain, eye movements, and the body's muscle tone or 'tension'; that is, the extent to which muscles are relaxed. Other physiological responses such as heart rate, body temperature, respiration, the amount of oxygen in the blood, body position, and leg movements or even snoring noises can also be recorded, depending on what information is required.

Although the different devices used to monitor and record the physiological responses can look and feel cumbersome when attached, after an initial period of adjustment the person usually falls into their regular sleep pattern. An important advantage of the devices is that precise observations and measurements can be made during sleep without actually waking the person.

Three of the more commonly used techniques for measuring physiological responses associated with sleep are electroencephalography, electromyography, and electro-oculography.

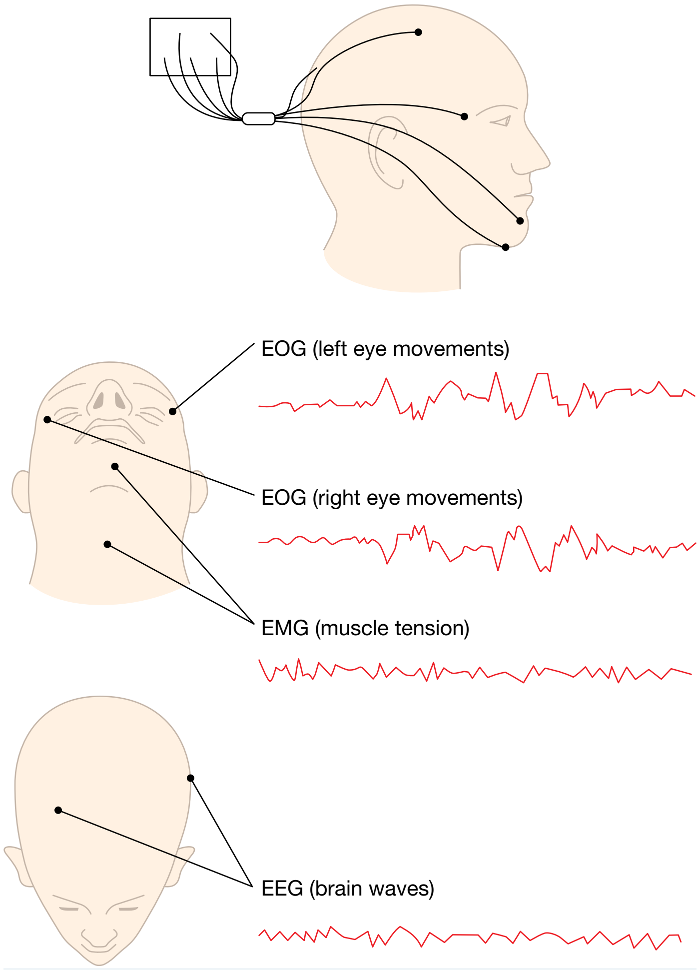


Figure 6.4 Three commonly measured physiological responses when studying consciousness are electrical activity of the brain, measured using an EEG; muscle tension, measured using an EMG; and eye movements, measured using an EOG. Electrodes that are strategically placed on the scalp (EEG), around the eyes (EOG) and near muscles on the face and body (EMG) detect, amplify and record patterns of activity.

6.3.1 Electroencephalography (EEG)

Electroencephalography (EEG) is a method of studying brain waves produced during sleep. Brain waves are spontaneous, rhythmic electrical impulses that come from different brain areas.

An instrument called an *electroencephalograph* (also abbreviated as EEG) is used to detect, amplify and record the electrical activity through electrodes manually placed at various points on the scalp. Alternatively, a participant may be required to wear a head cap with prepositioned or adjustable electrodes to suit individual requirements.

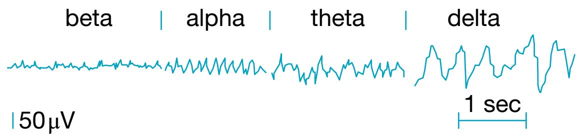
Each electrode simultaneously detects and receives signals from many thousands of neurons that are activated in the vicinity and the EEG averages this out. The EEG then amplifies and translates the activity in cortical areas beneath the electrodes into a visual pattern of brain waves.

The brain waves are recorded and displayed as a graph on a computer monitor or as a moving sheet of graph paper (see Figure 6.5). These EEG records are called *electroencephalograms*. The brain waves in the graph illustrate activity that can be matched to brain areas that correspond with the location of electrodes.

Brain wave patterns shown in EEG recordings vary in frequency and amplitude. *Frequency* refers to the number of brain waves per second. A pattern of *high-frequency* brain wave activity is faster and therefore has *more* brain waves per unit of time. A pattern of *low-frequency* brain wave activity is slower, and therefore has *fewer* brain waves per unit of time.

The *amplitude* or intensity of brain waves is measured in microvolts and can be visually judged by the size of the peaks and troughs of the waves from a baseline of zero activity. *High-amplitude* brain waves have *bigger* peaks and troughs, whereas *low-amplitude* brain waves have *smaller* peaks and troughs.

Four commonly described brain waves are named after letters in the Greek alphabet — beta, alpha, theta and delta. These waves are shown below in an order ranging from highest to lowest frequency, and therefore from fastest to slowest waves. Beta have the highest frequency and lowest amplitude, whereas delta have the lowest frequency but highest amplitude.



Beta pattern: A predominantly *beta brain wave pattern* is associated with alertness and intensive mental activity during normal waking consciousness. Beta waves are also present when dreaming during a period of rapid eye movement sleep.

Alpha pattern

When we are awake and alert but mentally and physically relaxed and internally focused, the EEG shows a predominantly *alpha brain wave pattern.* For example, if you complete a mentally active task and sit down to rest and calmly reflect on what you did, your brain waves will be mostly alpha, especially if you close your eyes.

Theta pattern

A predominantly theta brain wave pattern is most commonly produced when we are very drowsy, such as when falling asleep or just before waking. They may also be produced when awake and engaged in creative activities.

Delta pattern

Delta waves are most commonly associated with deep, dreamless sleep or unconsciousness.

Sleep studies using EEG recordings indicate that as we fall asleep, and throughout a typical sleep episode, the brain produces distinguishable patterns of electrical activity that tend to follow a regular sequence. These patterns are used by researchers to distinguish between different types and stages of sleep that are experienced by all healthy, sleeping people under normal circumstances, although there are age-related variations.

Corresponding to changes in brain wave patterns recorded by the EEG are changes in other physiological responses, such as muscle tension, eye movements, heart and respiration rates.

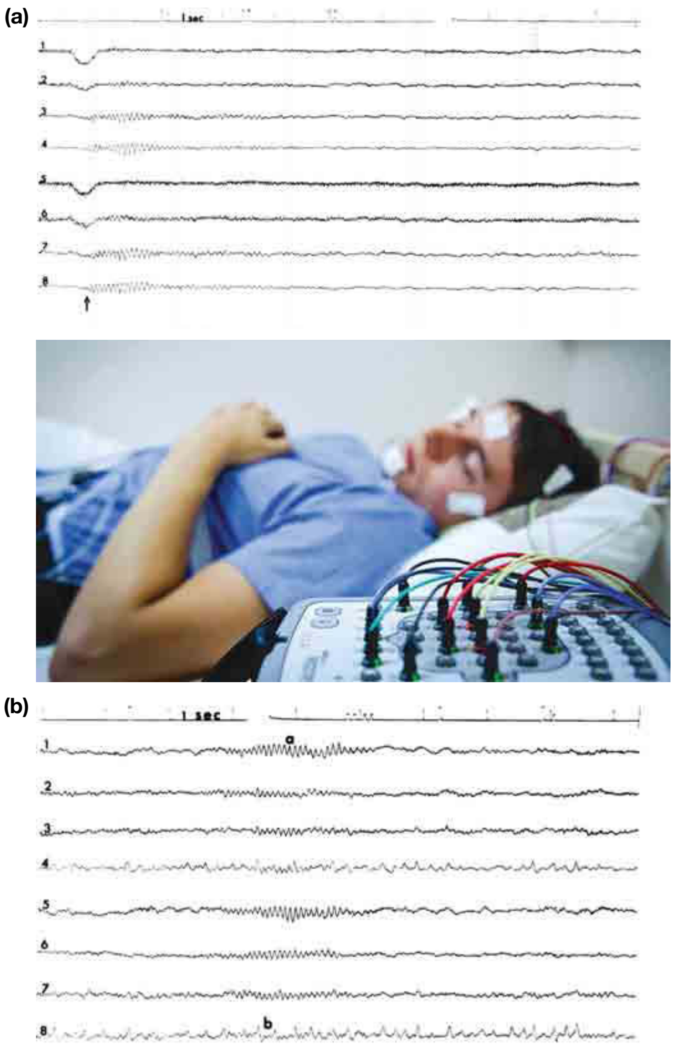


Figure 6.5 An EEG records the electrical activity at different locations in a participant's brain through precisely located electrodes attached to the scalp. Each electrode detects activity at a different point on the skull and is displayed as a row of EEG data. (a) shows the EEG of a drowsy adult while (b) shows the EEG of a sleeping adult.

6.3.2 Electromyography (EMG)

Electromyography (EMG) is a method of studying the electrical activity of muscles produced during sleep. An electromyograph (EMG) device is used to detect, amplify and record the electrical activity. This data is obtained by attaching electrodes to the skin above the relevant muscles. Sometimes the activity in facial muscles is recorded. At other times, leg muscles, muscles on the torso (main part of the body), or a combination of these are recorded.

The records of the EMG are displayed as line graphs (called *electromyograms*), like those produced by the EEG. They can be produced on paper or on a computer monitor. The recordings generally show the strength of electrical activity occurring in the muscles, which indicates changes in muscle activity (movement) and muscle tone (tension).

When falling asleep, we usually become less and less alert as we drift into deeper stages of sleep. Sleep studies using EMG recordings show that while this is occurring, our muscles progressively relax (i.e. decrease in muscle tone) and there is less movement. Overall, the higher the level of muscular activity and tone, the more alert we tend to be and vice versa. There are also distinguishable periods when our muscles may spasm (during light sleep) or be completely relaxed (during deep sleep).

6.3.3 Electro-oculargraphy (EOG)

Electro-oculargraphy (EOG) is a method of measuring eye movements or eye positions during sleep. An *electro-oculargraph* (EOG) device is used to detect, amplify and record the electrical activity in eye muscles that control eye movements. This is done through electrodes attached to areas of the face surrounding the eyes.

The records of the EOG (*electro-oculargrams*) are displayed as line graphs, similar to those produced by the EEG and EMG.

An EOG device is most commonly used to measure changes in eye movements over time during different types and stages of sleep and while dreaming. Several varieties of eye movement are recorded during routine sleep studies – waking eye movements (WEMs), slow eye movements (SEMs) and rapid eye movements (REMs). Most importantly, sleep research studies using an EOG have been of immense value in clarifying the distinction between the two different types or periods of sleep called REM and NREM sleep.

Figure 6.6 EMGs and EOGs may be used to record muscle activity and eye movements in sleep research to study changes during different sleep stages, including dream periods. Electrodes attached to the skin on facial areas above muscles that control eye movements detect electrical activity of the muscles and hence eye movements. These are then amplified and recorded.

6.3.4 Sleep diaries

A **sleep diary** is a 'log' used to self-record and self-report sleep and waking time activities over a period of time, usually one week or more. When the activities are to be recorded for children, a parent may maintain the required records.

Sleep diaries are most often used in conjunction with physiological measures such as EEG and EMG to support the assessment of sleep disturbances or disorders, particularly their nature, severity and possible causes. Sleep diary recording typically involves *self-monitoring* of relevant data, whereas physiological measures involve data collection by someone else.

The data an individual is required to record in a sleep diary depends on what is being investigated. For example, records may be kept of:

- the time when trying to fall asleep
- the time when it is believed sleep onset occurred
- the number, the time and length of awakenings during sleep
- the time of waking up in the morning
- the time of getting up after waking up in the morning
- how well rested the individual feels upon awakening
- how sleepy the individual feels at different times during the day.

Figure 6.7 A sleep diary is a type of self-report that can be used to analyse patterns or practices that are helping or hindering sleep. Record keeping is relatively simple and requires minimal time each day.

In addition, records may be kept of events that can affect sleep, such as naps, the number of caffeinated or alcoholic drinks, use of medication, meals, exercise type, time or length, and other potentially influential activities when awake or asleep. Records may be in paper and pencil format or digital.

The sleep diary records are analysed by the researcher to identify patterns of behaviour or practices of relevance to their topic of research interest. If the researcher is investigating a sleep onset disturbance, they will be interested in behaviours that might be interfering with sleep. For example, participant habits such as vigorously exercising at night, or using electronic devices or social media in bed, have all been found to impair sleep onset.

Self-report sleep diaries are considered to be a *subjective* measure because they are based on or influenced by personal feelings or interpretations. Subjective data is often biased, can vary from person to person, day to day from the same person, and is not always entirely accurate. In contrast, an *objective* measure such as an electronic recording device is impartial and not subject to personal opinion or interpretation. However, this does not mean that subjective reporting through a sleep diary is not useful or cannot provide valuable information about sleep or sleep disorders.

An example of sleep diary data and record keeping is shown in Figure 6.8 below. In all cases, the participant (or patient) is given detailed verbal and written instructions on how to record entries and maintain the diary.

SLEEP DIARY – WEEK ONE

Your Name:

Did you consume caffeine (e.g. coke, coffee) in the hour before bed? Yes / No *(please circle)*   If yes, how often? Every night / 3-4 nights per week / 1-2 nights per week *(please circle)*

Date	Day	Total time of all daytime naps *(mins)*	Time went to bed in evening	After going to your bedroom, what did you do? (*Tick all that apply)*	Time went to sleep	Number of awakenings during night	Total time awake during night *(mins)*	Time woke up next morning	Who or what woke you up in the morning? *(Please tick)*	Time got out of bed	Total Sleep Time *(see instructions for calculation)*	Mood Scale *(see instructions)*
	Mon	*30 min*	*10:15pm*	Went straight to sleep ☐ Watched TV ☑ Read a book ☐ Played on the computer ☐ Listened to music ☑ Talked/text on phone ☐ Other: ______	*10:50pm*	*2*	*20 min*	*7:15am*	Woke myself ☑ A family member ☐ Alarm clock ☐ Other: ______	*7:20am*	8 hours and 5 minutes	4
				Went straight to sleep ☐ Watched TV ☐ Read a book ☐ Played on the computer ☐ Listened to music ☐ Talked/text on phone ☐ Other: ______					Woke myself ☐ A family member ☐ Alarm clock ☐ Other: ______			
				Went straight to sleep ☐ Watched TV ☐ Read a book ☐ Played on the computer ☐ Listened to music ☐ Talked/text on phone ☐ Other: ______					Woke myself ☐ A family member ☐ Alarm clock ☐ Other: ______			
				Went straight to sleep ☐ Watched TV ☐ Read a book ☐ Played on the computer ☐ Listened to music ☐ Talked/text on phone ☐ Other: ______					Woke myself ☐ A family member ☐ Alarm clock ☐ Other: ______			

Page 1

Prepared by Dr Sarah Biggs, The Ritchie Centre, Monash University, 2015 — © Sleep Health Foundation

Figure 6.8 Example of sleep diary data and record keeping

Source: Sleep Health Foundation. *Sleep diary for teenagers — week one.* https://www.sleephealthfoundation.org.au/resources/teacher-resources.html. Note: instructions for completing the diary are in a separate document at the site.

6.3.5 Video monitoring

Most sleep laboratories, centres or clinics are fitted with one or more video cameras to monitor and record externally observable physiological responses throughout a sleep episode, including behaviours when falling asleep and when waking. Video monitoring may also be conducted in a home environment.

Responses that may be targeted for video monitoring include:

- changes in posture or body position
- amount of 'tossing and turning'
- sleep-related breathing problems
- what happens when awakening from a nightmare or night terror
- behaviours associated with sleepwalking.

These types of responses can be examined together with those of other types of recordings, then linked to different sleep stages, sleep types or the specific aspect of sleep under investigation. Video monitoring enables ongoing visual contact with the sleeper and is particularly important with participants (or patients) who have a serious sleep disorder.

Video cameras can simultaneously record sounds made by the sleeper and use infrared technology so that recordings can be made in conditions of little or no light.

Video monitoring enables observations and data collection in real time over a prolonged period. Computer-assisted technologies can be used for later analysis of a scene or even a single frame. For example, software packages can be used for frame-by-frame analysis (motion segmentation), enhancement of blurred images and 3D enhancements. In addition, the recordings enable retrospective analysis of sleep-related behaviour as often as required by the researcher and the reliability of observations is enhanced when different researchers are used to assesses the recordings.

Figure 6.9 Video monitoring allows changes in responses, such as changes in position and 'tossing and turning', to be observed in a sleep laboratory.

6.3 LEARNING ACTIVITY 1

Review

1. Complete the table to summarise techniques that may be used to measure physiological and other responses associated with sleep.

Name of device	Response/s measured	Qualitative or quantitative data	Objective or subjective measure
a. electroencephalography (EEG)			
b. electromyography (EMG)			
c. electro-oculography (EOG)			
d. sleep diaries			
e. video monitoring			

2. a. Explain the difference between frequency and amplitude in relation to brain waves.
   b. Which brain wave is the fastest? The slowest?
3. For each of the following activities, state which brain wave pattern(s) would most likely be dominant — alpha, beta, theta or delta.
   a. lying on the beach, having just fallen asleep
   b. being woken up by an alarm mid-dream during a normal sleep episode
   c. in the deepest stage of sleep
   d. anaesthetised
   e. feeling very drowsy and struggling to keep eyelids open
   f. resting with eyes closed, just having entered a relaxed meditative state

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

6.3 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.30; ©VCAA

Which one of the following is an objective measure that could be used to investigate possible treatments that would reduce sleep disturbances?

A. electromyograph recording participants' brain wave patterns
B. video monitoring recording the time and duration of participants' awakenings
C. a questionnaire with a rating scale measuring participants' anxiety about sleep
D. a sleep diary in which the participants record how they felt after each night's sleep

Question 2 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.38; ©VCAA

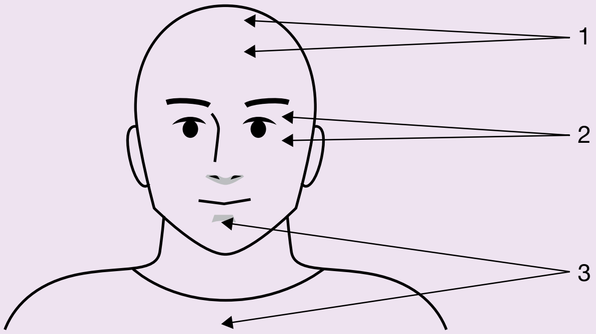
Which one of the following represents a quantitative measure of sleep that would indicate whether someone has moved during their sleep?

A. an electroencephalograph, which indicates a deep sleep
B. an electromyograph, which indicates changes in muscle tone
C. a video recording, which provides visual evidence of movement
D. an electro-oculograph, which records changes in eye movements indicating stages of sleep

Question 3 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.24; ©VCAA

Archer's physiological responses were monitored in three separate areas, as shown in the image below.



Which of the following identifies the equipment used to capture Archer's physiological responses at the points labelled 1–3 in the image above?

	1	2	3
A.	EMG	EEG	EOG
B.	EOG	EMG	EEG
C.	EEG	EMG	EOG
D.	EEG	EOG	EMG

Question 4 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.32; ©VCAA

Barry volunteered to stay overnight at a sleep laboratory so that his sleep patterns could be studied. Which of the following identifies the qualitative and quantitative measures that could be used to indicate Barry's state of consciousness?

	Qualitative measures	Quantitative measures
A.	electro-oculograph (EOG) electroencephalograph (EEG)	sleep diary video monitoring
B.	electromyograph (EMG) video monitoring	electroencephalograph (EEG) electro-oculograph (EOG)
C.	sleep diary video monitoring	electromyograph (EMG) electro-oculograph (EOG)
D.	sleep diary electro-oculograph (EOG)	video monitoring electroencephalograph (EEG)

Question 5 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.22; ©VCAA

The most reliable measure of sleep would be a combination of

A. video monitoring and self-reported sleep logs.
B. physiological measures recorded in a sleep laboratory and self-reported sleep logs.
C. physiological measures recorded in a sleep laboratory and video monitoring on the same night.
D. physiological measures recorded in a sleep laboratory and video monitoring on a different night.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

6.4 Regulation of sleep–wake patterns by internal biological mechanisms

Rhythmic events occur constantly in the environment. The sun rises and sets each day, the moon moves through its monthly cycle, and the tides and seasons regularly repeat themselves in the same order through time. These periodic changes are naturally occurring and predictable — night follows day and when most of the winter has passed we know that spring isn't far away.

Many of our naturally occurring physiological functions and various psychological functions also follow a set pattern of periodic changes. Such changes that repeat themselves through time in a cyclical way are called **biological rhythms**. Examples include core body temperature, blood pressure, blood sugar level, hunger and satiety (feeling 'full'), digestive secretions, secretion of certain hormones (such as melatonin, cortisol and testosterone), menstruation and the sleep–wake cycle. Among animals, behaviours such as mating, hibernating and migration are linked to biological rhythms.

Our behaviour and how we think and feel are also influenced by biological rhythms. For example, biological rhythms and the neurological structures and processes that drive them influence what time of day we are most alert, hungry, tired or physically primed to undertake various activities.

Biological rhythms can be linked to cyclical changes in environmental cues, such as sunrise and sunset, day length, the amount of light and the passing of a season. Although physiological and psychological functions can vary between individuals and within the period of an individual's lifetime, disruptions to biological rhythms can affect our physical health and mental wellbeing.

Each biological rhythm is maintained and controlled by a biological clock. A **biological clock** is an innate timing mechanism that regulates the cycle of a biological rhythm. Its functioning is genetically determined and occurs at the cellular level.

It is believed that nearly every tissue and organ contain biological clocks, and that every single normally functioning cell in our body may be controlled by its own biological clock. In addition, there is a 'master clock' in the brain, possibly more, that coordinates the activities of all the 'peripheral clocks' found throughout the body so that they function in a synchronised way (NIGMS, 2020).

Two categories of biological rhythms are circadian and ultradian rhythms. These are primarily distinguished on the basis of the time period over which they occur under normal circumstances.

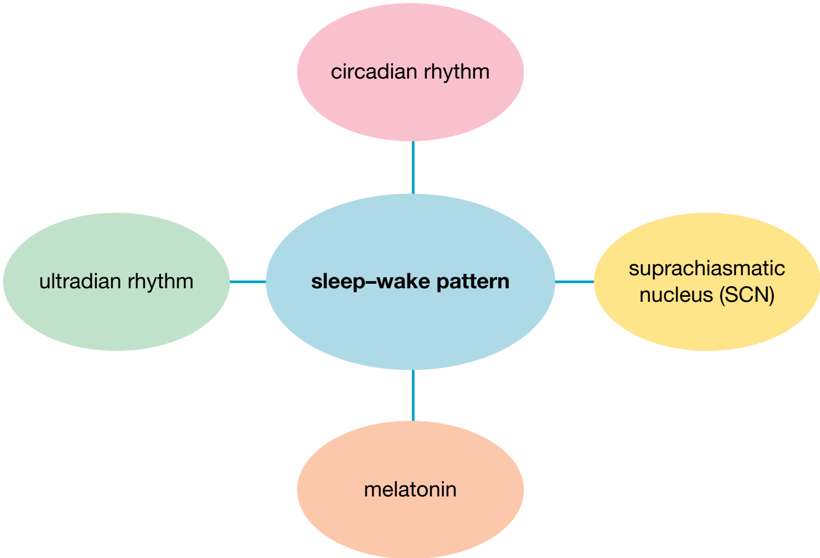


Figure 6.10 Four of many internal biological mechanisms that influence the regulation of our sleep–wake patterns

6.4.1 Circadian rhythms

A **circadian rhythm** involves physiological, psychological or behavioural changes that occur as part of cycle with a duration of approximately 24 hours. The term circadian comes from the Latin words *circa dies* which mean 'about one day'.

The daily human sleep–wake cycle is the most extensively studied circadian rhythm. Under normal circumstances, sleepiness is highest at night and lowest in the day. This circadian rhythm also causes us to feel more or less alert at certain points of the day.

The sleep–wake cycle originates within each individual and is therefore referred to as **endogenous**. Anything that has its origins outside an organism is called **exogenous**. For example, a time-giving cue in the external environment is exogenous.

Although internally produced, self-sustaining and persisting in the absence of external, exogenous cues such as daylight or artificial light, our sleep–wake cycle is nonetheless influenced by environmental time-giving cues or stimuli which are used to keep in-sync with the 24-hour day–night cycle that occurs as the Earth rotates on its axis.

This ability to be synchronised with external time cues is an important property of the sleep–wake cycle (and other circadian rhythms). Accordingly, if a shift in external cues to which it is aligned occurs, the sleep–wake cycle can also shift and be aligned to new cues. For example, numerous studies of individuals in isolated environments where no natural light or other indicators of the time of day are available have found that the sleep–wake cycle is different when compared with before and after isolation.

When in the time-free environment, the sleep–wake cycle becomes 'free running' and tends to be pushed forward in time. Participants tend to go to sleep slightly later and awaken a little later as they drift into a cycle slightly longer than 24 hours, at about 24.2 hours or so (and in some cases up to 25 hours). When 'out-of-sync' with their normal environment after isolation in a time-free environment, each participant's sleep–wake cycle quickly adjusts to match the 24-hour day–night cycle of the normal environment following re-exposure to environmental time cues, such as light–dark, clocks, meal times, TV programs and work routines (Czeisler et al., 1999).

In sum, our preference to sleep at night and be up during the day isn't due to environmental clock time, school or work schedules, habit or convenience. It is tied to a circadian rhythm. This daily rhythm is regulated by a biological clock in our brain called the suprachiasmatic nucleus.

Figure 6.11 The human sleep–wake cycle is a naturally occurring 24-hour circadian rhythm regulated by a biological clock. This complex timekeeper is controlled by an area of the brain that primarily responds to light, which is why we are ordinarily most alert during the day, and less alert and more ready to sleep when it is dark outside.

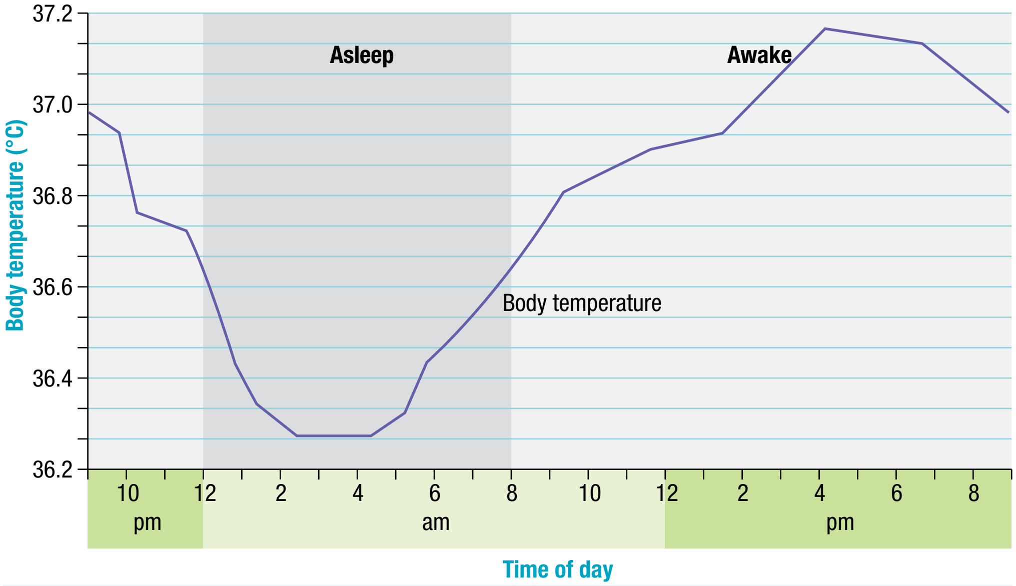


Figure 6.12 The 24-hour circadian core body temperature cycle in relation to sleep and awake times. Both of these circadian rhythms are regulated by the same brain structure. Note that drowsiness increases as core body temperature decreases (and vice versa).

6.4.2 Ultradian rhythms

An **ultradian rhythm** is a biological rhythm that involves physiological, psychological or behavioural changes that occur as part of a cycle shorter than 24 hours. The term ultradian originates from the Latin, meaning 'more often than daily'.

Many different ultradian rhythms that fluctuate in cycles and repeat throughout each day have been described. Some are interdependent and tied to a daily circadian rhythm. Ultradian rhythms include our heartbeat, which occurs thousands of times each day in a fairly regular and predictable rhythm. Respiration is another example of an ultradian rhythm occurring many times over the course of a day. Hunger and eating behaviour, secretion of certain hormones, the activity of certain neurotransmitters in the brain, alertness and activity levels have also been described as ultradian rhythms that occur less frequently than heartbeat and respiration.

The best-known ultradian rhythm is human sleep. When we go to sleep it is not a single constant activity like 'one long snooze'. Instead, it occurs as a sequence of distinctly different states and stages. There are also alternating periods of sleep with and without rapid eye movements and other physiological responses that are also considered ultradian rhythms.

Generally, a complete sleep cycle lasts for about 90 minutes, but its duration and the number of cycles that occur are influenced by many variables such as age, health and environmental cues.

Figure 6.13 Eating behaviour is an ultradian rhythm that follows a much shorter cycle than our daily sleep–wake cycle. Generally, this cycle repeats itself about three times a day, as we eat three meals a day that are relatively evenly spaced across our daily wake period.

6.4.3 Suprachiasmatic nucleus

An area of the brain's hypothalamus called the **suprachiasmatic nucleus (SCN)** is considered to be the master biological clock that regulates the timing and activity of the sleep–wake cycle (as well as all other peripheral clocks involved with circadian rhythms).

The SCN is actually a pair of pinhead-sized structures (i.e. two nuclei) that together contain about 20 000 neurons. It is named for its location just above ('supra') the optic chiasm, the point where the optic nerves that connect the eyes and brain cross. This strategic position enables the SCN to respond to light and control the production of melatonin, a hormone that makes us feel drowsy.

When the SCN receives information about the amount of incoming light from the eyes, it adjusts our sleep–wake cycle accordingly. It does so by sending neuronal messages to the nearby pineal gland to secrete more or less melatonin into the blood. This regulatory activity occurs deep inside the brain.

It is believed that feedback on the level of melatonin in the blood is used by the SCN to modify output of melatonin and help regulate the overall timing of the sleep–wake cycle. There is also internal communication between the SCN and brain areas and systems in regulating the cycle (and the peripheral clocks).

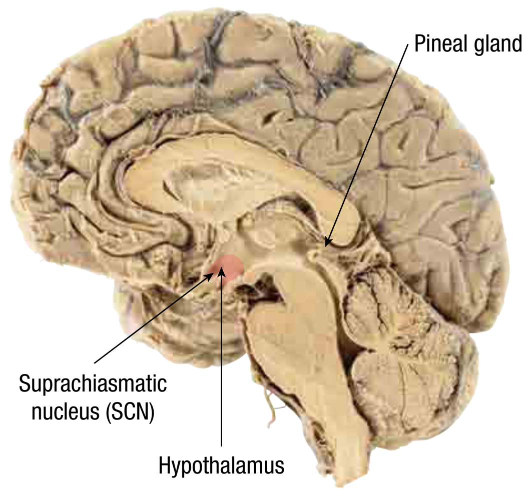


Figure 6.14 The circadian sleep–wake cycle is regulated by the suprachiasmatic nucleus (SCN) within the hypothalamus.

When light is detected, the SCN also performs functions such as initiating an increase in body temperature and the release of stimulating hormones like cortisol to promote alertness and support other arousal activities. The chain reaction of changes is suppressed when it is dark.

By adjusting our sleep–wake cycle in response to light and dark on a daily basis, the SCN keeps the cycle in-sync with the 24 hour day and night cycle of our external environment and ensures sleepiness is highest at night and lowest in the day.

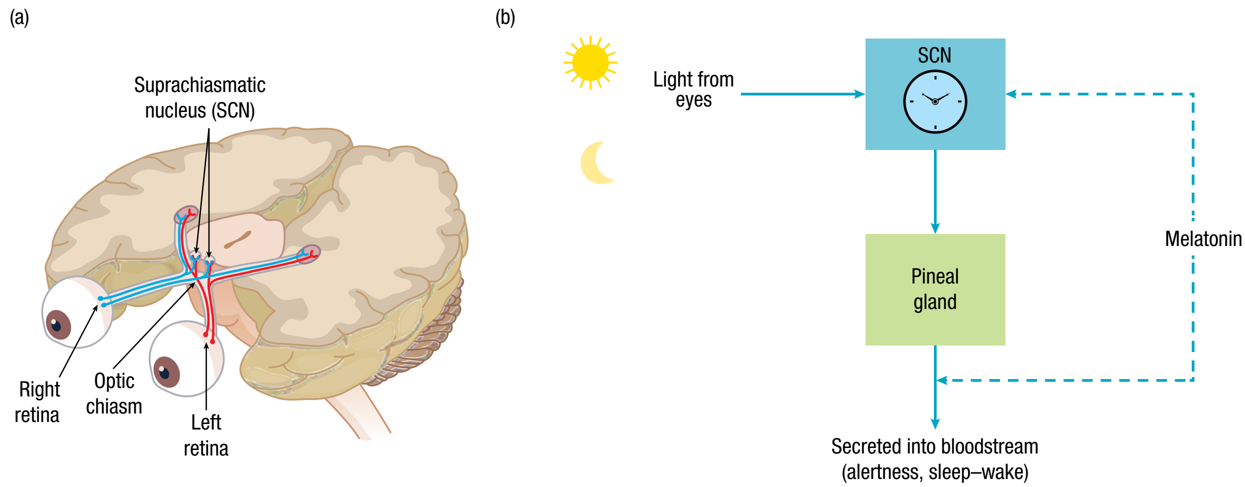


Figure 6.15 (a) The SCN receives information about the amount of light from the eyes and adjusts our sleep–wake cycle accordingly. It signals the nearby pineal gland to produce and secrete more or less melatonin in relation to light intensity. For clarity, the SCN is shown proportionally larger than other structures. (b) The amount of melatonin present in the blood is associated with alertness. A higher melatonin level is associated with greater drowsiness and vice versa. The amount that is secreted varies with the amount of light that is detected. Note the melatonin feedback loop enabling the SCN to detect the level of melatonin in the blood and modify the output from the pineal gland to maintain an optimum level.

6.4.4 Melatonin

Melatonin is a hormone that is involved in the initiation of sleep and in the regulation of the sleep–wake cycle. It is produced by the pineal gland in the brain and released into the blood stream, through which it reaches every organ in the body. The amount of melatonin present in the blood is associated with alertness. A higher melatonin level is associated with greater drowsiness and vice versa.

The amount of melatonin that is secreted varies with the amount of light that is detected by the SCN. As a result, melatonin helps regulate our sleep–wake cycle and synchronise it with night and day. In doing so, it facilitates a transition to sleep and promotes consistent, quality rest (Suni, 2022a).

When there is less light, such as after sunset, the SCN signals the pineal gland to produce and secrete more melatonin, which will make us drowsy and induce sleepiness. The melatonin level in the blood stays elevated all through the night, then falls back to a low daytime level before the light of a new day.

When the SCN detects light in the morning, it inhibits the release of melatonin. That is why melatonin is sometimes called the 'Hormone of darkness' or the 'Dracula of hormones' — it only comes out in the dark. Even if the pineal gland is switched 'on' by the SCN, it will not produce melatonin unless the person is in a dimly lit environment.

In addition to sunlight, artificial lighting can be bright enough to impede the release of melatonin. This includes room lights and light emitted by mobile phones, tablets and other electronic devices.

Melatonin that is produced synthetically is sometimes prescribed to treat sleep disorders such as sleep onset insomnia and other problems with falling asleep or when the sleep–wake cycle is persistently out-of-sync with the time of day. It tends to be helpful or provide some relief and has also been found to be generally safe for short-term use. Unlike many other sleep medications, there is a low likelihood of becoming dependent on its use or experiencing a 'hangover effect' after waking (Suni, 2022a).

People who have lost their sight and cannot coordinate their natural sleep–wake cycle using natural light can stabilise their sleep patterns by taking small amounts of melatonin at the same time each day (NINDS, 2022).

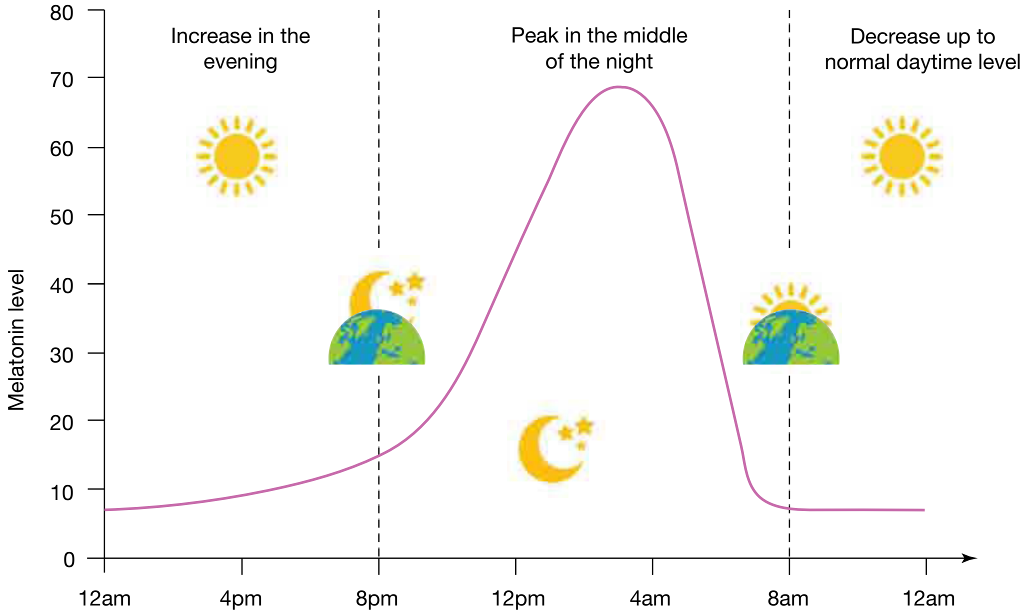


Figure 6.16 Melatonin level across a 24-hour day–night cycle. The level changes in relation to the amount of light, peaking in the middle of the night to about 8 times more than the regular daytime level.

Source: Adapted from Wahl et al., (2019). The inner clock: Blue light sets the human rhythm. *Journal of Biophotonics, 12*(12), e201900102.

on Resources

Weblink Video on circadian rhythms and the SCN 4 m 9s

6.4 LEARNING ACTIVITY 1

Review

1. a. What is a biological rhythm?
   b. Describe the relationship between a biological rhythm and a biological clock.
   c. Is a biological clock the same as a circadian rhythm? If so, why? If not, how are they related?
2. State three criteria that could be used to assess whether a particular type of biological rhythm could be called a circadian rhythm.
3. Distinguish between circadian and ultradian rhythms with reference to relevant examples.
4. How do endogenous and exogenous differ in relation to source?
5. a. What is the suprachiasmatic nucleus (SCN) and where is it located?
   b. Animal experiments using small mammals such as hamsters and rats have enabled researchers to better understand the roles of the SCN. What effect on circadian rhythms and cyclical behaviours or processes could be hypothesised when the SCN is intentionally destroyed?
6. Explain the roles of the SCN, melatonin, pineal gland, light and other environmental cues in regulating the human sleep–wake cycle. You may use a diagram to support your explanation.
7. Explain from a biological perspective why digital media use for a prolonged period when in bed just before sleep can adversely affect sleep onset.

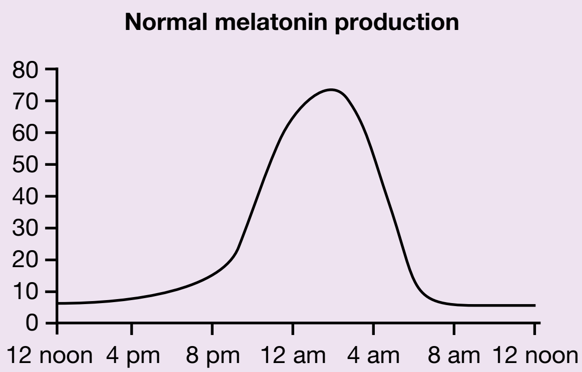
To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

6.4 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.35; ©VCAA



Which one of the following options names and explains the type of rhythm shown in the graph above?

A. ultradian rhythm, because melatonin levels fluctuate in the cycle
B. ultradian rhythm, because melatonin release follows a 24-hour pattern peaking at 3 am
C. circadian rhythm, because the level of melatonin peaks during the night and returns to normal during the day
D. circadian rhythm, because the build-up of melatonin occurs as part of the cycle, which is shorter than 24 hours

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.34 (adapted); ©VCAA

An individual's bodily functions follow naturally occurring and predictable rhythms.

Which one of the following is true of the rhythm that individuals usually have while sleeping?

A. a rhythm within a circadian rhythm
B. a circadian rhythm that occurs throughout the night
C. a rhythm that lasts approximately eight hours
D. a circadian rhythm that matches the core body temperature rhythm

Question 3 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.63; ©VCAA

Dr Terrence is running an experiment to investigate the effect that room temperature has on the time taken for people to fall asleep.

In this experiment, the independent variable is

A. room temperature.
B. time taken for people to fall asleep.
C. body temperature when people fall asleep.
D. time taken by people to adapt to room temperature.

Question 4 (1 mark)

Source: VCAA 2006 Psychology 1, Section A, Q.43 (adapted); ©VCAA

While carrying out an experiment on sleep–wake patterns and behaviour, the psychologist unintentionally encouraged the experimental group to perform well.

The psychologist's influence on the participants confounded the results and is known as the

A. participant effect.
B. experimenter effect.
C. bias effect.
D. random allocation effect.

Question 5 (5 marks)

Source: VCAA 2020 Psychology 1, Section B, Q.5; ©VCAA

Predicting the body clock of shiftworkers

Australian researchers led by Doctor Julia Stone from Monash University have developed a model that makes predictions about a person's body clock based on non-invasive measurements. The usual procedure for tracking the body clock is taking blood tests that measure melatonin. In the research, in addition to measuring melatonin levels, doctors and nurses wore a wrist band that measured their physical activity and the amount of light they were exposed to over a range of day and night shifts as well as on their days off. The research demonstrated that the model provides an accurate prediction of a person's body clock shift, verified by the melatonin levels recorded. This research could result in the development of a device that could provide shiftworkers with information about their body clock and thus help them manage the alignment of the body clock and the work schedule. Given that the impact of shiftwork can be much harder to manage than the impact of jet lag, this is welcome news.

References: JE Stone et al., 'Application of a limit-cycle oscillator model for prediction of circadian phase in rotating night shift workers', *Scientific Reports*, 9:11032, 30 July 2019, https://doi.org/10.1038/s41598-019-47290-6; J Elder, 'Keeping shift workers alert on the job: New study finds how to predict a person's body clock', *The New Daily*, 2 August 2019, https://thenewdaily.com.au/life/wellbeing/2019/08/02/body-clock-shift-workers

a. The article uses the term 'body clock'. Using appropriate psychological terminology, explain what the authors mean when they refer to the term 'body clock'. 2 marks
b. Why are levels of melatonin measured in this research? 3 marks

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

6.5 NREM and REM sleep

Over the course of a typical night's sleep we experience two different states or types of sleep known as **NREM sleep**, or non-rapid eye movement sleep, and **REM sleep**, or rapid eye movement sleep. While both have characteristics in common, such as natural occurrence and reduced awareness, there are significant differences between them in addition to eye movements.

REM and NREM sleep occur in virtually all mammals and birds, and they are as distinct from one another as each is from wakefulness. For example, NREM sleep has stages, whereas REM sleep does not. In addition, REM and NREM sleep are linked to specific brain waves and changes in bodily activity. For example, NREM sleep has been described as sleep with a relatively inactive brain in a body that can move and REM sleep as sleep with an active brain in a paralysed body (Carskadon & Dement, 2011).

As shown in the **hypnogram** ('sleep graph') in Figure 6.17 below, NREM and REM sleep periods alternate throughout a typical episode in a cyclical way, with one following the other. The biological purpose or function of the alternations between NREM and REM sleep is not yet understood, but irregular cycling and absence of either sleep state are associated with sleep disturbances and disorders.

A complete sleep cycle consists of a period of NREM sleep with transitions between its 3 stages (but not necessarily all its stages) and a period of REM sleep. There is REM sleep in every cycle, even if only for a short time. We also have very brief arousals many times during a nightly sleep episode. Generally, in the ideal case of a healthy young adult who sleeps well, each cycle is repeated about 5 or 6 times each night, depending on the duration of the sleep episode.

The lengths of individual cycles show considerable variability during a typical sleep episode. For example, the average length of the first NREM–REM sleep cycle, measured from sleep onset to the end of the first REM period, is about 70 to 100 minutes. The duration of the second and later sleep cycles, measured from the end of a REM sleep period to the end of the next, is generally longer lasting — about 90 to 120 minutes. Overall, however, the average length of each NREM–REM sleep cycle is commonly described as 'about 90 minutes'.

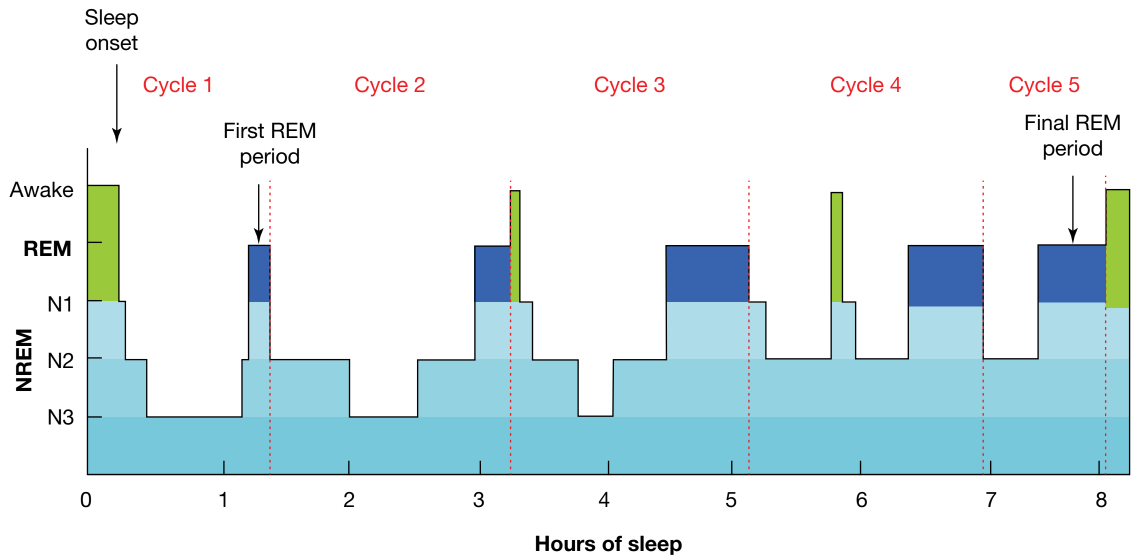


Figure 6.17 A sleep episode across a single night for a healthy young adult. The hypnogram shows alternating cycles of NREM and REM sleep and the relative amount of sleep spent in each of these. Note that as the sleep episode progresses, stage 3 deep sleep may not be experienced and that REM sleep periods tend to get longer and be closer together. Stage 1 may be skipped at different times during the episode, most commonly just before the first REM period. There may also be brief awakenings during the episode.

Source: Based on Carskadon M., & Dement W.C. (2005). Normal human sleep: An overview. In M.H. Kryger, T. Roth & W.C. Dement (Eds.), *Principles and practice of sleep medicine* (4th ed., pp. 13–23). Philadelphia: Elsevier Saunders.

There are also other variations in the patterns and proportions of NREM and REM sleep. In younger adults, stage 3 deep sleep tends to predominate in an NREM period during the first half of the sleep episode, particularly in the first two cycles. As the night progresses, stage 2 begins to account for the majority of NREM sleep, and stage 3 may disappear.

Consequently, the first third of the night is the time when the deepest sleep usually occurs. REM sleep periods increase as the night progresses and is longest in the last third of the night. In addition, brief episodes of wakefulness tend to occur in later cycles, generally in association with transitions between NREM and REM sleep, but these brief arousals are usually not remembered in the morning. The wakeful periods are considered part of a sleep episode rather than waking time (Carskadon & Dement, 2011; Sleep Health Foundation [SHF], 2022a).

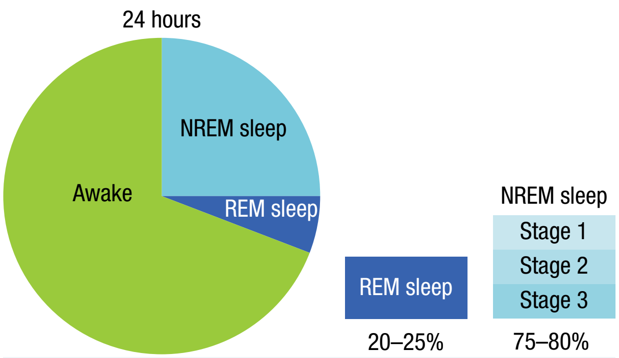


Figure 6.18 Average proportion of time younger adults spend daily in NREM and REM sleep

6.5.1 NREM sleep

NREM sleep is now commonly described as having three stages (with stage 3 previously known as stages 3 and 4). As shown in Figure 6.18 above, approximately 75–80% of our total sleep time is spent in NREM sleep. Typically, the first half of the night has more NREM sleep than the second half of the night.

Each of the three stages has a distinguishable pattern of physiological activity. Change in brain wave pattern is primarily used to identify an individual's stage of sleep and their transition between stages. Every stage is marked or dominated by a particular brain wave pattern that is different from that of the other stages. Although the brain is active during NREM sleep, it is not as active as during REM sleep or during normal waking consciousness.

Overall, NREM sleep is characterised by a reduction in physiological activity during transition from stage 1 to 3. Each successive stage is indicative of a deeper sleep, with stage 1 as the lightest and stage 3 as the deepest. As sleep gets deeper, the brain waves get slower and bigger, breathing and heart rate slow down, and blood pressure drops. We also transition back again from the deep sleep of stage 3. As shown in Figure 6.17, it is common to miss one or more of the NREM stages and have brief periods of awakening during a sleep episode.

The transition period from being awake to being asleep is usually called **sleep onset** and the amount of time it takes to fall asleep once the attempt to do so is made is called **sleep latency**. The terms are often combined as *sleep onset latency*. However, all three terms refer to the 'pre-sleep period'. This pre-sleep period is normally followed by stage 1 of NREM sleep. Consequently, NREM stage 1 is the entry point of a sleep episode for most people (but in infancy and certain sleep disorders such as narcolepsy, sleep onset may occur directly into REM sleep).

The precise definition of when an individual can be said to have actually fallen asleep has been an ongoing topic of debate, primarily because there is no single measure that is 100% clear-cut 100% of the time for all people. For example, in studies of sleep onset, some people report that they are still awake when their brain wave pattern and other physiological responses clearly indicate the presence of sleep (Carskadon & Dement, 2011).

Nonetheless, during sleep onset, our body is winding down. We may drift into and out of a true sleep state during sleep onset, but tend to gradually lose awareness of ourselves and our surroundings.

Stage 1

NREM stage 1 (N1) is when sleep begins in the first sleep cycle and is a period of relatively light sleep.

Physiological changes that indicate a lower level of bodily arousal — a decrease in heart rate, breathing, body temperature and muscle tension — are all evident in N1. Slow, rolling eye movements are also likely to be observed.

As a result of the muscles relaxing, we sometimes experience involuntary muscle twitches (called *hypnic jerks*), as if our body, or a part of our body, seems to go into a spasm. In addition, there is an overall slowdown of brain waves from their daytime wakeful patterns.

N1 in the first sleep cycle of a healthy young adult lasts for about 5 minutes after falling asleep, but for as little as 1 minute or so for some people or up to 7 or 8 minutes for others. In relation to an entire sleep episode, it amounts to about 4 or 5% of the total sleep time.

We can be easily awakened during N1 by a gentle nudge or sound such as a door closing, which means N1 has a *low* arousal threshold. If awoken, we may feel as if we haven't been asleep at all. Sometimes, we may deny ever having been asleep, even after we have failed to respond to an external stimulus earlier in the stage.

Stage 2

NREM stage 2 (N2) is a period of light sleep, sometimes described as moderate sleep because it gradually becomes deeper.

As we enter N2 in the first cycle, there is a continued slowing of heart rate, breathing, muscle activity and body movements. Body temperature also continues to fall and eye movements stop.

Brain waves also generally slow further during N2. Although the brain wave pattern is overall slower, it is marked by brief bursts of electrical activity (called *sleep spindles*). These typically occur every 3 to 6 seconds during N2. Their presence is used to signal transition to N2.

Although our sleep is less easily disturbed than it is in N1 and requires more intense stimuli than in N1 to awaken (which means N2 has a *higher* arousal threshold than N1), we can still be easily aroused from sleep during N2.

When people are awakened during the first half of this stage in particular, about 7 out of 10 report that they really didn't think they were asleep, but were just dozing and thinking. About midway through N2, however, we are unlikely to respond to anything except extremely strong or loud stimuli, indicating that our sleep has become noticeably deeper (Coren, 1996).

N2 in the first cycle lasts for about 10 to 25 minutes and lengthens with each successive cycle, eventually constituting about half of the total sleep episode. We therefore spend more of our repeated sleep cycles in N2 sleep than in any other sleep stage or type.

As N2 sleep progresses, there is a gradual appearance of the slow brain wave activity characteristic of N3, the third stage of NREM sleep.

Stage 3

NREM stage 3 (N3) is a period of deep sleep. Our heart rate and breathing slow to their lowest levels. Our muscles are completely relaxed and we barely move. There are no eye movements.

Brain waves become even slower, with the largest and slowest brain waves, called *delta waves*, becoming predominant. They occur more than 50% of the time. This is why N3 may also be called *slow wave sleep* or *delta sleep.*

N3 has the *highest* arousal threshold, so it can be difficult to awaken someone in this stage — harder than in any other stage. It is at this point during a sleep episode that people are often said to be 'sleeping like a log' or 'out like a light'. When they are woken, especially if woken abruptly, they can feel groggy and take several minutes to orient themselves, and usually have a poor memory of sleep events. This is sometimes referred to as 'sleep drunkenness', although psychologists prefer the term *sleep inertia* when referring to the post-awakening 'mental lag'.

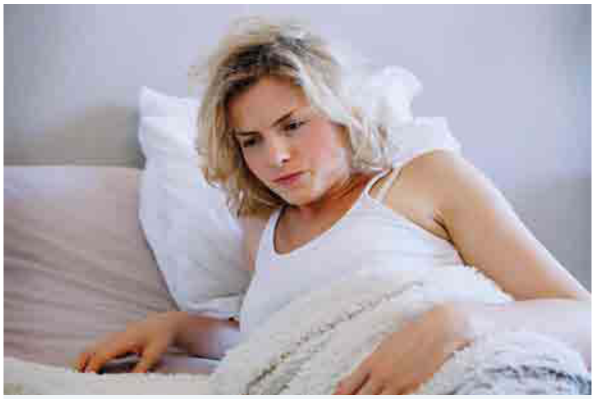


Figure 6.19 NREM stage 3 is the deepest stage of sleep with the highest arousal threshold. When awoken during this stage, a person often experiences a performance impairment called sleep inertia.

In the first sleep cycle, a person may spend between 20 to 40 minutes in N3 (depending on their age), after which a series of body movements usually marks the transition to the lighter NREM sleep stages.

As the night progresses, less and less time is spent in N3 deep sleep and it may disappear altogether.

Overall, N3 makes up about 10 to 15% of total sleep time.

The progression through the first NREM sleep cycle from N1 to N3 takes about 45 to 60 minutes or so before we gradually move back up through the lighter sleep of N2 and then into the first period of REM sleep. Typically, a 5- to 10-minute period of N2 precedes the initial REM sleep period (Carskadon & Dement, 2011; NINDS, 2022; Pacheco & Singh, 2022).

6.5.2 REM sleep

Approximately 20–25% of our total sleep time is spent in REM sleep. As the term suggests, REM sleep is defined by spontaneous bursts of rapid eye movement during which the eyeballs quickly move beneath the closed eyelids, darting back and forth and up and down in jerky, but coordinated movements.

The brain wave pattern associated with REM sleep is generally like that produced during alert wakefulness. The body's internal functioning is more active during REM sleep than during NREM sleep. The heart rate is faster and more irregular. Blood pressure rises, and breathing is shallower, faster and more irregular when compared with NREM sleep. However, the sleeper looks totally relaxed.

Although there are occasional twitching movements in the small muscles of the face, fingers and toes, most of the skeletal muscles (those attached to bones) are limp, and the body shows few outward signs of movement. An observer might say the sleeper appears paralysed during REM sleep. Consequently, REM sleep is also called *paradoxical sleep* — internally, the brain and body are active, while, externally, the body appears calm and inactive. The purpose of the apparent body paralysis remains unclear.

Research indicates that most dreaming occurs during REM sleep. In sleep laboratories, if a research participant is woken during REM sleep, about 80% of the time they will report having been dreaming at the time of being woken. Although some people believe they do not dream at all, research findings suggest that we typically dream several times a night, even though we may not remember dreaming.

Dreams also occur during all NREM sleep stages and can be as bizarre as those in REM sleep, but these are generally shorter, less frequent, less structured, less likely to be recalled and less vivid than those of REM dreams. Typical REM dreams have a narrative structure and consist of storylines that can range from realistic to complete fantasy. NREM dreams may be better referred to as 'dream imagery' – more colours and abstract shapes than the storybook-type dreams that the active REM brain constructs (Suzuki et al., 2004; Kennedy, 2011).

REM sleep periods lengthen and occur closer together as a sleep episode progresses. The first REM period that occurs earlier in the episode may last for only 1 to 5 minutes or so, the second about 12–15 minutes, the third about 20–25 minutes, while a later REM period towards the end of a sleep episode may last even longer. This may explain why you are often dreaming when you are woken by an alarm in the morning.

Whether or not REM sleep is considered to be light or deep sleep when compared with NREM sleep depends on which criteria are used. REM sleep is clearly more like wakefulness than NREM sleep when brain

Figure 6.20 The eye muscles are exempt from the paralysis of REM sleep. These double-exposure photographs capture the rapid eye movements, during which vivid dreaming occurs, as do heightened levels of internal physiological responses such as heart rate, respiration rate and brain wave activity.

wave activity is considered. However, if muscle tone is considered, then REM sleep can be called deep sleep due to muscle tone being at its lowest point. Therefore, psychologists tend to view REM sleep as sharing properties of both light and deep sleep.

The arousal threshold of REM sleep throughout the night is variable. It seems to depend on when during a REM period awakening is attempted. Generally, the arousal threshold may be like that of N2 or N3 (Ermis et al., 2010).

REM sleep is not a uniform state in relation to physiological responses. For example, a REM sleep period may comprise bursts of rapid eye movement activity accompanied by muscle twitches and breathing irregularities separated by episodes of relative inactivity.

This has led some researchers to define REM phases or periods called *tonic REM* and *phasic REM*, which are more similar to each other than to any of the NREM stages. However, the tonic–phasic distinction is primarily made for research purposes only. Although it has been found that it is largely during the phasic period that muscle twitches and bursts of rapid eye movements occur, REM sleep usually is not divided into stages (Carskadon & Dement, 2011; NINDS, 2022; Pacheco & Singh, 2022).

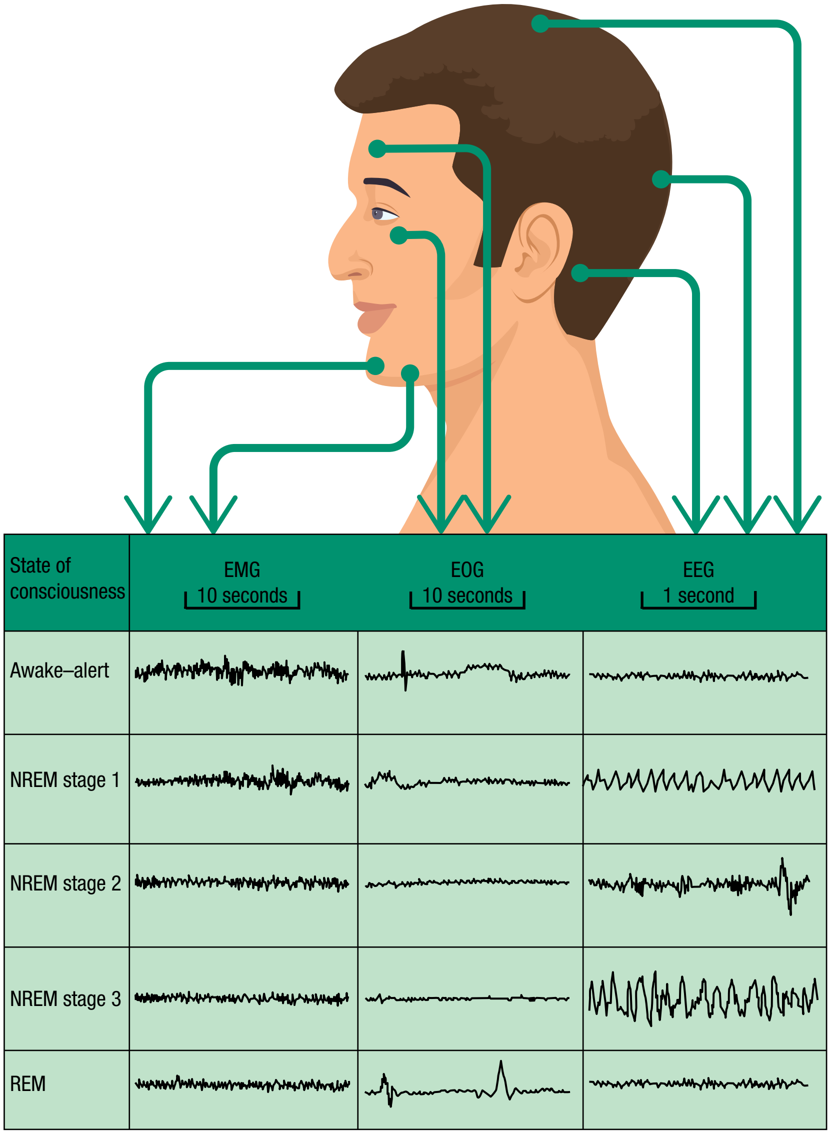


Figure 6.21 Comparison of NREM and REM sleep on three physiological responses. Brain waves in particular mark different NREM sleep stages and onset of REM sleep (in addition to eye movements). For example, when large, slow delta waves comprise more than 50% of the brain wave activity the person has entered stage 3, the deepest stage of sleep, and it will be very difficult to awaken them.

on Resources

Weblinks Video on sleep stages, sleep cycle and the biology of sleep 22 m 16 s

Video: 2-Minute Neuroscience on sleep stages and the sleep cycle 1 m 59 s

6.5 LEARNING ACTIVITY 1

Review

1. Distinguish between a sleep cycle and a sleep episode in relation to a typical night's sleep.
2. Explain whether sleep cycles and nightly sleep episodes may occur voluntarily, involuntarily or both.
3. What measure is primarily used to identify onset of different sleep stages?
4. Complete the following table to summarise some key differences between NREM and REM sleep.

Characteristic	NREM sleep	REM sleep
proportion in a sleep episode		
number of stages		
eye movements		
change in brain wave pattern		
change in muscle tone		
change in heart rate		
change in respiration		
change in arousal threshold		
body movements		
occurrence of dreaming		

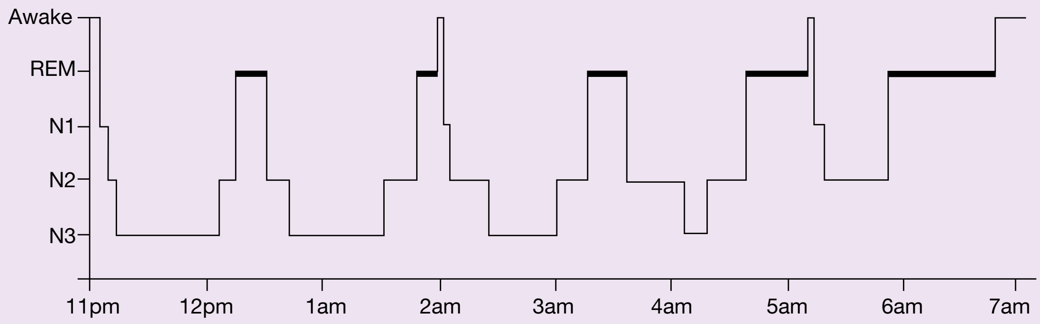
5. A researcher obtained sleep data on three participants observed in a sleep laboratory. Extracts from the data are summarised below. Consider the data for each participant and identify the NREM stage during which the data were likely to have been obtained or whether the data indicate REM sleep.

   a. **Participant 1**
   EOG pattern: no eye movement
   EMG pattern: little muscle tension and movement
   EEG pattern: brain wave activity quite slow (mainly medium amplitude, medium frequency theta waves)
   Other physiological responses: breathing has settled into a more regular pattern; slight drop in blood pressure, temperature and heart rate
   Observations:
   - Participant reported that they were 'just dozing' during this time.
   - Participant reported hearing something smash on the floor in the sleep researcher's office (low arousal threshold).

   b. **Participant 2**
   EOG pattern: frequent eye movements under closed eyelids
   EMG pattern: no muscle tension or movement apart from occasional facial twitches
   EEG pattern: irregular high frequency brain wave activity (periods of low amplitude beta-type brain waves and occasionally some alpha-type waves)
   Other physiological responses: fast and irregular heart rate and breathing; relatively high blood pressure
   Observations:
   - Participant was difficult to awaken (high arousal threshold).
   - Participant reported they had been dreaming and could describe the dream in vivid detail.

   c. **Participant 3**
   EOG pattern: no eye movement
   EMG pattern: almost no muscle tension or movement
   EEG pattern: only very slow brain waves (low frequency, high amplitude delta)
   Other physiological responses: heart rate, blood pressure and temperature all low; slow and steady breathing
   Observations:
   - Participant was very difficult to awaken (high arousal threshold).
   - Participant was disoriented on awakening.
   - Participant reported they had been dreaming but had limited recall of the dream.

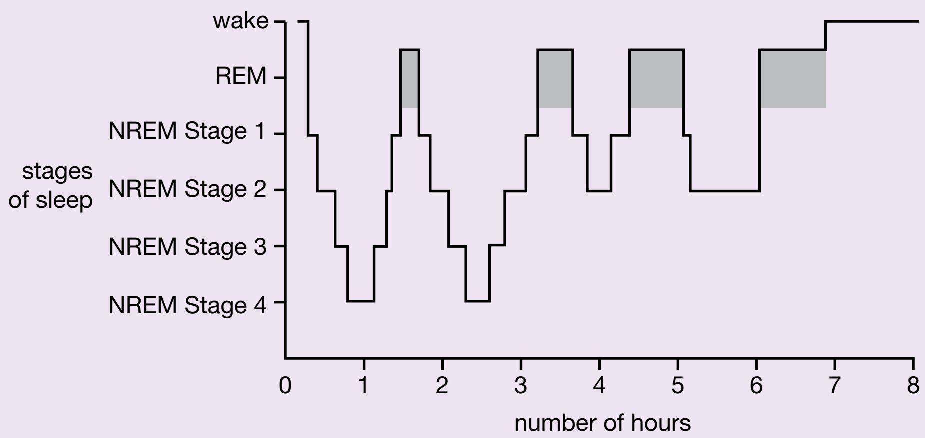
6. a. Identify the NREM–REM sleep cycles in the hypnogram below of a healthy young adult.



b. Comment on the accuracy of the hypnogram with reference to five characteristics of a typical sleep episode.

7. *Source: VCAA 2018 Psychology, Section B, Q.5a (adapted); ©VCAA*
The figure below is a hypnogram representing the sleep cycle of a healthy adult. NREM is shown to comprise four stages, which is the former, traditional description.

Sleep cycle of a healthy adult



Outline **two** differences between rapid eye movement (REM) sleep and non-rapid eye movement (NREM) sleep evident in the hypnogram above.

8. Compare the hypnograms in questions 6 and 7 above. Assume they are for two different individuals. Who had the best quality sleep? Why?

9. a. Why is REM sleep sometimes referred to as paradoxical sleep?
b. Explain whether REM sleep is best described as deep sleep or light sleep.

10. In which half of the major sleep episode is a person:
a. more easily awakened?
b. more likely to be harder to awaken?
c. likely to be dreaming? Explain each answer.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

6.5 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.10; ©VCAA

Which of the following indicates a typical night of sleep for an adult?

	Duration (minutes)	Number of complete sleep cycles
A.	30–40	1 or 2
B.	60–70	4 or 5
C.	10–15	4 or 5
D.	90–120	4 or 5

Question 2 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.10; ©VCAA

Johnny fell asleep during his English class. His arm twitched and he woke up suddenly.

Johnny was most likely in
A. rapid eye movement (REM) sleep.
B. stage 1 non-rapid eye movement (NREM) sleep.
C. stage 2 NREM sleep.
D. stage 3 NREM sleep.

Question 3 (1 mark)

Source: VCAA 2014 Psychology, Section A, Q.16 (adapted); ©VCAA

Megan was in non-rapid eye movement (NREM) stage 2 sleep when her alarm rang at 6 am. She woke up instantly, refreshed and ready for the day.

If Megan's alarm had rung after she had been asleep for only a couple of hours, it is likely that
A. she would wake easily as she would still be in the first sleep cycle.
B. it would be difficult to wake her as she is likely to be in NREM stage 1 sleep.
C. it would be difficult to wake her as she is likely to be in NREM stage 3 sleep.
D. it would be difficult to wake her as she is likely to be in rapid eye movement (REM) sleep.

Question 4 (1 mark)

Source: VCAA 2012 Psychology 1, Section A, Q.10 (adapted); ©VCAA

As a person progresses through the stages of sleep to Stage 3
A. EOG recordings indicate an increase in muscle movement.
B. EOG recordings indicate an increase in rapid eye movement.
C. EEG recordings decrease in amplitude and increase in frequency.
D. EEG recordings increase in amplitude and decrease in frequency.

Question 5 (1 mark)

Source: VCAA 2010 Psychology 1, Section A, Q.37 (adapted); ©VCAA

A typical night's sleep for an adult includes four to five sleep cycles. Which of the following patterns best describes a typical sleep cycle from early in the night?
A. awake, NREM stage 3, NREM stage 2, NREM stage 1, REM, NREM stage 3, NREM stage 2, NREM stage 1
B. awake, NREM stage 1, NREM stage 2, NREM stage 3, REM, NREM stage 1, NREM stage 2, NREM stage 3
C. awake, REM, NREM stage 3, NREM stage 2, NREM stage 1, NREM stage 2, NREM stage 3, REM
D. awake, NREM stage 1, NREM stage 2, NREM stage 3, NREM stage 2, NREM stage 1, REM

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

6.6 Differences in, and explanations for, the demands for sleep across the life span

Sleep patterns change considerably with age. From infancy to adulthood, there are marked changes in the proportions of REM and NREM sleep, including the percentage of time spent in each NREM stage. Virtually all age-related changes are predictable (Carskadon & Dement, 2011). For example, three of these changes are evident in Figures 6.22 and 6.23:

- from birth onward, the total amount of time we spend sleeping gradually decreases as we get older;
- the proportion of time spent in REM sleep decreases markedly during the first two years and then remains relatively stable through to a very old age; and
- there is an age-related decrease in the proportion of NREM sleep that persists through to a very old age.

Early in life, after birth, we sleep for about 16 hours a day, about 50% of which is REM sleep. By the end of infancy at about 2 years of age we have overall spent more time asleep than awake, however, total sleep time has declined to around 12–13 hours and REM sleep as a percentage of total sleep is about 20–25%.

By the end of childhood and onset of adolescence, total sleep time drops to around 9 hours and about 2 hours or 20–25% is REM sleep. The gradual decrease in total sleep time continues through childhood, adolescence and adulthood, but the 20–25% proportion of REM sleep is maintained well into old age (except in people with a neurodegenerative brain disorder).

In later adulthood, at around 60 or so years of age, the total sleep time averages about 6 hours. Individuals in their sixties and older tend to report that their sleep is much lighter with increased awakenings than when they were younger. This coincides with research findings that NREM sleep of elderly people is mostly stage 2 light sleep. The age-related decrease and eventual disappearance of NREM stage 3 is also seen in other mammals. Furthermore, as shown in Figure 6.23, by age 85, stage 3 sleep has significantly diminished (Lavie, 1996; Breedlove & Watson, 2020).

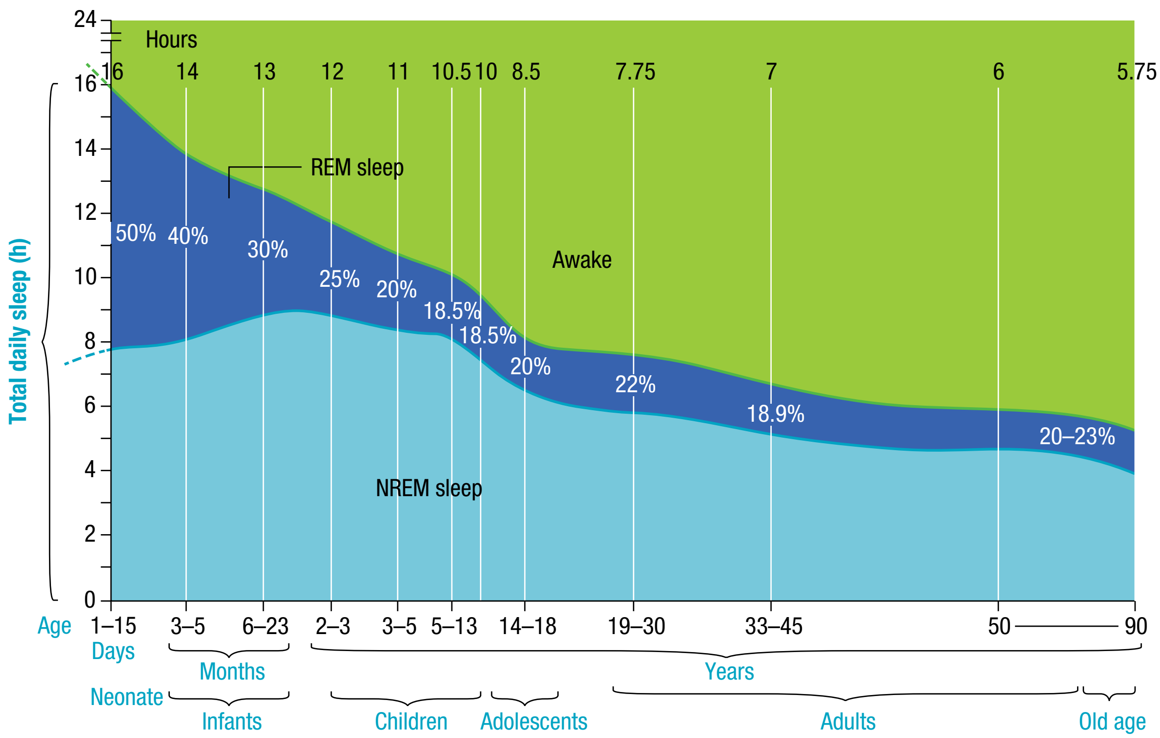


Figure 6.22 Proportions of REM and NREM sleep in humans across the life span

Source: Based on Roffwarg, H.P., Muzzio, J.N., & Dement, W.C. (1966). Ontogenetic development of the human sleep–dream cycle. *Science, 152*, 604–619.

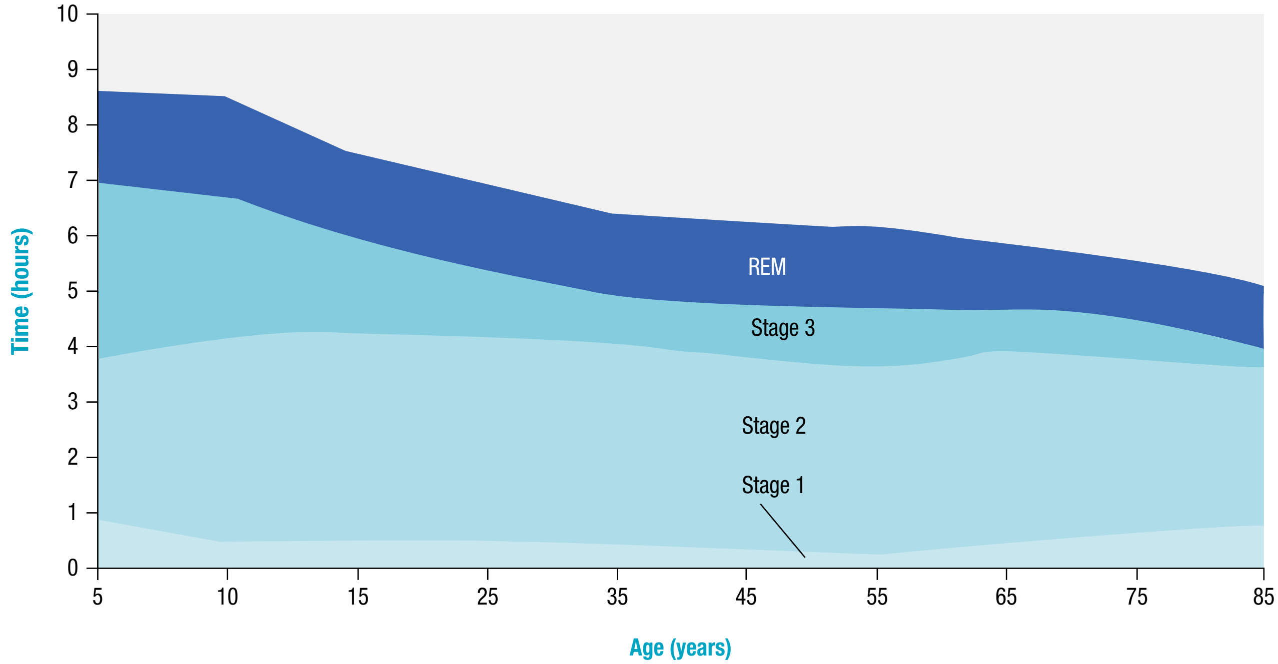


Figure 6.23 Age-related trends for REM sleep and NREM sleep stages

Source: Based on Ohayon et al. (2004). Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: Developing normative sleep values across the human life span. *Sleep, 27*(7), 1255–1273.

6.6.1 Newborns and infants

From birth to about 2 months of age, sleep onset may occur at any time of the day or night, with no regular rhythm or concentration of sleeping and waking periods. Sleep duration also tends to be irregular, with the length of one episode lasting from 30 minutes to 3 or 4 hours. The cyclic alternation of NREM–REM sleep is present from birth, but there are fewer sleep cycles. Infants fed from the bottle tend to sleep for longer at a time than breastfed babies (3–4 hours versus 2–3 hours).

As shown in Figure 6.22, in the first two weeks of life, 50% of the infant's sleep is REM sleep. However, the infant's REM sleep is quite active, with lots of facial movements such as smiles and grimaces, and, unlike when older, there are muscle twitches and arms and legs may move too.

It is unclear as to why so much time is spent in REM sleep. Various theories have been proposed, including REM sleep providing stimulation that is essential to the maturation of the nervous system. In addition, it has been proposed that activity such as muscle twitches may provide sensory feedback to the brain that guides the development of sensori-motor networks in the brain (Breedlove & Watson, 2020; Del Rio-Bermudez et al., 2020).

Figure 6.24 In the first two weeks of life, 50% of the infant's sleep is REM sleep.

Sleep onset also occurs through REM sleep, not NREM stage 1, and each sleep episode consists of only one or two cycles, which is tied to the shorter duration of a sleep episode. This distinctive sleep pattern is believed to occur primarily because the young infant's circadian rhythms are not fully developed nor fully synchronised with the daily day–night cycle of their external environment.

At around 2 or 3 months when circadian rhythms start to exert their influence, particularly the cyclical production of melatonin, there are longer periods of wakefulness during the day and longer periods of sleep at night. Environmental cues influencing night sleep preference include a greater responsiveness to social cues, such as bedtime routines.

By 3 months of age, the NREM–REM sleep cycles become more regular. Sleep onset now begins with NREM stage 1, REM sleep decreases and shifts to the later part of the sleep cycle, and the total NREM–REM sleep cycle is typically 50 to 60 minutes.

By 6 months of age, total sleep time reduces slightly and the longest continuous sleep episode lengthens to about 5 to 8 hours at night. Sleep episodes therefore become less fragmented. In addition, a full NREM cycle comprising all stages is likely to have emerged. The muscle paralysis typical of REM sleep has also set in. These changes emerge between the ages of 2 and 6 months and are primarily attributed to the maturation of the brain and biological mechanisms governing the NREM–REM sleep cycle.

By about 12 months old, the infant sleeps 14 to 15 hours per day with the majority of sleep occurring as a single episode in the evening. This may be complemented by one or two naps during the daytime. There are full sleep cycles but the proportion of REM sleep is still relatively high compared with childhood, adolescence and adulthood (Colten et al., 2006; Carskadon & Dement, 2011; Pacheco, 2022a; SHF, 2022b).

6.6.2 Children

Total sleep time continues to decrease as the child gets older, from about 13 to 11 hours between 2 to 5 years of age. This has been attributed to maturation and other biological factors, as well as social factors such as decreased daytime napping, the introduction of preschool time routines and other changes that can influence sleep, including how, with whom, and where children sleep.

The proportion of REM sleep continues to decrease and the amount of NREM sleep increases, with a greater percentage of sleep time spent in stages 2 and 3. As shown in Figure 6.23, about half the NREM sleep of children is stage 3 deep sleep and this decreases markedly from about age 10.

The stage 3 sleep of young children is both qualitatively and quantitatively different from that of older adults. For example, it is extremely difficult to wake a 10-year-old when delta brain waves are predominant in the night's first sleep cycle. In addition, children up to mid-adolescence often 'skip' their first REM sleep period, which may be due to the quantity and intensity of delta brain wave sleep activity early in the sleep episode (Colten et al., 2006; Carskadon & Dement, 2011; SHF, 2022b).

6.6.3 Adolescents

With increasing age, the total time spent sleeping decreases, as does the amount of REM sleep. However, if bedtime is fixed, the duration of REM sleep tends to remain constant. By mid-adolescence, the first REM period is unlikely to be skipped, and a sleep episode resembles that of young adults.

Within NREM sleep, the amount of stage 3 deep sleep progressively declines and the time spent in stage 2 increases. By late adolescence, N3 sleep has decreased by nearly 40% since early childhood. This occurs even when the length of a sleep episode remains constant (Carskadon & Dement, 2011).

Research findings indicate that adolescents tend to get less sleep than they need to function at their best. One reason is a biologically driven change in their sleep–wake cycle that changes the timing of sleep, delaying its onset for one to two hours. Lifestyle factors also contribute to this change.

Many adolescents also tend to have irregular sleep patterns across the week when compared with adults and young children. Teenagers in particular tend to stay up late during the week, even later on the weekends and then sleep in late, which can further affect their circadian sleep–wake cycle and impact on the quality of their sleep. Many cope with the shift in their sleep–wake cycle and their irregular sleep patterns, but some do not. The sleep–wake cycle shift in adolescence is explained in the next topic (Suni, 2022b; Turgeon & Wright, 2022).

6.6.4 Adults

Individuals vary in their sleep needs, particularly as they get older, but most people sleep appreciably less as they age. By adulthood, we average about 8 hours of sleep a night, 20–25% of which is REM sleep.

As evident in Figure 6.22, the overall pattern of sleep shows a progressive decline in the duration of a typical sleep episode and in the proportions of time spent in REM and NREM sleep. There is also a gradual loss of NREM stage 3 sleep.

As an individual ages (between the ages of 20 to 60), deep sleep declines at a rate of about 2% per decade. By age 60 or so, a severe reduction is evident. People at age 60 may spend only about half as much time in NREM stage 3 as they did at age 20, sometimes not at all. Eventually, stage 3 disappears altogether, particularly in males. Females appear to maintain their deep sleep stage later into life than males.

Sleep also tends to become more fragmented as we age, with more night time awakenings among older adults. One reason for more frequent awakenings is the decline in NREM stage 3 sleep with age — we are harder to awaken during slow delta wave sleep. Younger adults may experience brief awakenings, but they are usually minor and occur close to when there is a transition from NREM to REM sleep, so their sleep remains relatively consolidated.

Most older people average about 8 hours sleep each day. However, they may not get all their sleep at night. About 4 in 10 older people have at least one 30 minute nap every day. Many people over the age of 80 nap for more than one hour each day.

Older people also tend to become sleepier in the early evening and wake earlier in the morning compared to younger adults. Some fall into a regular pattern of sleeping and waking earlier but the usual total amount of sleep is still obtained. Others take longer to fall asleep. About 1 in 3 females and 1 in 6 males take more than half an hour to get to sleep.

The reasons for changes in the sleep–wake cycle among older people are not fully understood. It has been proposed that it may be due to an age-related deterioration in the biological clock (SCN) that drives the sleep–wake cycle and the reduction in melatonin production that is evident among older people.

The inability to maintain long sleep episodes and the bouts of wakefulness may also reflect the influence of other factors such as daytime napping, medical problems, decreased mobility leading to a reduction in exercise, irregular meal times and inconsistency of exposure to external cues that influence the sleep–wake cycle.

It is a common misconception that sleep *needs* decline with age. Research findings show that that our sleep needs remain constant throughout adulthood. The reality is that, as people age, they tend to have a harder time falling asleep, sleep lightly, wake up more often and spend less time in deep, refreshing sleep than when they were younger. The prevalence of sleep disorders also tends to increase with age. For example, about 25% of older people have sleep apnea or periodic limb movement disorder, and about 40% have insomnia. These problems often disturb the sleep of the bed partner as well. In addition, Advanced Sleep Phase Syndrome, which is examined in the next topic, is most prevalent among older adults (Colten et al., 2006; Carskadon & Dement, 2011; SHF, 2019a; Stanford Health Care, 2021).

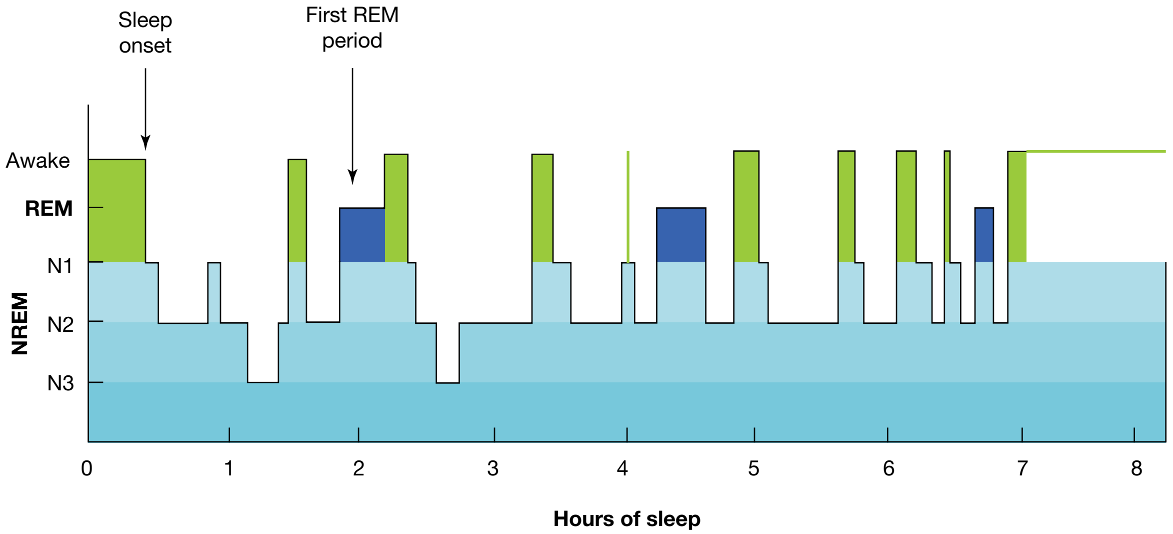


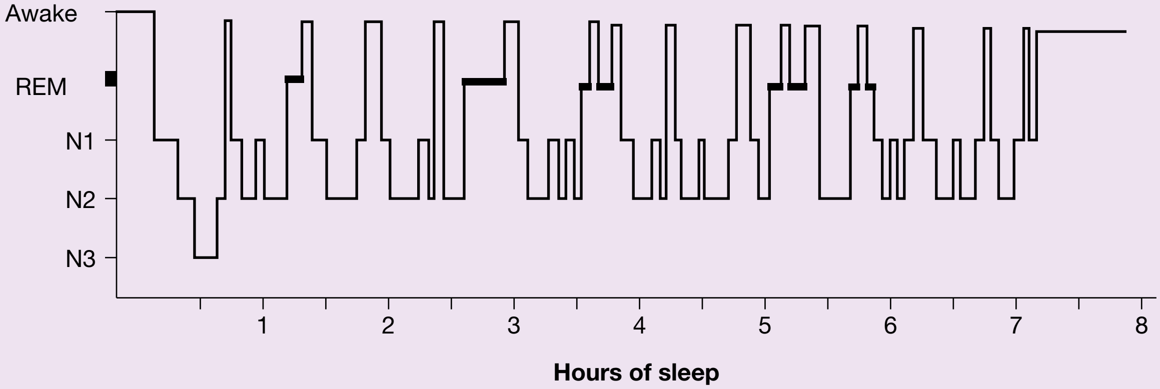
Figure 6.25 The sleep pattern of an elderly person. Note the significant reduction in stage 3 deep sleep as the sleep episode progresses and the frequent awakenings throughout the episode.

Source: Based on Breedlove, S.M., & Watson, N.V. (2020). *Biological psychology: Behavioral neuroscience* (9th ed.). New York: Oxford University Press.

6.6 LEARNING ACTIVITY 1

Review

1. Construct a table to summarise sleep–wake patterns of newborns and infants, children, adolescents, adults and elderly people with reference to two distinguishing features of each life span stage.
2. List five general trends in the pattern and proportions of NREM and REM sleep across the life span.
3. a. Explain age-related changes in sleep in three life span stages with reference to circadian rhythm changes.
   b. Give two examples of psychological or social factors that may influence an age-related shift in the sleep–wake cycle.
4. Compare and contrast the sleep patterns of a young adult and elderly person shown in the hypnograms below.



Source: Based on Neubauer, D.N. (1999). Sleep problems in the elderly. *American Family Physician, 59*(9), 2551–2558.

Ensure that you refer to:

- sleep onset
- time in REM sleep
- time in NREM sleep and its stages
- awakenings — fragmented versus consolidated sleep across an episode.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

6.6 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2011 Psychology 1, Section A, Q.7; ©VCAA

Sleep changes as we age. Which one of the following statements best describes a noticeable change that occurs?

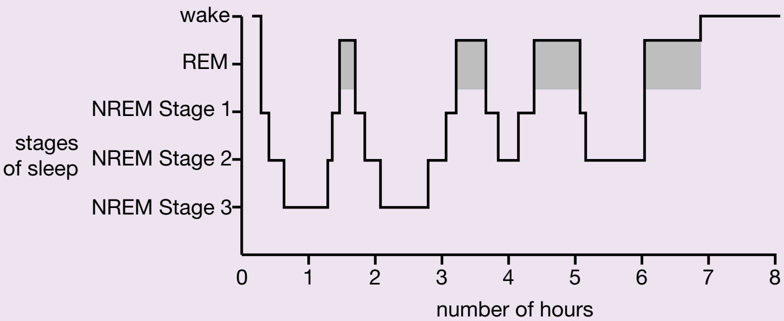
A. The time spent sleeping overall increases as we age.
B. The proportion of time spent in NREM sleep increases as we age.
C. As we progress over time from infancy to old age, the proportion of time spent in stages 1 and 2 of NREM sleep significantly decreases.
D. The proportion of time spent in REM sleep significantly decreases from infancy and then remains steady as we continue ageing.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.33 (adapted); ©VCAA

Dr Abdulla is a sleep researcher. He has collected data from four healthy participants: a child, an adolescent, an adult and an elderly person. Dr Abdulla forgot to label the hypnograms so he decided to try to identify them by considering the typical sleep patterns for each life stage.

The hypnogram shown is likely to belong to which participant?



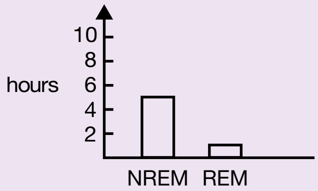
A. the adolescent, because adolescents go to sleep later at night
B. the adult, because adults have four to five sleep cycles per night
C. the child, because children spend 20 per cent of their sleep in REM
D. the elderly person, because elderly people wake frequently during the night

Question 3 (1 mark)

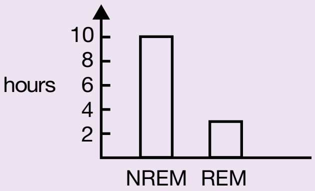
Source: VCAA 2017 Psychology, Section A, Q.38 (adapted); ©VCAA

Ben is a healthy 6-year-old and Charles is a healthy 65-year-old.

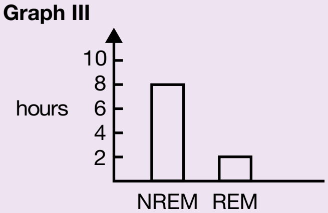
Graph I



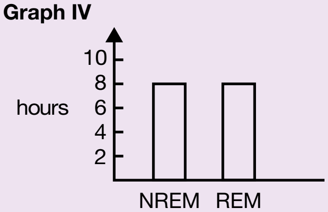
Graph II



Graph III



Graph IV



Which of the graphs on the previous page best represent the amount of time spent in NREM sleep and REM sleep in a typical 24-hour period for Ben and Charles?

	Ben	Charles
A.	Graph III	Graph I
B.	Graph II	Graph IV
C.	Graph I	Graph II
D.	Graph IV	Graph III

Question 4 (1 mark)

Source: VCAA 2014 Psychology, Section A, Q.24; ©VCAA

As a person ages, the total amount of time that they spend asleep each night

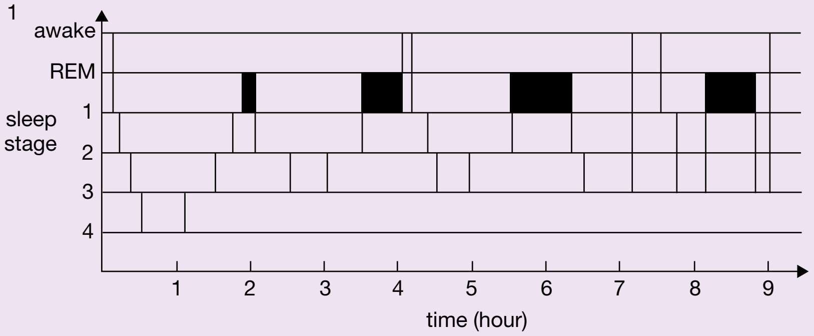
A. decreases, while the proportion of time spent in REM sleep increases.
B. decreases, while the proportion of time spent in NREM sleep increases.
C. increases, while the proportion of time spent in REM sleep also increases.
D. does not change in relation to the percentage of time spent in REM sleep and NREM sleep.

Question 5 (1 mark)

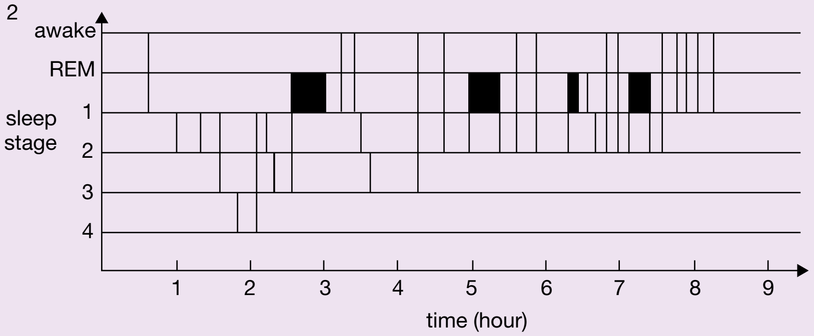
Source: VCAA 2011 Psychology 1, Section A, Q.7; ©VCAA

The following graphs show the typical sleep cycles for two distinct age groups.

Graph 1



Graph 2



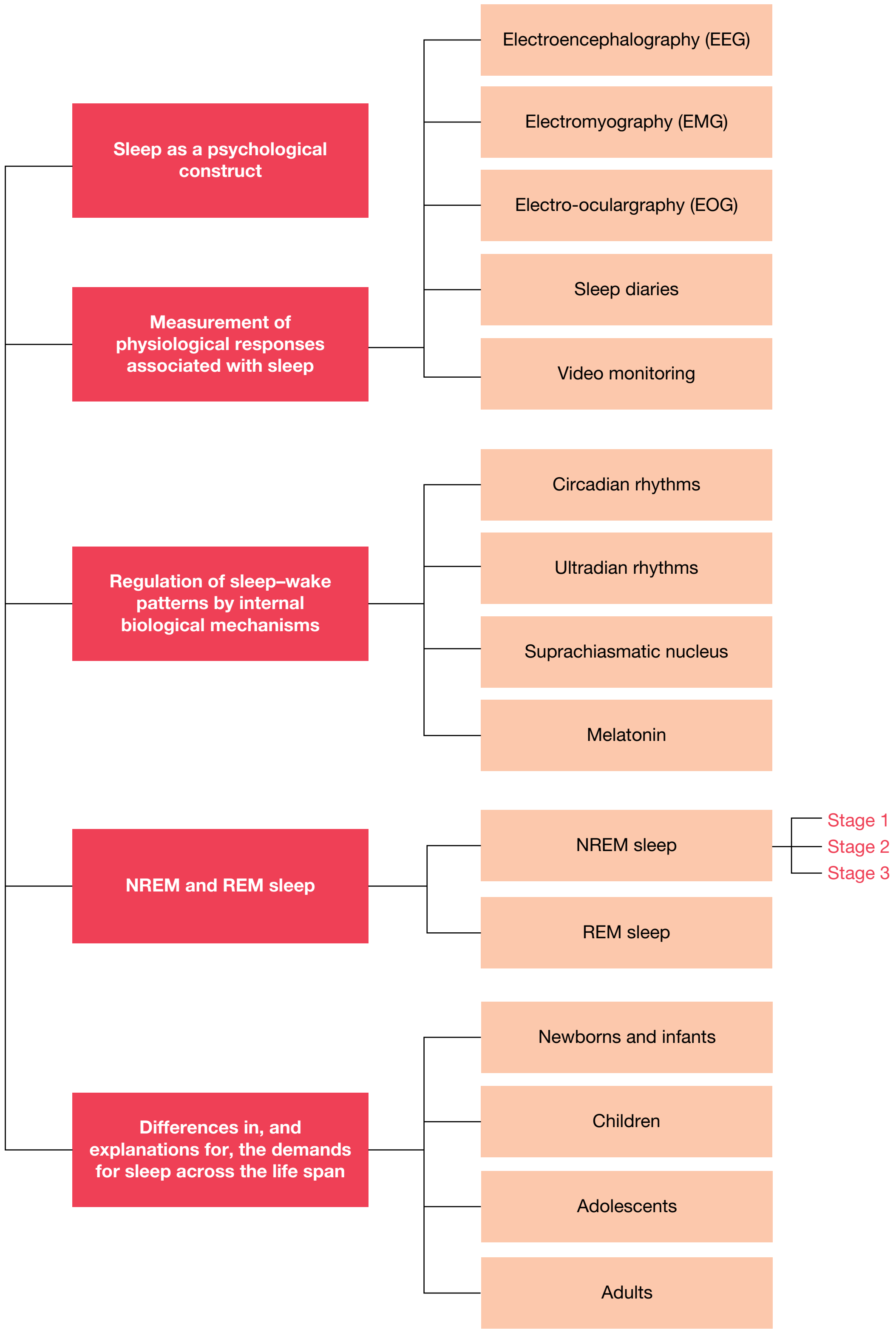
The typical sleep cycles represented in Graphs 1 and 2, in order, are

A. infant, adolescent.
B. infant, elderly person.
C. elderly person, infant.
D. adolescent, elderly person.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

6.7 Review

Topic summary



Key terms

alpha brain wave p. 393
altered state of consciousness (ASC) p. 387
arousal threshold p. 409
biological clock p. 400
biological rhythm p. 400
beta brain wave p. 393
brain wave p. 393
brain wave pattern p. 393
consciousness p. 386
circadian rhythm p. 401
deep sleep p. 394
delta brain wave p. 393
electroencephalography (EEG) p. 393
electromyography (EMG) p. 394
electro-oculargraphy (EOG) p. 395
endogenous p. 401
exogenous p. 401
hypnogram p. 407
induced state of consciousness p. 388
light sleep p. 394
melatonin p. 404
naturally occurring state p. 387
normal waking consciousness p. 387
NREM sleep p. 407
NREM stage p. 408
psychological construct p. 391
REM sleep p. 407
sleep p. 390
sleep diary p. 395
sleep episode p. 393
sleep latency p. 408
sleep onset p. 408
sleep–wake cycle p. 388
sleep–wake pattern p. 400
states of consciousness p. 386
suprachiasmatic nucleus (SCN) p. 403
theta brain wave p. 393
ultradian rhythm p. 402
video monitoring p. 397

Note: The **References** for the entire title can be accessed in learnON and are also available as a downloadable PDF.

on Resources

Digital documents: Key terms glossary — Topic 6 (doc-37996)
Topic summary — Topic 6 (doc-37997)
Key diagrams PowerPoint — Topic 6 (doc-37999)

Exam question booklet Exam question booklet — (eqb-0128)

6.7 Topic 6 test

Section A: 25 marks **Section B:** 35 marks **Total:** 60 marks

Access learnON to answer the following test questions online and receive **immediate feedback**.

Section A — Multiple-choice questions

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

A psychological construct is used to describe psychological activities that cannot be

A. measured.
B. explained.
C. directly observed.
D. experimentally investigated.

Question 2

A person's awareness of something either internal or external to themself and of their own existence may be defined as

A. sustained attention.
B. divided attention.
C. consciousness.
D. a circadian rhythm.

Question 3

Which of the following data collection procedures typically involves self-monitoring?

A. video monitoring
B. sleep diary
C. laboratory observation
D. naturalistic observation

Question 4

A computer-assisted speed and accuracy test used to assess consciousness is best described as a/an _____ measure.

A. subjective
B. objective
C. biased
D. physiological

Question 5

High-frequency brain waves are _____ and therefore involve _____ brain waves per unit of time.

A. faster; more
B. slower; less
C. faster; less
D. slower; more

Question 6

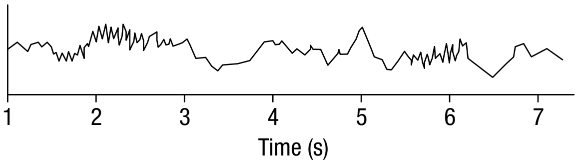
Electrical activity associated with eye movements during sleep are measured through the process of _____; whereas electrical activity associated with different muscle groups on the body during sleep are measured through the process of _____.

A. electro-oculography; electromyography
B. electroencephalography; electromyography
C. electromyography; electro-oculography
D. electro-oculography; electroencephalography

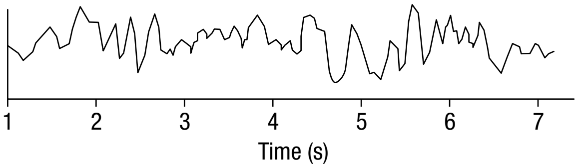
Question 7

Which pattern shows the brain waves of a very alert person during normal waking consciousness?

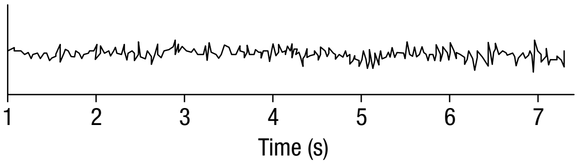
A.



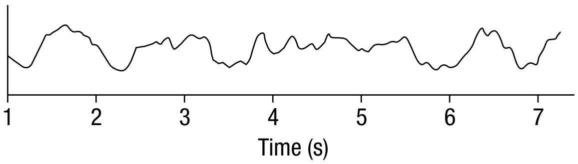
B.



C.



D.



Question 8
Melatonin is a
A. neurotransmitter.
B. hormone.
C. biological clock.
D. biological mechanism.

Question 9
All biological rhythms are regulated by
A. a biological clock.
B. the pineal gland.
C. cyclical changes.
D. sunlight.

Question 10
Which of the following statements about ultradian and circadian rhythms is correct?
A. Circadian rhythms have a cycle with a duration longer than 24 hours, whereas ultradian rhythms have a cycle with a duration less than 24 hours.
B. Ultradian rhythms have a cycle with a duration longer than 24 hours, whereas circadian rhythms have a cycle with a duration less than 24 hours.
C. Circadian rhythms have a cycle with a duration of about 24 hours, whereas ultradian rhythms have a cycle with a duration less than 24 hours.
D. Ultradian rhythms have a cycle with a duration of about 24 hours, whereas circadian rhythms have a cycle with a duration less than 24 hours.

Question 11
Circadian rhythms are controlled by
A. the optic chiasm.
B. melatonin.
C. light.
D. the suprachiasmatic nucleus.

Question 12
The sleep–wake cycle may be described as
A. a rhythm with a duration of about 90 minutes.
B. an ultradian rhythm occurring within a circadian rhythm.
C. an ultradian rhythm that is a naturally occurring ASC.
D. a circadian rhythm that occurs throughout a typical sleep episode.

Question 13
The amount of time it takes to fall asleep once the attempt to do so is made is called
A. sleep latency.
B. sleep onset.
C. the arousal threshold.
D. an altered state of consciousness.

Question 14
With each complete sleep cycle throughout a typical night's sleep by older adolescents, the
A. duration of REM sleep decreases.
B. duration of REM sleep increases.
C. duration of deep sleep increases.
D. brain becomes less active.

Question 15
Which of the following is true of REM sleep?
A. Muscle tone decreases appreciably during REM sleep.
B. The first REM period in the first sleep cycle of a young adult has a duration of about 50 minutes.
C. Brain wave activity decreases appreciably during REM sleep.
D. The first REM period in the first sleep cycle of a newborn infant occurs after an NREM sleep cycle.

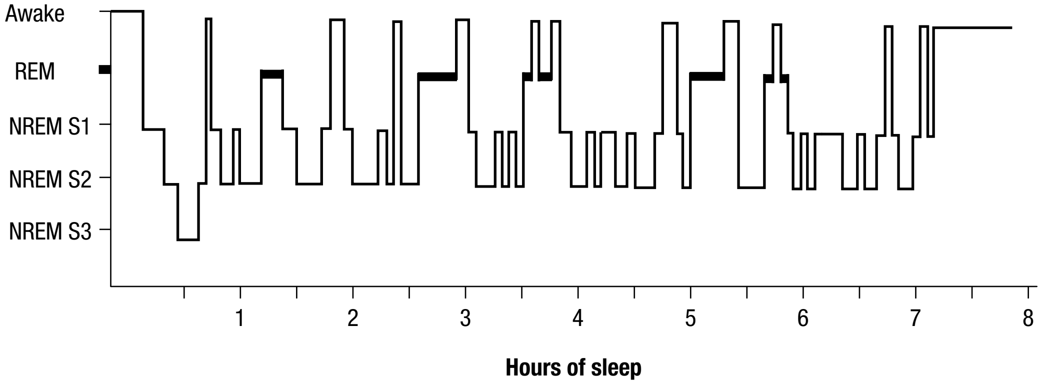
Question 16
Which of the following would usually be excluded when calculating total sleep time for an individual?
A. brief awakenings
B. sleep onset period
C. REM sleep periods
D. NREM dream periods

Question 17
A high arousal threshold means that a sleeping person is
A. in NREM stage 1.
B. waking.
C. easy to awaken.
D. difficult to awaken.

Question 18
How soon after a healthy young adult falls asleep are they normally likely to experience REM sleep in a typical sleep episode?
A. immediately
B. about 1–5 minutes
C. after the first sleep cycle
D. about 80–90 minutes

Question 19
In a typical nightly sleep episode in a healthy adult, _____ tend(s) to predominate during the first half, whereas _____ tend(s) to predominate in the last half.
A. NREM stage 3; REM and NREM stage 2
B. NREM stages 1 and 2; REM and NREM stage 2
C. REM and NREM Stage 2; NREM stage 3
D. NREM stages 1 and 2; NREM stage 3

Use the following hypnogram to answer questions 20–23.



Question 20

Approximately how old is the person whose hypnogram is shown?

A. 0–2 weeks
B. 14–19 years
C. 30–50 years
D. 70 years+

Question 21

The hypnogram shows that the person experienced

A. consolidated sleep.
B. mostly light sleep.
C. mostly deep sleep.
D. a prolonged period of NREM stage 2 sleep.

Question 22

About how many times did the person awaken after falling asleep?

A. 1
B. 2
C. 12
D. 21

Question 23

The person spent about _____ in NREM stage 3 sleep.

A. 15 minutes
B. 30 minutes
C. 1 hour
D. no time

Question 24

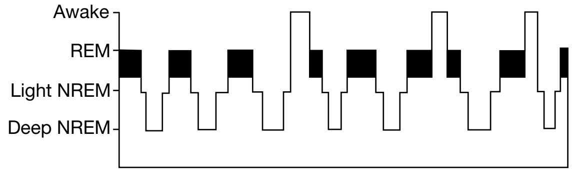
Which of the following statements about the sleep of a young healthy adult is correct?

A. REM sleep is usually about 75% to 80% of total sleep time.
B. Slow wave delta sleep is rarely experienced.
C. REM sleep periods tend to occur closer together during a normal night's sleep.
D. Cyclic alternation of NREM sleep and REM sleep occurs less frequently than in childhood.

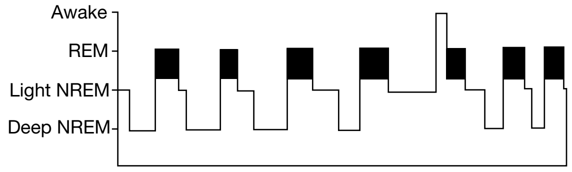
Question 25

Which of the four hypnograms shows the sleep episode of a 1-week-old infant?

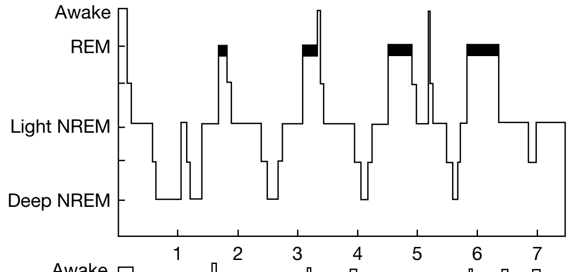
A.



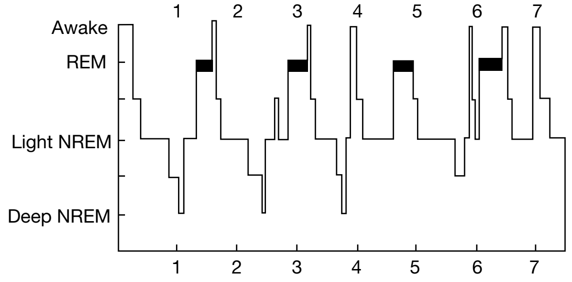
B.



C.



D.



Section B — Short answer questions

Question 1 (2 marks)

Deep sleep may be defined as starting during NREM stage _____ when a pattern of _____ brain waves is established.

Question 2 (2 marks)

Describe two criteria that could be used to assess whether a biological rhythm could be called a circadian rhythm.

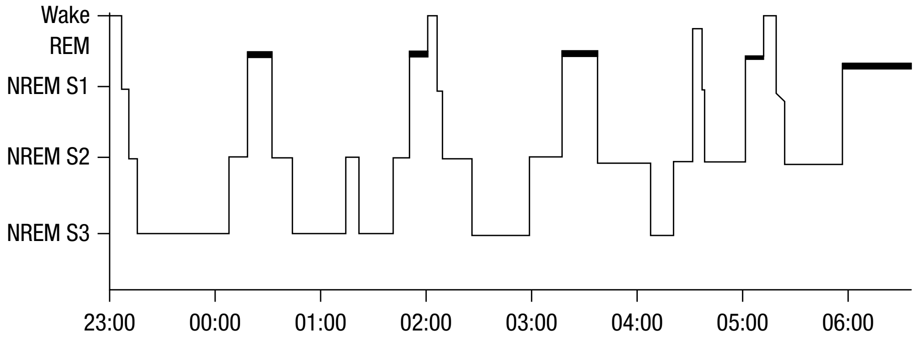
Question 3 (2 marks)

Distinguish between a sleep cycle and a sleep episode.

Question 4 (4 marks)

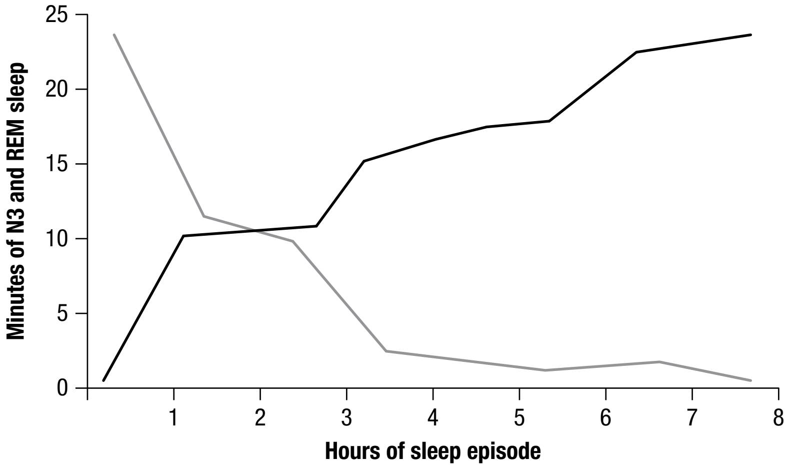
a. Identify all the sleep cycles in the hypnogram below which shows the progression of NREM–REM sleep during a single sleep episode. 1 mark

b. Explain whether the hypnogram shows the sleep of a healthy young adult with reference to three characteristics of a typical sleep episode of a young adult. 3 marks



Question 5 (2 marks)

Label the two plot lines in the graph below to show which line represents NREM stage 3 sleep and which line represents REM sleep.



Question 6 (4 marks)

List four differences in sleep across the life span with reference to the total amount of sleep and changes in the pattern and proportions of REM and NREM sleep (including NREM stages).

Question 7 (6 marks)

An experiment was conducted to investigate the effects of consuming chocolate on brain wave activity. 122 participants were randomly assigned to one of three conditions and consumed either chocolate with a high (60%) concentration of cacao (the active ingredient in chocolate), low (0%) cacao chocolate, or water. Brain waves and mood were measured before and after a 60-minute digestion period.

The results showed a decrease in alpha and theta activity and an increase in beta activity in the frontal and parietal lobes following consumption of a 60% cacao chocolate bar compared with control conditions. No condition-specific mood changes or sex differences were found.

a. Name the instrument used to measure brain wave activity. 1 mark
b. Name the experimental design. 1 mark
c. Identify the experimental and control groups. 2 marks
d. What was the placebo treatment and why was it used in this particular experiment? 2 marks

Question 8 (13 marks)

To test the effectiveness of a new sleeping pill, a researcher conducts an experiment at the participants' homes rather than in a sleep laboratory.

Eighteen volunteer adult participants, who reported that they have been suffering from sleep-onset insomnia (i.e. difficulty falling asleep) for more than a year, are each given a packet of 14 pills and asked to take one each night for 14 consecutive nights, 15 minutes before their usual sleeping time. They are also given a special apparatus to record the time they fall asleep. The apparatus, worn on the body, measures various physiological responses associated with sleep–awake states, has a timing device and has been reported by participants in previous studies as not being uncomfortable in any way. Researchers have also found it to be far more valid and reliable than similar measures devised as smart phone apps.

The participants do not know that they have been randomly allocated to either of two groups. The researcher's assistant is also unaware of the group to which each participant has been allocated.

Group 1 has 9 participants whose pills are arranged in the pack so that pills 1 to 7 are the new sleeping pills, and pills 8 to 14 look and taste like the sleeping pills but do not contain the sleep-inducing ingredient. Group 2 also has 9 participants, but their pills are arranged so that pills 1 to 7 are the fake pills and pills 8 to 14 are the new sleeping pills.

The results are shown in the following table.

Table 1 Time taken to fall asleep

Group	Mean time (minutes)	
	Sleeping pills	Non-sleeping pills
1	37	64
2	78	31

a. Identify the independent and dependent variables. 2 marks
b. Name the experimental design. 1 mark
c. Was counterbalancing used to control in this experiment? 1 mark
d. Identify the experimental and control groups, if any. 2 marks
e. Explain the difference between a placebo effect and an experimenter effect in relation to this particular experiment. 2 marks
f. Name and describe the procedure(s) used to control placebo and experimenter effects in this experiment. 2 marks
g. What conclusion can be drawn from the results? 1 mark
h. Identify a relevant extraneous or confounding variable that may have affected the results of the experiment. 1 mark
i. Explain a way in which this variable may have been minimised or controlled in the experiment. 1 mark

on Resources

Go to learnON to access answers to the Topic 6 test. A customisable Word version of the test can also be downloaded from the **Digital documents** tab of the Resources panel.

7 Importance of sleep in mental wellbeing

TOPIC CONTENT

7.1 Overview

KEY KNOWLEDGE

- the effects of partial sleep deprivation (inadequate sleep either in quantity or quality) on a person's affective, behavioural and cognitive functioning, and the affective and cognitive effects of one night of full sleep deprivation as a comparison to blood alcohol concentration readings of 0.05 and 0.10
- changes to a person's sleep-wake cycle that cause circadian rhythm sleep disorders (Delayed Sleep Phase Syndrome [DSPS], Advanced Sleep Phase Disorder [ASPD] and shift work) and the treatments of circadian rhythm sleep disorders through bright light therapy
- improving sleep hygiene and adaptation to zeitgebers to improve sleep-wake patterns and mental wellbeing, with reference to daylight and blue light, temperature, and eating and drinking patterns

Source: © VCAA, *VCE Psychology Study Design: 2023–2027*. p.39.

Some nights, we fall asleep easily and the night passes with little or no interruption to our sleep. When we awaken after a good night's sleep we feel terrific — refreshed, energised and ready to take on the world. Other nights, onset of sleep is slow, perhaps not until well into the early morning hours. Or we may fall asleep quite quickly but awaken too many times throughout the night.

We usually don't feel so great after these types of 'bad' sleep experiences. Merely getting out of bed when the alarm goes off can be a huge effort. We may snap at the first person we see over something that is really quite trivial. At school or work we may lack motivation, find it hard to concentrate for too long and react more slowly than usual. However, we generally recover quite quickly from isolated 'bad' sleep experiences, especially if we follow it up with a 'good' night's sleep at the next available opportunity.

Some people, however, don't sleep as much or as well as they would like to on a regular basis. They may have trouble with the timing of their sleep, falling asleep, staying asleep, waking up, staying awake and/or a problem with the quality of their sleep after they manage to fall asleep. Their problem with sleep quantity or quality occurs because their sleep–wake cycle is disturbed in some way.

The term **sleep disturbance** is used to refer to any sleep-related problem that disrupts an individual's normal sleep–wake cycle, including problems with sleep onset, waking from sleep and abnormal behaviour occurring during sleep. The disruption may be temporary, occasional or persistent.

Figure 7.1 When we awaken after a good night's sleep we feel refreshed, energised and ready to take on the world, but not so great after a 'bad' sleep experience.

If a sleep disturbance is persistent and regularly disrupts sleep, causing distress or impairment in important areas of everyday life during normal waking hours, then it is usually referred to as a **sleep disorder**. This means that sleep disorders are generally considered serious disturbances to the normal sleep–wake cycle that may impact on the time, amount and/or quality of sleep.

Sleep disorders are often classified as either primary or secondary, depending on their root cause. This classification assists understanding of the symptoms and helps with the planning of treatment.

A *primary sleep disorder* is a persistent sleep disturbance that cannot be attributed to another condition, such as another sleep disorder, a mental health or medical problem, or use of a legal or illegal drug. The sleep disorder is the main, or 'primary', cause of the sleep disturbance. It occurs in its own right and cannot be explained by another condition. For example, someone may experience regular awakenings throughout their major sleep episode because they have the primary sleep disorder called insomnia that typically involves persistent difficulty falling asleep and/or staying asleep.

A *secondary sleep disorder* involves a sleep disturbance that is a by-product of or results from another condition, or use of a substance. For example, someone may experience regular awakenings whenever they sleep because of their back pain, a bladder problem, a breathing irregularity, stress, an anxiety disorder or depression. In this case, the sleep problem is 'secondary' to something else — another underlying condition. It is believed to improve with treatment of the underlying condition so the target of treatment would be the underlying secondary condition (AASM, 2014a).

When our sleep is disturbed more often than we prefer, whether because of timing, quantity, quality or some other problem, it can adversely impact on our health and wellbeing. A range of impairments to various aspects of our emotional, behavioural and cognitive functioning have been identified. Some sleep disturbances develop into a sleep disorder that is a risk factor for subsequent development of a serious physical or mental health problem. Some sleep disturbances, such as those that are breathing-related or involve seizures, can even be life threatening.

Sleep problems, disturbances and disorders are very common, affecting virtually everyone at some point in their lives. However, they are largely under-reported, under-recognised and under-diagnosed, and often left untreated. While ongoing sleep problems typically cause some degree of personal distress and interfere to some extent with an individual's behaviour and everyday functioning, virtually all of them can be successfully treated or managed.

In this topic we examine the importance of sleep in mental wellbeing. We consider some of the more common sleep disturbances, then ways of improving sleep-wake patterns that can affect mental wellbeing. We start with the effects of a sleep concern virtually all people experience at various points in time throughout the life span.

7.1 LEARNING ACTIVITY

Multiple-choice questions

1. Sleep disturbance is best described as
   - **A.** insufficient sleep quantity.
   - **B.** insufficient sleep quality.
   - **C.** insufficient sleep quantity and quality.
   - **D.** any sleep-related problem that disrupts one's normal sleep–wake cycle.
2. A sleep disorder is best described as any
   - **A.** type of sleep problem.
   - **B.** type of sleep disturbance.
   - **C.** sleep disturbance that cannot be attributed to another underlying condition.
   - **D.** persistent disturbance of an individual's typical sleep pattern that impairs their daily functioning in unwanted ways.

3. A sleep disorder is considered _____ when it is not caused by or associated with a physical or mental illness, or use of a substance.
   A. primary
   B. secondary
   C. harmless
   D. persistent
4. A sleep disorder is considered _____ when it is caused by or associated with a physical or mental illness, or use of a substance.
   A. primary
   B. secondary
   C. temporary
   D. harmless
5. Which of the following is most likely to be caused by a sleep disorder?
   A. waking up late for an important appointment because an alarm wasn't set
   B. feeling drowsy, fatigued, and lacking concentration most days at work due to insufficient sleep
   C. waking up late for an important appointment due to sleeping through an alarm that was set
   D. regular use of prescribed melatonin to assist sleep onset and improve sleep quantity and quality

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

7.2 Effects of partial sleep deprivation

Research shows that inadequate sleep is a common problem in Australia. Four in every ten Australians from all age groups report not getting enough good quality sleep often enough. The sleep experiences of numerous adolescents and shift workers illustrate the nature and extent of this issue. Our ability to function and feel well while we are awake significantly depends on whether we are getting enough total sleep and enough of each type of sleep. It also depends on whether we are sleeping at a time when our body is prepared and ready to sleep.

There are no rules on how much sleep we need but it is clear that we each need a certain amount of total sleep at different ages or stages of development to help ensure that we function at our best and maintain good health. Our major sleep episode of the day needs to be of the correct quantity and quality and occur when we are ready for sleep.

It is best that this episode occurs as one consolidated block. Fragmented sleep is not good quality sleep. We also need to have the correct amounts of the different sleep types to be considered normal sleep.

Normal sleep consists of the correct quantity and quality of both NREM and REM sleep. As humans we are capable of adapting in ways that enables us to survive on less sleep than we actually need. However, when we aren't getting enough sleep, it is important to consider how well our bodies and our minds are functioning and the impact on our quality of life.

When we fail to get enough sleep or have a 'good' sleep, we experience sleep deprivation. **Sleep deprivation** is a general term used to describe a state caused by inadequate quantity or quality of sleep, either voluntarily or involuntarily. This means that sleep deprivation may occur because we choose to go without sleep, such as when we stay up all night with friends or watch a sports match. It may also occur due to reasons outside our control, such as when we must work a night shift roster, travel rapidly across multiple time zones or have a diagnosable sleep disorder.

Sleep *quantity* refers to the amount of sleep. This can be measured objectively using time. Sleep *quality* refers to how well we feel we have slept. This primarily relies on subjective self-report measures.

We tend to judge sleep quality on the basis of how rested or recovered we feel on waking and throughout the day, so psychologists often use the terms ‘restfulness’ and ‘restorative’ when describing sleep quality. Sleep quantity influences our perception of sleep quality. The number of interruptions or arousals (partial or full) during a sleep episode are also commonly considered when we judge sleep quality because these influence whether our sleep episode is consolidated or fragmented (Harvey et al., 2008).

Researchers often distinguish between partial and total sleep deprivation. **Partial sleep deprivation** involves having less sleep (either quantity or quality) than what is normally required. This may occur periodically or persistently over the short-term or long-term. For example, someone may have too little sleep for one or more days, weeks, months and so on. Most sleep disorders are associated with partial sleep deprivation that occur routinely over a prolonged period.

In contrast, **total sleep deprivation** involves not having any sleep at all over a short-term or long-term period. The person stays awake for one or more days or weeks. This usually takes place under extreme conditions, such as when people try to break records, often using stimulants to help them stay awake.

Figure 7.2 (a) Many parents of young infants experience partial sleep deprivation involving loss of both sleep quantity and quality. (b) In 1959, New York radio DJ Peter Tripp stayed awake for 201 hours (8.4 days). His record was broken in 1964 by 17-year-old American high school student Randy Gardner who stayed awake for 264 hours (11 days). However, the longest period of total sleep deprivation that is widely recognised is 18.7 days.

learnON

learnMORE | Total sleep deprivation for prolonged periods

Access learnON to read about individuals who have attempted to break the world record for going without sleep.

Psychologists have conducted research on both types of sleep deprivation, investigating the effects of partial and total deprivation across short and prolonged periods. Studies have been conducted on inadequate sleep in relation to total sleep time, NREM sleep, REM sleep or some other feature of a sleep episode or the entire sleep–wake cycle. In many cases, sleep recovery patterns following sleep loss have been investigated as this provides insights on sleep patterns, sleep functions and other aspects of sleep.

In this topic we examine the effects of partial sleep deprivation on a person's mental wellbeing, specifically affective, behavioural and cognitive functioning. These are often interrelated and overlap, so it can be difficult to draw a neat line between sleep deprivation effects in relation to such broad categories of human functioning.

You have undoubtedly experienced partial sleep deprivation. It often results in a range of uncomfortable side effects. The severity and extent of the effects depend on a range of factors, including:

- the amount of total sleep loss
- the nature of the sleep loss
- when sleep loss occurs
- why it occurs
- its frequency
- the period of time over which the sleep deprivation occurs
- the personal characteristics of the individual involved.

Generally, the effects of partial sleep deprivation tend to be minor and temporary when they occur occasionally or on a short-term basis. If sleep deprivation persists and daily sleep requirements have not been met over a period of time, a sleep debt may build.

Sleep debt is the accumulated amount of sleep loss from insufficient sleep. It is sometimes described as the difference between the amount of sleep that is needed to function at an optimal level and the amount a person actually gets. For example, a nightly sleep debt of 60 minutes between Monday and Friday would add up to a total sleep debt of 5 hours.

Sleep debt does not continue to grow to an amount that must be entirely repaid. For example, if you slept for one hour less than you needed to for 28 days, this does not mean that you need to sleep for 28 extra hours to function at an optimal level again. Generally, after a period of sleep deprivation, only some of the sleep debt needs to be recovered.

Although we do not need to fully compensate for lost hours of sleep to recover from sleep deprivation effects, there is considerable research evidence that long-term sleep deprivation of any type places the individual at a greater risk for a range of diseases and health problems, including obesity, diabetes and various cardiovascular diseases. It is also associated with an increased risk of accident and injury in people of all age groups.

There are many reasons why a person may not get enough sleep or experience poor sleep quality at any given time. However, the most common causes of partial sleep deprivation (without the presence of a sleep disorder) are lifestyle factors, including school or work-related factors. Consequently, most people are affected.

Sleep-disrupting lifestyle factors, if not changed, can also lead to the development of a sleep disorder. For example, habitually staying up late gaming, using social media or drinking caffeinated beverages before the major sleep episode can cause sleep-onset insomnia.

Sleep deprivation may not only trigger a sleep disorder, it can also be the consequence of having a sleep disorder.

7.2.1 Affective functioning

Many people tend to be easily irritated or short-tempered after they awaken from poor sleep, which you may know through personal experience. The link between sleep deprivation and mood change has been long-established by psychological research. It has been observed repeatedly by researchers among all sorts of participants under numerous sleep deprivation conditions.

Psychologists have also investigated links between sleep deprivation and other aspects of affective (emotional) functioning. Many have found that sleep deprivation can interfere with emotional regulation and reactivity. In particular, there is a strong link between inadequate sleep and our ability to control our emotions, often resulting in *amplified emotional responses*. Our emotional reactions may be too quick and more intense or exaggerated, often out of proportion to how we would ordinarily react when not sleep deprived.

Sleep loss seems to compromise our brain's ability to process emotional information, make accurate emotional perceptions and then regulate how we respond emotionally. We can find it harder to accurately judge other people's emotions and reactions, making us more prone to unwarranted emotional outbursts.

For example, some studies have found a strong link between sleep deprivation and impaired facial recognition of emotions and between sleep deprivation and reduced emotional empathy. Both can impact on our ability to identify and appreciate the emotional state of others, which are important aspects of our emotional decision making and reactions in our everyday interactions with others (Vandekerckhove & Wang, 2017).

When we haven't slept well, our emotional response threshold can be lowered, increasing our emotional reactivity and making us more likely to overreact to relatively neutral events. Sleep loss can also have a detrimental effect on our ability to sort out the unimportant from the important, and this can lead to poor judgments in relation to our emotional responses. We may overreact emotionally to trivial matters when there is actually no need to react. We may feel provoked or emotionally explode when no provocation actually exists. We may find it harder to control impulses.

For example, some studies have found that sleep loss is associated with becoming aggressive more quickly than usual and with the outward expression of aggressive impulses. We are more likely to quarrel with other people and get frustrated and overreact in traffic jams. Even a single night of inadequate sleep can have these effects.

NREM and REM sleep seem to play different roles in emotion regulation. For example, research findings suggest that emotional reactivity is more likely to occur with REM sleep deprivation (Rosales-Lagarde et al., 2012). However, the exact neural processes that account for the link between sleep and emotion regulation remain unclear. They share the complex set of brain structures called the limbic system (which includes the amygdala), so this area has been a target of research interest.

Figure 7.3 There is a strong link between inadequate sleep and our ability to control our emotions, often resulting in amplified emotional responses. Our emotional reactions may be too quick and more intense or exaggerated, often out of proportion to how we would ordinarily react when not sleep deprived.

7.2.2 Behavioural functioning

Sleep deprivation also directly influences many aspects of our behaviour. One of the immediate effects on behavioural functioning can be **sleep inertia** — a temporary period of reduced alertness and performance impairment that occurs immediately after awakening. This is a sleep-to-wake transition effect that can follow a poor night's sleep, especially if abruptly awoken.

With sleep inertia, the individual typically feels groggy, partly awake and disoriented as they transition toward full alertness. Sometimes described as a 'state of grogginess', sleep inertia is strongest at wake time, but dissipates, or decays, rapidly thereafter. It usually lasts for a few minutes but can last for much longer.

Sleep inertia can interfere with the ability to perform a wide range of behavioural and cognitive tasks, including the simplest of everyday actions. Overall, our reaction time tends to be slow and we tend to perform below our best until we reach full alertness and recover from the inertia effects. Motor and cognitive functions in particular are not at their full capacity during sleep inertia, so performing tasks that require full alertness but can compromise the safety of the individual involved and others need to be avoided. For example, road traffic and on-the-job accidents can occur during sleep inertia.

Awakening during the deep sleep of NREM stage 3 produces more sleep inertia than awakening in stage 1 or 2. Waking up during REM sleep produces sleep inertia more like awakening from deep sleep than light sleep stages. Sleep inertia may also be experienced after a short nap. In addition, it tends to last longer when a person has been sleep deprived, as compared to no deprivation (Bruck & Pisani, 1999; Santhi et al., 2013).

The predominant behavioural effect of sleep deprivation over a period of time is excessive sleepiness when awake. Excessive sleepiness most commonly occurs during the day, especially in the early morning, but it may be experienced at night; for example, by the shift worker who has their major sleep episode during the day. As well as affecting our mood, emotions and emotional reactivity, excessive sleepiness involves difficulty in maintaining an alert awake state.

Fatigue is also a common symptom. There is a persistent feeling of tiredness and lack of energy.

Figure 7.4 Sleep deprivation often results in sleep inertia — a temporary period of reduced alertness and performance impairment that occurs immediately after awakening.

Like sleep inertia, fatigue contributes to drowsiness, difficulty maintaining concentration and reduced awareness of the environment. It also reduces our efficiency and we tend to take longer to finish tasks, have slower than normal reaction times and make more mistakes. These can have significant negative effects on performance of our daily activities, especially those requiring vigilance or sustained attention.

Slower reaction time in particular is a significant impairment when driving or doing other tasks that require a quick response. You don't need to fall asleep at the wheel to be a danger. And slower reactions can affect people in all types of situations.

Sometimes lack of sleep or excessive sleepiness may result in unintended, involuntary lapses into microsleeps. A **microsleep** is a sleep episode that lasts for a few seconds. During a microsleep, a person will briefly close their eyes partially or fully, though a microsleep can also occur with eyes open. Other common characteristics are a blank expression on the face and a nodding head. The person may remain sitting or standing and they will have become less responsive to external stimuli. After a microsleep, which may last between 1–15 seconds, the person may have no recollection of what happened during their microsleep. They may not recognise that that they briefly fell asleep, but may be aware of a lapse in concentration when they wake up (Koch, 2016; Summer, 2022).

Microsleeps can affect how you function. For example, if you're listening to the teacher explaining something in class, you might miss some of the information or feel like you don't understand the point on your return to normal waking consciousness. In reality, though, you may have slept through part of the lesson and not been aware of it. More importantly, there is reduced responsiveness and people lose conscious control of their performance during a microsleep, so it is potentially life threatening if experienced when driving, operating machinery or doing something else involving some degree of danger to oneself or others.

Risk-taking behaviour is also associated with partial sleep deprivation. For example, researchers have found that pedestrian behaviour is generally riskier when sleep deprived. This effect worsens when distracted by text messaging.

In one experiment, participants were required to engage in a virtual reality simulated pedestrian environment in two conditions: sleep deprived (no sleep previous night) and normal sleep (normal sleep routine). During each condition, participants made half the road crossings while text messaging.

While sleep deprived, participants crossed significantly closer to oncoming vehicles compared with after normal sleep. While text messaging, participants crossed closer to vehicles and took longer to initiate crossings. Safety risks were amplified through combined sleep deprivation plus text messaging, leading to more virtual hits and close calls and shorter time before vehicle contact while crossing (Fobian et al., 2020).

Research studies have identified many other aspects of behaviour functioning associated with partial sleep deprivation. These include:

- impaired regulation or control of behaviour; for example, behaviour problems at home; naughtiness and disruptive behaviour at school
- higher teacher rated inattentiveness of students in class
- poorer teacher rated social functioning by school children
- school lateness and absenteeism
- lower participation rate in extracurricular activities at school
- higher injury rates and injury prone behaviours in preschool age and school age children
- reduced motor coordination, particularly eye–hand coordination
- reduced speed and accuracy.

Figure 7.5 The virtual reality simulated environment used in an experiment that investigated the effects of sleep deprivation on pedestrian safety. The results showed that pedestrian behaviour is generally riskier when sleep deprived compared with after normal sleep, moreso when distracted by text messaging.

Fobian et al. (2020). The effects of sleep deprivation and text messaging on pedestrian safety in university students. *Sleep*, *43*(9). https://doi.org/10.1093/sleep/zsaa057

7.2.3 Cognitive functioning

Research studies have long established that sleep deprivation may impair cognitive functioning. This has been found in relation to a wide range of mental abilities of varying complexity, many of which are also involved in our affective and behavioural functioning.

It is clear that even a relatively small amount of sleep deprivation can adversely affect attention. In particular, excessive sleepiness due to sleep deprivation tends to reduce alertness and our ability to stay focused on a task.

With prolonged sleep deprivation, we tend to experience lapses in sustained attention and reduced ability to divide our attention on tasks that require simultaneous attention to multiple sources of information. These skills are required for the performance of many everyday tasks such as driving a motor vehicle or cooking the family dinner, as well as numerous jobs in the workplace. Tasks often begin well, but performance tends to deteriorate as task duration increases.

The greater the sleep deprivation, the more likely it is that attention will be impaired and that errors associated with loss of attention will increase. This is even more likely when a task lacks interest or complexity. For example, when sleep deprived research participants are required to complete simple, monotonous, repetitive tasks, such as identifying bleeps and flashing lights on a computer monitor, they will inevitably make a significantly higher number of errors than when they had not been deprived of sleep. In the real world, these types of errors can occur in visual tasks similar to those involved in reading x-rays, neuroimages, baggage screening and even air traffic control.

When sleep deprived, our ability to think clearly tends to reduce, especially for tasks that require more complex thought (such as when solving maths problems). We are also more likely to think in irrational ways, and have difficulty making decisions and solving problems that require creative thinking. There is a tendency to need more time to analyse situations and respond physically to events as they happen. We tend to lose situational awareness and it is easier to overlook important details.

In children, sleep deprivation has been found to reduce verbal creativity and the ability to think abstractly. The ability to do tasks that need visual and spatial abilities (such as working with different patterns or maps) or work involving eye–hand coordination, such as drawing and writing, may also be affected. Adults experience similar impairments.

Figure 7.6 Sleep deprivation impacts on our ability to pay attention and concentrate for extended periods, especially for simple, monotonous or repetitive tasks.

There is also considerable research evidence that sleep deprivation may impair various learning and memory processes. Generally, sleep-deprived participants tend to perform worse on learning and memory tasks, compared with well-rested individuals, especially when sleep deprivation is prolonged. For example, reduced attention can adversely impact on acquisition of new information during learning. Similarly, processing information in short-term memory can be significantly impaired, making it difficult to keep details in conscious awareness for use when required.

The deterioration in cognitive functioning from prolonged partial sleep deprivation has further implications for shift workers in jobs with significant responsibility for the health and wellbeing of others. For example, medical staff in the emergency department of a hospital cannot afford to miss any changes in vital signs and must be able to think clearly and make decisions quickly if a patient's condition changes.

Likewise, it is critical that an air traffic controller, who must continually scan a monitor for small but significant changes in aircraft position, doesn't miss important information. In these types of situations, errors in judgment, as well as wrong decisions and lack of clear, logical thinking can have devastating consequences (Goel et al., 2009; Gruber et al., 2014; SHF, 2020a).

Figure 7.7 People who have to work long shifts without sleep sometimes have to grab opportunities to sleep whenever they can.

Resources

Interactivity Are you sleep-deprived? (int-8794)

7.2 LEARNING ACTIVITY 1

Review

1. Explain the meaning of sleep deprivation with reference to sleep quantity and quality.
2. a. Distinguish between sleep quantity and sleep quality.
   b. How are sleep quantity and sleep quality commonly measured?
   c. What is a possible objective measure of sleep quality?
3. How are partial and total sleep deprivation defined?
4. a. What is sleep debt?
   b. How is it calculated? Show nightly sleep debt as a formula.
   c. Use the formula to calculate total sleep debt after 5 week nights based on optimal nightly sleep of 9.25 hours and a mean nightly sleep loss of 45 minutes.
   d. How can sleep debt recovery by sleeping in during the weekend adversely impact on the sleep–wake cycle and waking at a desired or required time on Monday?
5. a. What is sleep inertia and when is it more likely to be experienced?
   b. Explain whether a person is asleep or awake when experiencing sleep inertia.
6. a. What is a microsleep and when is it more likely to occur?
   b. Explain whether a microsleep is a mini-version of a major sleep episode.
7. Prepare a table or Venn diagram in which you summarise some of the possible effects of partial sleep deprivation using the headings 'affective', 'behavioural' and 'cognitive'.
8. Twins Sara and Adam partied for two consecutive nights on the weekend of their 18th birthday and had almost no sleep throughout this period. On the morning after the last party, both attended their casual jobs. Sara is employed as a lifeguard at the local pool. Her duties include closely monitoring activity in the pool to ensure swimmers' safety, responding quickly to unsafe situations and dealing calmly with swimmers behaving in an unsafe manner. Adam works at a Tattslotto agency. His duties include scanning Tattslotto tickets, identifying when to pay out on winning tickets from beeps on the computer and explaining to customers the processes involved in filling out their tickets.
   a. Describe the possible impact for Sara and Adam of their sleep deprivation on their respective abilities to do the tasks required in their casual jobs.
   b. When Sara and Adam had their first major sleep episode, what were the likely pattern and proportions of NREM and REM sleep?
9. a. How quickly and how well do people usually recover from the effects of partial sleep deprivation?
   b. What key factor(s) would influence(s) recovery from partial sleep deprivation?

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7.2 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.29; © VCAA

Phoenix and her friends drove to a music festival in Byron Bay. They arrived the night before the festival and they all slept in Phoenix's small car for the night. Phoenix and her friends all experienced very disturbed sleep.

What behavioural effect may Phoenix and her friends experience the next day due to being partially sleep deprived?

A. an inability to sit still while listening to the music
B. a lack of interest in making conversation with each other
C. being unable to remember the names of all the bands that they were listening to
D. feeling particularly hungry and wanting to visit a food truck for burgers and chips

Question 2 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.42; © VCAA

Phil had recently bought a new pair of very expensive running shoes. He was looking forward to wearing the new shoes during an upcoming race. A few days before the race, Phil went to put on his new shoes and could not find them. He started to panic, his heart started beating quickly and sweat started to run down his face. He frantically searched his entire bedroom but could not find his new shoes anywhere.

Phil slept for only four hours on the night he lost his new running shoes. He was worried about how he would participate in the race without them. He continued to have only four hours of sleep each night leading up to the race.

Which one of the following is an example of how Phil's affective functioning could change following his sleep deprivation?

A. more short-tempered
B. poorer completion of complex tasks
C. greater difficulty undertaking simple tasks
D. reduced ability to process declarative memories

Question 3 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.29; © VCAA

Brian is a healthy 55-year-old man who is an avid sports fan. He stayed up late on both Saturday night and Sunday night to watch American baseball and got very little sleep. At work on Monday, he was partially sleep deprived.

Which of the following changes to Brian's affective and cognitive functioning are likely to occur as a result of his partial sleep deprivation?

	Affective changes	Cognitive changes
A.	increased number of errors	increased positive mood
B.	increased irritability	reduced retention of information
C.	reduced retention of information	reduced number of errors
D.	increased negative mood	shorter response times

Question 4 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.11; © VCAA

After a few days of sleep deprivation, it is most likely that a person would experience

A. no increase in the amount of sleep on the nights following the sleep deprivation.
B. an increased amount of sleep on one or more nights.
C. an increased amount of slow-wave sleep only.
D. an increased amount of REM sleep only.

Question 5 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.59; © VCAA

A researcher noticed that after 24 hours of sleep deprivation, subjects began to show periods of very slow eye closure and lapses of attention while completing a driving task on a computer simulator.

The periods of very slow eye closure were most likely an indication of

A. microsleep.
B. REM sleep.
C. stage 2 sleep.
D. rebound slow-wave sleep.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

7.3 Comparing effects of one night of full sleep deprivation vs blood-alcohol concentrations of 0.05 and 0.10

In an influential study on how sleep deprivation can change conscious experience and adversely impact on human performance, Australian psychologist Drew Dawson and neurologist Kathryn Reid (1997) identified a significant relationship between fatigue due to a moderate level of sleep deprivation, legal levels of alcohol consumption and impaired performance.

7.3.1 Cognitive effects

Dawson and Reid (1997) found that performance on a variety of cognitive tasks following 17 hours of full sleep deprivation (which they called 'sustained wakefulness') had decreased to a level that was equivalent to that of a person with a **blood-alcohol concentration (BAC)** reading of 0.05% (which is the legal driving limit in Australia and many other countries). Performance following 24 hours of sustained wakefulness was equivalent to that of someone with a BAC of 0.10%.

Dawson and Reid obtained their results using 40 participants in a within subjects experiment with counterbalancing. In the first condition, the participants were kept awake for 28 hours (from 8.00 am to 12 noon the following day). In the second condition, they were asked to consume 15 grams of alcohol every 30 minutes until their BAC reached 0.10%. An Australian standard drink contains 10 grams of alcohol (12.5 ml of pure alcohol).

In both conditions, participants were assessed on 'cognitive psychomotor performance' at half-hourly intervals. This required completion of a computer-administered test of eye–hand coordination involving an unpredictable tracking task (i.e. the correct tracking movement could not be predicted). Eye–hand coordination involves the visual processing of information to guide hand movements. As well as visual–motor integration, the eye–hand task used in the experiment required concentration (e.g. selective attention), speed, accuracy and decision making. Performance can also be influenced by other participant variables such as mood and motivation.

As shown in Figure 7.8, performance on the tasks decreased significantly in both experimental conditions. Statistical analysis led Dawson and

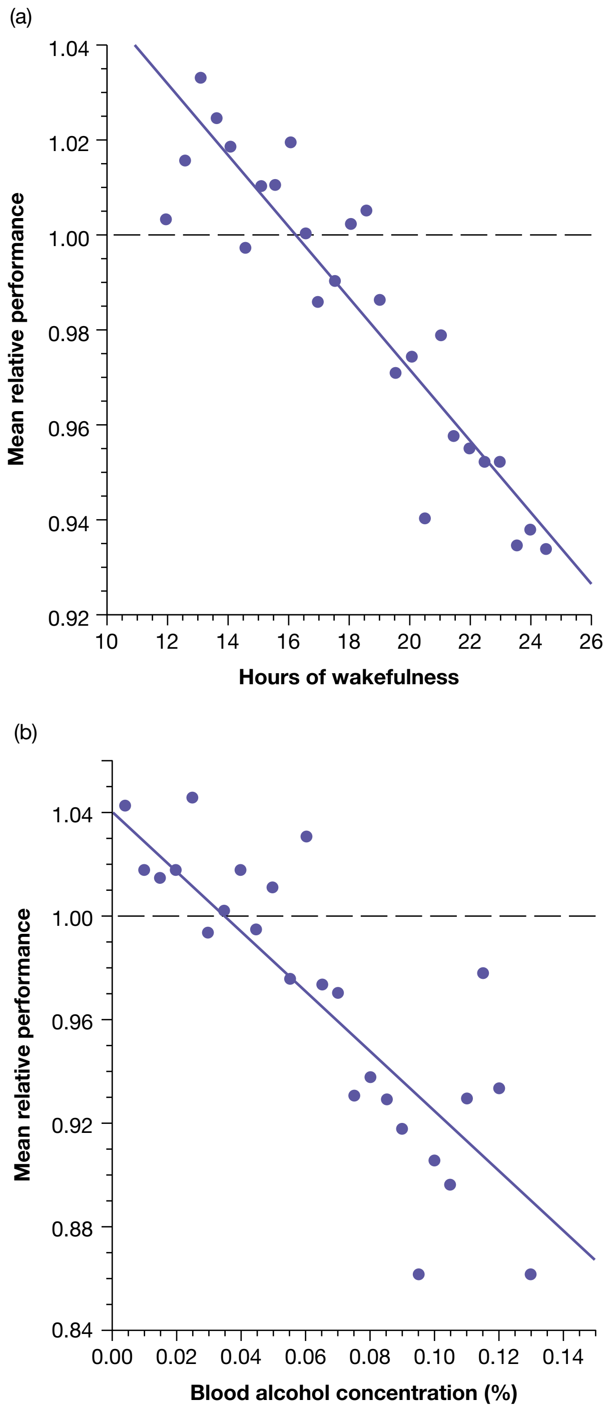

Figure 7.8 Scatterplots showing performance in the (a) wakefulness and (b) alcohol conditions in the Dawson and Reid (1997) experiment

Reid to conclude that the effects of moderate sleep deprivation (i.e. 24 hours) on performance are similar to moderate alcohol intoxication (i.e. 0.10%). Furthermore, the results showed that the performance impairment effects of moderate sleep deprivation are equivalent to or greater than the amount of alcohol that is deemed legally unacceptable when driving, working and/or operating dangerous machinery.

Although there are exceptions, similar results have since been obtained by other researchers on a variety of cognitive and concentration tasks. However, generalising the findings to real life settings from computer simulations often involving relatively simple tasks under controlled laboratory conditions requires careful consideration of a wider range of variables that also impact on human performance, including the interactions between sleep deprivation and alcohol consumption combined. Mood is one such variable that can impact on the results of BAC and sleep deprivation studies.

7.3.2 Affective effects

There is considerable research evidence that sleep deprivation and alcohol consumption, either independently or in combination, have affective effects. They influence and are influenced by our mood state.

Generally, sleep deprivation results in a negative mood state (e.g. irritability, short-tempered), which you probably know through personal experience, and alcohol consumption results in either a positive or negative mood state, depending on such variables as the amount of sleep deprivation or alcohol, the individual and the context.

Figure 7.9 Researchers have found that cognitive performance after 17 hours of full sleep deprivation is like that of a person with a BAC reading of 0.05%. Performance following 24 hours of sleep deprivation is equivalent to that of someone with a BAC reading of 0.10%.

In turn, our mood state influences our conscious experience and can either enhance or impair concentration and cognitive performance. For example, inadequate sleep can make us cranky and thereby interfere with our ability to concentrate and think clearly. This can undermine performance on a variety of simple and complex cognitive tasks.

In addition, our mood can influence alcohol consumption, such as whether or not to drink, what we drink and the rate and amount of consumption. Similarly, our mood can influence sleep deprivation; for example, whether or not we have difficulty falling or staying asleep.

In sum, sleep deprivation, alcohol, cognition, concentration and mood are intertwined and may interact in complex ways in influencing conscious experience.

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Access learnON for follow-up research on links between sleep deprivation, BAC level and cognitive function.

7.3 LEARNING ACTIVITY 1

Review

1. a. In what way are the effects of a full day's sleep deprivation on cognitive and concentration tasks like the effects of the legal BAC of 0.05%?
   b. Briefly outline a research study that provides evidence of this conclusion and refer to results preceding and up to 0.05% BAC/24 hours wakefulness.
2. How was sleep deprivation operationalised in the Dawson and Reid (1997) experiment?
3. Dawson and Reid used a within subjects experimental design with a counterbalancing procedure.
   a. Explain what counterbalancing involves in relation to the Dawson and Reid experiment and why it was used.
   b. Explain an advantage and a limitation of the within subjects design used by Dawson and Reid.

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7.3 LEARNING ACTIVITY 2

VCAA exam questions

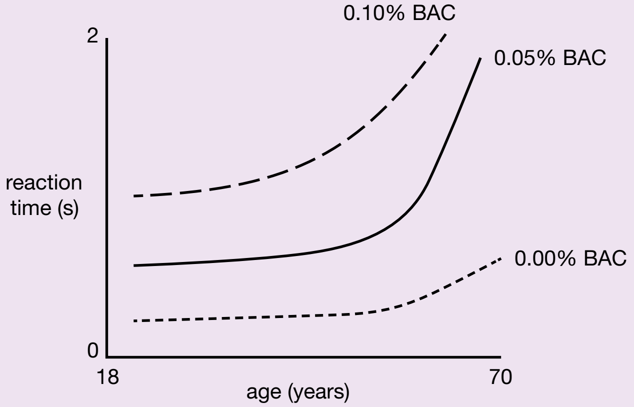
The following information relates to questions 1–5.

Parminder compared the effects of consumption of alcohol on reaction times in people at various stages of life.

His stratified sample included participants aged 18 to 70 years. In the repeated measures experiment, participants consumed one standard drink of alcohol at half-hourly intervals until they reached 0.10% blood alcohol concentration (BAC). Participants completed a series of computer-based tests for reaction times at BACs of 0.00%, 0.05% and 0.10%.

Additionally, once participants reached 0.10% BAC, Parminder asked all participants to write down on a lined piece of paper their immediate feelings, thoughts and memories, and to provide an estimate of how long they thought the tests ran for.

The graph below represents reaction time, in seconds, versus age, with the lines representing the trend of results for each level of BAC.



Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.33; © VCAA

The graph above demonstrates that

A. an altered state of consciousness is achieved.
B. the higher the BAC, the greater the reaction time.
C. an improvement in reaction times occurs as age increases.
D. reaction times decrease significantly in both the 0.05% and 0.10% BAC conditions.

Question 2 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.34; © VCAA

Which of the following includes both an independent variable and a dependent variable for Parminder's study?

	Independent variable	Dependent variable
A.	age	reaction time
B.	reaction time	BAC
C.	cognitive performance	amount of alcohol consumed
D.	amount of alcohol consumed	BAC

Question 3 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.35; © VCAA

Parminder believed when the participants were in the 0.10% BAC condition, they achieved an altered state of consciousness at the end of the study. The most likely indication of participants being in an altered state of consciousness at the end of the study would be if they

A. reported being in control of their emotions.
B. recalled their stream of thoughts during the study.
C. remembered the conversations of passers-by outside the laboratory.
D. estimated the study going for a shorter or longer time than it did.

Question 4 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.36; © VCAA

Which of the following accurately describes the two types of data Parminder was gathering during the testing period and after the last test?

A. subjective and qualitative
B. self-report and qualitative
C. objective and quantitative
D. quantitative and qualitative

Question 5 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.37; © VCAA

In a second study, not involving alcohol, with different participants, Parminder examined the effects on reaction time of being awake for 24 hours. The results from Parminder's second study were likely similar to which one of the following results from his first study?

A. the 0.10% BAC condition, sleep affected
B. the 0.05% BAC condition, mood affected
C. the 0.10% BAC condition, cognition affected
D. the 0.05% BAC condition, concentration affected

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

7.3 LEARNING ACTIVITY 3

Analysis and evaluation of research on sleep deprivation, alcohol consumption and performance

Consider Dawson & Reid's (1997) experiment and answer the following questions.

1. Formulate a possible research hypothesis for the experiment.
2. Identify the independent and dependent variables relevant to sleep deprivation, alcohol and at least one of the cognitive or concentration tasks.
3. What is another term for a within subjects experiment?

4. Briefly describe the experimental conditions.
5. What conclusion(s) was drawn by the researchers on the basis of the results obtained?
6. What is a limitation of this particular experiment?
7. Comment on the generalisability of the results from the lab setting to real life.

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7.4 Circadian rhythm sleep disorders

Under normal conditions, our internally programmed circadian sleep–wake cycle and the sleep–wake schedule we maintain are closely aligned. This is essential to our ability to keep sleep and wakefulness in-sync with our environment and to undertake our daily activities as best we can. The importance of synchronisation becomes apparent when our sleep–wake cycle and sleep–wake schedule get out of phase, or out of sync.

Circadian rhythm sleep disorders (also called *circadian rhythm sleep–wake disorders*) are a group of sleep disorders involving sleep disturbance that is primarily due to a mismatch between an individual's sleep–wake pattern and the pattern that is desired or required. The disturbance may be caused by:

- a naturally occurring change or a malfunction of biological mechanisms or processes regulating the sleep–wake cycle
- a mismatch between an individual's sleep–wake cycle and the day–night cycle of their physical environment
- a mismatch between an individual's sleep–wake cycle and the sleep–wake schedule required by their school, work or social schedule.

Circadian rhythm sleep disorders essentially involve a problem with the timing of the sleep and wake states. The individual cannot sleep when sleep is desired, needed, or expected. As a result of sleep episodes occurring at the least preferable or inappropriate times, the corresponding wake periods may also occur at undesired times. Therefore, the individual usually complains of insomnia, excessive sleepiness or both. For most circadian rhythm phase disorders, once sleep is initiated, the sleep episode will tend to have its natural duration, with NREM–REM sleep cycles occurring as they normally do (AASM, 2014a; Pacheco, 2022b).

In this section, we examine the three most common types of circadian rhythm sleep disorders — Delayed Sleep Phase Syndrome (DSPS), Advanced Sleep Phase Disorder (ASPD) and Shift work disorder.

Figure 7.10 Circadian rhythm sleep disorders include the delayed sleep–wake cycle in adolescence, the advanced sleep–wake cycle shift in older age and disruption to the cycle due to working overnight or rotating shifts.

7.4.1 Delayed Sleep Phase Syndrome (DSPS)

If you stay up late most nights because you can't get to sleep at a reasonable time, then struggle to wake up and get out of bed in the morning to get to school or work on time, you may be experiencing this sleep pattern.

Delayed Sleep Phase Syndrome (DSPS), also called *Delayed Sleep Phase Disorder*, is a condition in which the major sleep episode is delayed in relation to the desired sleep time or what is considered a conventional time. There is a natural tendency to go to sleep later and therefore wake up later than what is normal according to 'society's clock'. Onset of the entire sleep–wake cycle is significantly delayed, often by 2 or 3 hours and in some cases much longer. For example, if the major sleep episode has shifted from 11 pm–7 am to 3 am–11 am, then there is a four-hour phase delay.

Three prominent symptoms people with DSPS tend to experience are sleep-onset insomnia, difficulty awakening at the desired or necessary time, and excessive sleepiness.

Sleep-onset insomnia means that they will have difficulty falling asleep despite having adequate time and opportunity for sleep. If they attempt to go to sleep earlier than their natural desire for sleep onset, then they are likely to lie awake tossing and turning. This can cause anxious or stressful thoughts and therefore worsen their insomnia. In the morning, when required to wake at the desired or necessary time, they will be unable to do so spontaneously. Instead, they will awaken to the sound of an alarm or some other external stimulus with great difficulty and feel very sleepy for a considerable period of time.

When sleep is allowed to occur on the delayed schedule, it is essentially normal in quantity and quality for the person's age. It simply occurs at a later time. When allowed to wake up spontaneously after the major sleep episode, daytime functioning is normal (AASM, 2014a; ASA, 2022a).

The main problem for people with a persistent delayed sleep phase is their sleep pattern gets out of sync with the day–night cycle and other time cues in the environment. This may result in a mismatch between their school or work start time and therefore require waking up earlier than would otherwise occur naturally. In such cases, it can lead to sleepiness throughout the day and other sleep deprivation effects.

People who have a delayed sleep phase which interferes with school, work or other routine activities often compensate by napping during the day, or sleeping excessively on weekends to counterbalance sleep deprivation during the week. This can give temporary relief, but perpetuates the delayed sleep phase.

For most individuals, going to bed at a time different to what is normal for them will result in the circadian rhythm adjusting and allowing them to fall asleep and wake up as desired. For those with delayed sleep phase, even when suffering through lack of sleep, the body maintains its inclination to go to bed at the usual time, making it difficult to fall asleep even when feeling physically tired. Likewise, the body will tend to wake up at the same time, regardless of the amount of sleep, be it too little or too much (ASA, 2022a).

DSPS tends to emerge or worsen during adolescence and continue into early adulthood. Estimates of its prevalence among adolescents and young adults range from 7–15%. It affects both males and females equally.

DSPS tends to be resistant to many treatment methods. Some adolescents delay their sleep schedules for social reasons and may not have underlying abnormalities in their circadian rhythm. In such cases, their sleep–wake schedule tends to normalise in early adulthood.

DSPS is the most common of all the circadian rhythm phase disturbances. While it involves a circadian rhythm disruption or malfunction, the specific cause of this dysfunction is not entirely understood (AASM 2020a; SHC, 2021; SHF, 2021; ASA, 2022a).

7.4.2 Advanced Sleep Phase Disorder (ASPD)

Advanced Sleep Phase Disorder involves a shift in the sleep–wake cycle that is the opposite of the delayed sleep phase. As indicated by the name of the disorder, the timing of the major sleep episode is advanced so it occurs earlier.

Advanced Sleep Phase Disorder (ASPD) is a persistent disturbance of the sleep–wake cycle characterised by advance of the major sleep episode to an earlier time compared to desired or conventional sleep times. The disorder results in compelling evening sleepiness, early sleep onset, and awakening earlier than the desired or necessary times.

People with the disorder keep going to bed and waking up too early because of their difficulty or inability to remain awake or asleep until they want to. Typical sleep onset times are between 6 pm and 8 pm, and wake times are between 1 am and 3 am. These sleep onset and wake times occur despite the person's best efforts to delay sleep to later hours (AASM, 2014a).

As with Delayed Sleep Phase Syndrome, when sleep occurs on the advanced schedule, it is essentially normal in quantity and quality for the person's age. However, when the person needs to keep a conventional schedule involving a delay of their usual early sleep time, they will continue to have an early wake time. Even though they have managed to stay up later and had less sleep, they typically can't go back to sleep if they want to as they have early morning insomnia.

The overall effect is persistent sleep deprivation and daytime sleepiness. In turn, they experience significant distress and/or impairments in important areas of everyday life. The severity may worsen depending on school, work or social obligations.

Compared with a delayed sleep phase, individuals with an advanced sleep phase generally have less difficulty maintaining school, work, or social requirements since societal norms fit more easily into the sleep–wake schedule associated with ASPD (Crowley & Youngstedt, 2013).

ASPD is a rare disorder but more common among older people (about 1% of males and females in middle age or older). The circadian rhythm and sleep–wake times tend to naturally advance to some degree in older people, which may account for the increased prevalence of the advanced sleep phase in this population.

The specific reason for this change in the circadian sleep–wake cycle and its desynchronisation from the day–night cycle is not clearly understood. It has been proposed that it may be due to an age-related deterioration in the biological clock (SCN) that regulates the sleep–wake cycle, the reduction in melatonin production that is evident among older people and/or a shift in the circadian timing of melatonin secretion to 2–4 hours earlier than normal. This may be associated with decreased exposure to light in the late afternoon/early evening and increased exposure to early morning light due to early morning awakenings (Colten & Altevogt, 2006; APA, 2013; SHF, 2020b).

Treatment methods for the disorder aim to change the sleep–wake cycle to a more normal timing using melatonin and bright light visual stimulation. These are examined in section 7.4.4.

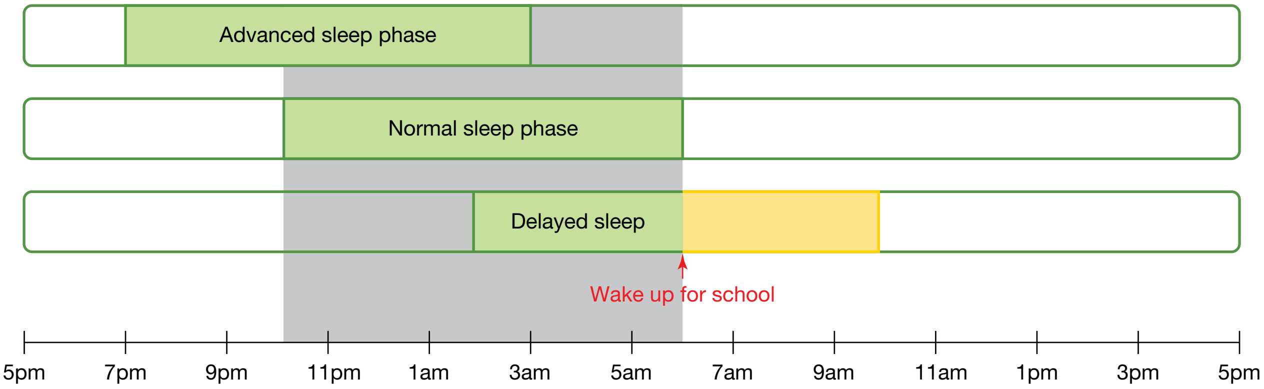

Figure 7.11 Delayed sleep phase compared with normal and advanced phases.

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learnMORE | Sleep–wake cycle shift to a delayed sleep phase during adolescence

Access learnON for an explanation of this sleep–wake cycle shift in terms of biological, psychological and social contributory factors.

7.4 LEARNING ACTIVITY 1

Review

1. Explain the meaning of the term circadian rhythm phase shift.
2. Why is a persistent sleep–wake cycle shift classified as a circadian rhythm sleep disorder?
3. An individual's major sleep episode has shifted from 11 pm–7 am to 3 am–11 am.
   a. Is this shift a phase advance or phase delay?
   b. Calculate the amount of phase shift.
4. Complete the table to compare and summarise the two types of phase shifts.

Circadian rhythm sleep disorder	Key symptoms	Effects
Advanced Sleep Phase Disorder		
Delayed Sleep Phase Syndrome		

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7.4 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.31 (adapted); © VCAA

Charini is a 15-year-old who is having trouble staying awake at school. Despite being tired, Charini finds it hard to fall asleep until at least 11 pm.

Which of the following best describes Charini's sleep problems?

	Name of sleep disorder	Characteristic
A.	sleep–wake shift	melatonin secretion peaking later in the day
B.	Advanced Sleep Phase Disorder	the inability to sleep due to melatonin reuptake
C.	sleep-onset insomnia	cortisol being released earlier in the morning to assist with waking up
D.	circadian phase disorder	melatonin secretion peaking early in the day

Question 2 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.27; © VCAA

Which one of the following is a biological cause of shifts in the sleep–wake cycle during adolescence?

A. too much REM sleep
B. too much light in the morning
C. delayed release of sleep-inducing hormones
D. later bedtime due to homework and/or part-time work

Question 3 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.19; © VCAA

The sleep–wake cycle shift during adolescence is typically caused by

A. depression and the sleep debt.
B. delayed release of the hormone adrenaline.
C. delayed release of the hormone melatonin.
D. overproduction of the hormone melatonin.

Question 4 (2 marks)

Source: VCAA 2019 Psychology, Section B, Q.5b; © VCAA

Year 12 student Steph was concerned about the possible adverse impacts that staying up late to study might have on the ability of drivers who are on their learner permit or probationary driver licence to accurately perceive visual stimuli while driving. To investigate this, Steph conducted research as described below.

Participants

Twenty people over the age of 18 from Steph's school community volunteered to participate.

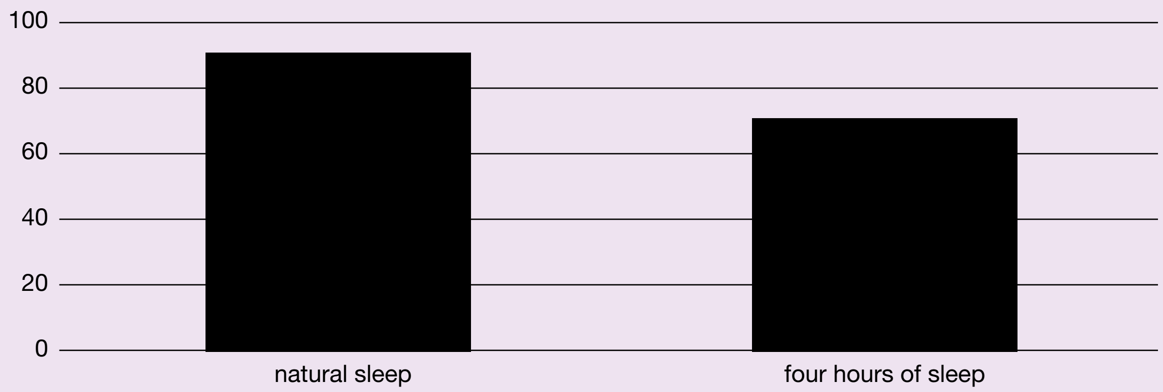
Method

Day 1 – Participants experienced one night of natural sleep and completed a computer-based visual perception test at 9 am the following morning. The test involved identifying 30 letters of varying sizes displayed for brief periods.

Day 2 – Participants were required to sleep for only four hours in total over a 24-hour period and completed a similar computer-based visual perception test at 9 am the following morning.

Results

The results were recorded and collated as the mean percentage of letters accurately identified by participants under each set of conditions.



Steph chose not to include adolescents under the age of 18 in her research because they might be experiencing a circadian phase disorder.

a. Identify and describe the likely circadian phase disorder experienced by adolescents under the age of 18. 1 mark

b. Predict the effect that the circadian phase disorder identified in **part a.** would have on the results of Steph's research if adolescents under the age of 18 were added to the sample. Justify your response. 1 mark

Question 5 (4 marks)

Source: VCAA 2014 Psychology, Section B, Q.4; © VCAA

Describe two sleep–wake shifts that could be observed in the sleep patterns of a healthy adolescent compared with those of an adult.

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7.4.3 Shift work disorder

We live in a globalised world that operates 24 hours a day, 7 days a week (‘24/7’). Shift work is a type of work schedule designed to meet the demands of a 24/7 society. The practice typically divides the 24 hour day into shifts — set periods of time of about 8 hours or so during which employees perform their duties.

In Australia, three traditional shifts are the day, afternoon and night shifts. Day shifts typically start and end during the daytime, afternoon shifts start mid-afternoon and end in the evenings, and night shifts start late in the evening and end during the daytime. These may be on a *fixed* schedule and require employees to work the same shift on a regular, ongoing basis, or they may be on a *rotating* schedule and require employees to change shifts every so often to work a mix of day and/or afternoon and/or night shifts.

Numerous jobs within our society involve shift work. For example, shift work is common for police, paramedics and fire fighters; doctors and nurses; aged care workers; pilots and airline staff; customs, border protection and immigration officers; hospitality staff; transport drivers; security staff; mail sorters; miners and cleaners. Many of these jobs involve some degree of danger to the individual involved or carry significant responsibility for the safety and wellbeing of others.

Psychologists are particularly concerned about sleep disturbances associated with shift work that takes place outside the times of the normal ‘9 to 5’ work day, especially at night when the work is scheduled during the habitual hours of sleep. We are not nocturnal beings. Our body has a sleep–wake cycle that is biologically programmed to sleep best at night and to be awake and most alert during the day and early evening. Night shift work in particular disrupts this cycle and can cause shift work disorder.

Shift work disorder is a circadian rhythm sleep disorder that occurs as a result of work shifts being regularly scheduled during the usual sleep period. Work shifts overlap with all or part of the sleep period, requiring adjustment of sleep and wake times to the work times. The two primary symptoms of Shift work disorder are insomnia when a person is trying to go to sleep, and excessive sleepiness when a person needs to be awake and alert. The disorder is also associated with a reduction in total sleep time (APA, 2013; AASM, 2020b; WHO, 2022).

People who work on permanent night shift are more likely to have the disorder or experience problems with sleep quantity and quality than people who do not do shift work. They often complain of being tired,

Figure 7.12 One in six Australian employees follow a shift work schedule in their main job.

both on and off the job. It is often not easy to sleep enough or to sleep well during the day. Many sleep less when they go to bed in the morning after a night shift. The reduction in sleep amount may be between 1–4 hours less a day than someone who doesn't work shifts. The sleep loss and circadian rhythm disturbance represent the main causes of sleepiness among shift workers. Many accumulate a sleep debt as they struggle to adjust to the disturbance while juggling work and lifestyle demands (AASM, 2014a).

Night shift workers also have a greater tendency to sleep twice during the day — a major episode in the morning after work and then a nap of an hour or so before going to work. However, they often find it difficult to fall asleep and/or maintain sleep during the day despite attempts to optimise environmental conditions for sleep. For example, during the day, there is more light, the phone rings more frequently and visitors may arrive. All these can interfere with daytime sleeping, fragmenting the major sleep episode and thereby compromising the quality of the sleep episode.

Difficulties with sleep onset or maintenance may lead to a difficulty in awakening. Overall, the major sleep episode of the night shift worker is reported by a significant number as unsatisfactory and unrefreshing. In addition, it is common for night shift workers to revert to daytime routines for a day or two during days off, which tends to make their circadian rhythm for the sleep–wake cycle unstable.

Excessive sleepiness is often experienced during the night and may impair performance because of reduced alertness. This has consequences for safety. For example, it is believed to contribute to the significant number of on-the-job accidents in the middle of the night or in the early hours of the morning, when employee performance also tends to be significantly lower. There is also a higher risk of accidents on the road, driving to and from work.

Figure 7.13 Excessive sleepiness associated with shift work is believed to contribute to the significant number of on-the-job accidents and accidents on the road, driving to and from work.

Rotating shift work schedules versus fixed schedules

Work rosters with rotating shift work schedules are associated with a higher frequency of sleep disturbances than rosters with fixed schedules. In particular, the most difficult rotating schedules to adjust to are those that change too quickly from one shift type to another because of the lack of time for the sleep–wake cycle to adjust and align with the day–night cycle of the individual's environment and other external sleep–wake cues.

Generally, if rotating shifts have to be used, the longer a person works on a particular shift, the more likely it is that their sleep–wake cycle will make at least some adjustments, and the better for the individual. A work roster for which the individual has longer periods on each shift before rotating to the next shift also tends to be better because it allows the individual to have a longer period off between one shift rotation and the next. This gives the body more time to reset its sleep–wake cycle to get in-sync with the external environment. A schedule with three-week shifts is generally considered preferable to one-week or three-day rotations.

We also tend to adapt more quickly when assigned to successively later shifts rather than to successively earlier shifts. It therefore tends to be best when the move from one shift to the next is a forward move so the new shift begins later in the day. For example, if a person has been working a day shift from 7 am to 3 pm, their next shift should be the afternoon shift, say from 3 pm until 11 pm, rather than moving backwards to an 11 pm to 7 am shift.

Because our natural sleep–wake cycle is slightly longer than 24 hours, by moving forwards through the shift rotation, the cycle is disrupted less than if a worker moved backwards through a shift rotation. Thus, workers will tend to adapt better and experience less disruption to their physiological and psychological functioning with a forward move than a backward move (Wickwire et al., 2017; SHF, 2019c; ASA, 2022b).

Relatively few people seem to fully adapt to the night shift even after many years of night shift work, in part because of resumption of full daytime activities and night time sleep during weekends and vacations. For example, a person may work the night shift for five consecutive nights, followed by two days and two nights off. During this ‘weekend’, the person may revert to a typical night time–sleep/daytime–awake schedule in order to spend time with family and friends. This causes their sleep–wake cycle to shift again, thus requiring another adjustment when the night shift work week begins. Without a constant sleep–wake schedule during the entire week, the body’s internally regulated circadian rhythm may always remain out of sync with the external environment.

Figure 7.14 The body tends to adapt more quickly when shift workers are assigned to successively later shifts.

7.4 LEARNING ACTIVITY 3

Review

1. Explain how shift work can disrupt a person’s sleep–wake cycle and make them susceptible to a circadian phase disorder.
2. What are the two main symptoms of shift work disorder?
3. Give an example of how a shift work roster may cause a change to sleep timing, quantity and quality, ensuring you explain each change.
4. Give an example of how psychological and/or social factors may contribute to the development or maintenance of a circadian phase disorder due to shift work.
5. a. What two features of a ‘shift-friendly’ roster may minimise sleep–wake cycle disruption and shift work effects?
   b. Explain the rationale underlying each desirable roster feature.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

7.4 LEARNING ACTIVITY 4

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2005 Psychology 1, Section A, Q.38; © VCAA

Sami's employment involves shift work. He finds it difficult to get adequate sleep and is often tired. As a result, he

A. often experiences hallucinations.
B. finds it difficult to complete complex tasks.
C. finds it difficult to complete simple tasks.
D. is more emotionally stable than usual.

Question 2 (1 mark)

Source: VCAA 2007 Psychology 1, Section A, Q.42; © VCAA

Lachlan works in a fruit-processing factory. His job is simply to look for fruit with marked skins and put them in a separate crate.

If he has gone without sleep for several days, he is most likely to

A. continue working efficiently as the task is not difficult.
B. sort the fruit as efficiently as usual but not listen as carefully to instructions.
C. make more mistakes than usual in checking the fruit for marked skins.
D. work faster than usual as he is concentrating more because he knows he is tired.

Question 3 (1 mark)

Source: VCAA 2012 Psychology 1, Section A, Q.4 (adapted); © VCAA

Maggie and Tom are two healthy assembly line workers who participated in a study on sleep–wake cycle effects of shift work. During the study, they had to record their respective number of hours of sleep. They submitted their sleep records to the researchers at the end of the study.

The type of data collected in Maggie's and Tom's sleep records was

A. qualitative only.
B. quantitative only.
C. counter balancing.
D. both qualitative and quantitative.

Question 4 (2 marks)

Source: VCAA 2015 Psychology, Section B, Q.6c; © VCAA

Ernie started a new job working regular night shifts in a factory. In his new job he is required to operate a machine.

Ernie persevered with his new job for six months but found it difficult to cope with working night shifts for extended periods. He finally started looking for another job as he was worried that he might eventually become involved in an accident.

State **one** physiological effect of long-term sleep deprivation and identify **one** reason why it may increase the likelihood of Ernie injuring himself or someone else at work.

Question 5 (1 mark)

Source: VCAA 2013 Psychology, Section B, Q.6; © VCAA

Bernie is a taxi driver. When his driving partner fell ill recently, Bernie took over his partner's shift, in addition to continuing his own shift. This resulted in a two-week period during which he experienced only four hours of sleep per night.

When waiting for a passenger, Bernie liked to challenge himself with the crossword puzzle in the newspaper.

Which would more likely be affected by Bernie's sleep deprivation — his ability to do the crossword puzzle or his ability to drive safely? Justify your answer.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

7.4.4 Treatment of circadian rhythm sleep disorders through bright light therapy

Interventions to treat circadian rhythm sleep disorders aim to re-set the biological clock (SCN) regulating a person's sleep–wake cycle to align it with the sleep–wake schedule they desire or require. Given that light exposure can cause our biological clock to advance or delay, thereby affecting the phase ('timing') of our sleep–wake cycle, light can be used to re-set it and gradually shift someone's circadian sleep–wake cycle to a more appropriate or conventional schedule.

Bright light therapy, also called *phototherapy*, involves timed exposure of the eyes to intense but safe amounts of light. When used for circadian rhythm sleep disorders, the aim is to shift an individual's sleep–wake cycle to a desired schedule, typically the day–night cycle of their physical environment.

The light may be sunlight or artificial. In many places, sunlight is not available at the right intensity at the required time for the right amount of time to be used for therapeutic purposes. Artificial light is therefore used as an alternative as it can affect the biological clock in the same way that sunlight does.

Various types of lamps, visors and other devices have been devised for use in bright light therapy. A *light box* is the most commonly used device. The box houses fluorescent tubes that produce light of variable intensity. As shown in Figure 7.15 below, it sits on top of a table or desk and is portable. During a treatment session, which is usually self-administered at home, the individual has to keep within a certain distance of the box, usually about 30 centimetres from it.

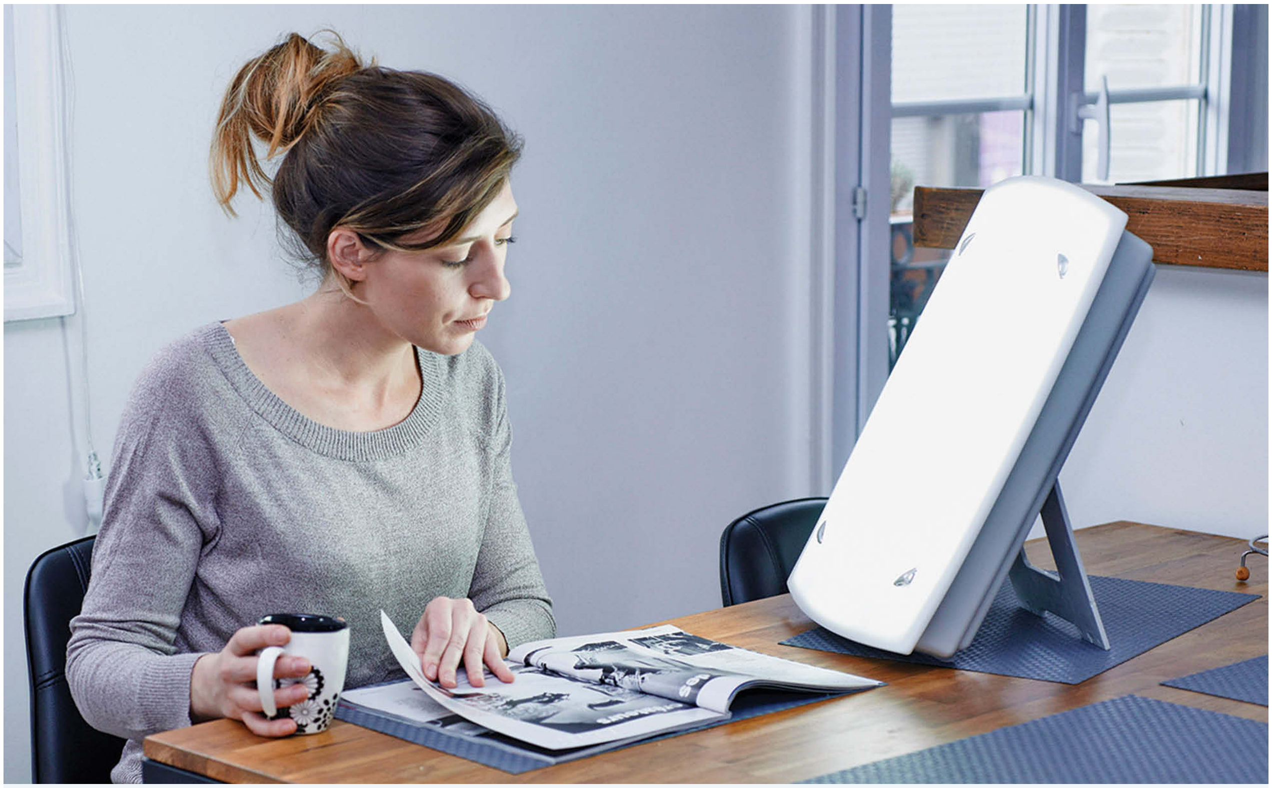

Figure 7.15 Bright light therapy involves timed exposure of the eyes to intense but safe amounts of light. LED or fluorescent blue light can be used to shift the circadian sleep-wake cycle when sunlight is not available at the right intensity at the required time for the right amount of time. Various types of lamps, visors and other devices have been devised for therapeutic use. A light box such as the one shown above is the most commonly used device. A suitable device must be capable of producing light intensity of at least 2500 lux, with 10 000 lux generally considered 'bright light' for therapeutic purposes (lux is a unit of illumination intensity as perceived by the human eye). Indoor evening room light is usually less than 100 lux and a brightly lit office is typically less than 500 lux.

Generally, the light that is emitted is brighter than indoor light but not as bright as direct sunlight. There is no need to look directly into the light. Instead, the person may simply face in the direction of the box. It is therefore possible to do activities such as texting, reading, gaming or even eating during a light exposure session. The light will be reflected from surfaces and received by the eyes for transmission to the SCN, which will then influence melatonin secretion from the pineal gland.

Bright light therapy requires a number of sessions across a number of days until the body adjusts to the new times. Exposure sessions can last from 15 minutes to two hours, once or twice a day, depending on the disorder, the required phase shift, the light intensity used, the equipment and the individual.

Generally, the three important variables are to use the light at the right time of day at the right intensity for the right amount of time. The timing of the light exposure in particular is critical. There is a peak or optimal time for light exposure and the closer to the time an individual is exposed to light, the more effective the treatment is likely to be. The peak time can be determined by core body temperature.

The sleep–wake cycle shift occurs gradually. For example, bright light exposure might be for 45 minutes each day for a week at times that are scheduled to get progressively earlier or later depending on the direction of the desired phase shift. Regular sleep patterns help to keep the biological clock set at the new time.

Bright light therapy may be used to treat each of the three circadian rhythm sleep disorders in the following ways.

Delayed Sleep Phase Syndrome: This causes people to feel sleepier much later at night than is desired and experience later sleep onset. As a result, their waking time also shifts to later in the morning. This sleep pattern can interfere with their schedule of activities for the day.

To correct a persistent delayed sleep phase, light exposure generally takes place during the early morning hours (e.g. between 6–8 am) to help advance the circadian rhythm to an earlier time (i.e. shift the phase forward) so that the person will be sleepier earlier and wake up earlier.

Advanced Sleep Phase Disorder: This causes people to feel sleepier much earlier at night than is normal, resulting in symptoms of sleepiness much earlier than desired, an early sleep onset and an awakening that is earlier than desired.

To correct a persistent advanced sleep phase, light exposure takes place early at night/in the evening to help delay the circadian rhythm to a later time (i.e. shift the phase backward) so that the person will be sleepier later and wake up later.

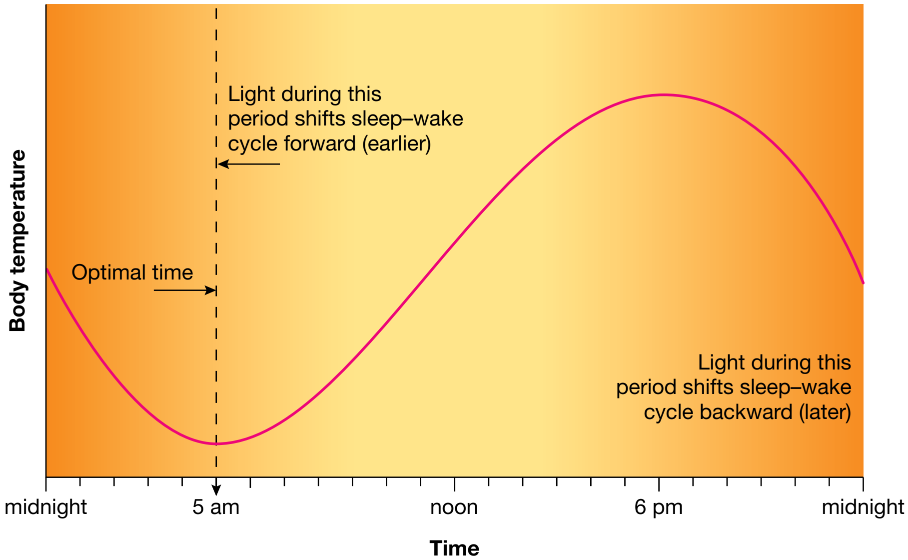

Figure 7.16 Normal circadian sleep–wake cycle with a waking time of 7 am. The timing of light exposure is crucial to bright light therapy. Optimal times for different circadian rhythm phase shifts can be determined by core body temperature (another circadian rhythm tied to the sleep–wake cycle).

Shift work sleep disorder: This occurs due to a work schedule, such as night shift, that takes place during the time when the body wants to sleep. Therefore, the person has to try to sleep when their body expects to be awake.

In general, using light treatment in the evening can help someone who regularly works nights. In such cases, it is also best to avoid daylight between the end of the shift and sleep time. Dark sunglasses or special goggles can be worn to help. Correcting a shift work sleep disorder is particularly difficult because the required work schedules, days off and social activities can alter exposure to light from day to day. The instability of the sleep–wake cycle due to frequent changes in the sleep times makes it harder to re-set the biological clock.

Bright light therapy has been found to be effective for treating the various phase disorders, at least partially for many people. Many people have reported sufficient improvement that enables them to function reasonably well on their new schedule. It does not seem to produce any major side effects when used within the proper limits for intensity and time. Minor side effects may include eye irritation, headache, nausea and dryness of skin (Dodson & Zee, 2010; AASM, 2020).

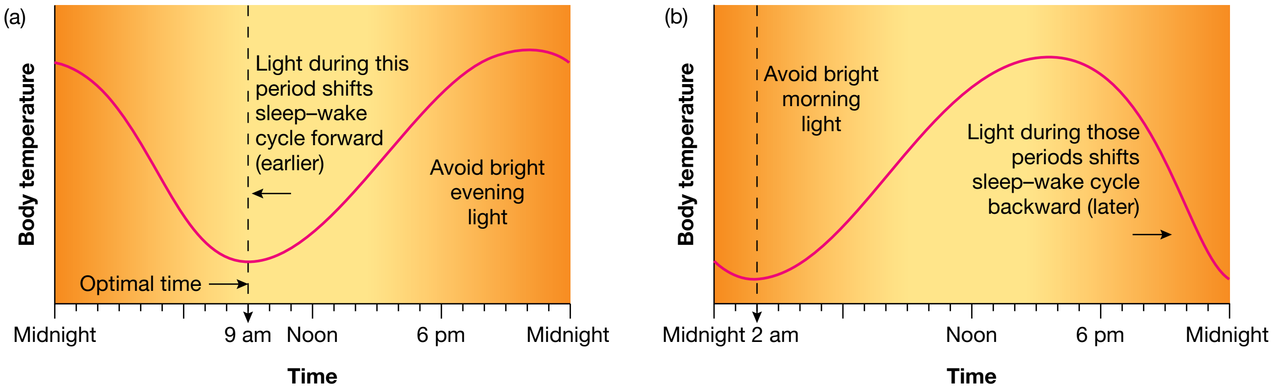

Figure 7.17 (a) Delayed circadian sleep–wake cycle with a waking time of 11 am or later (b) Advanced circadian sleep–wake cycle with a waking time of 4 am or earlier

7.4 LEARNING ACTIVITY 5

Review

1. a. What is bright light therapy?
   b. What three aspects of light usage are crucial to its effective use?
   c. How does bright light therapy influence circadian phase change?
   d. Complete the table below to summarise use of bright light therapy as a therapeutic intervention for the three circadian sleep disorders.

Circadian rhythm sleep disorder	Example of people likely to experience and when	Features of desynchronised phase shift	Timing of light exposure to re-shift sleep–wake cycle
Delayed Sleep Phase Syndrome			
Advanced Sleep Phase Disorder			
Shift work disorder			

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7.4 LEARNING ACTIVITY 6

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.34; © VCAA

Charini is a 15-year-old who is having trouble staying awake at school. Despite being tired, Charini finds it hard to fall asleep until at least 11 pm.

Charini's doctor recommends bright light therapy to address Charini's sleep issues. She provides Charini with a bright light therapy box.

Charini's doctor is likely to recommend that Charini administer the therapy

A. after lunch to feel more energised during the day.
B. in the morning to shift her ultradian rhythm backwards.
C. early in the morning to advance her circadian rhythm forward.
D. before she goes to bed to re-synchronise her sleep/wake cycle.

The following information relates to questions 2–5.

Cora, a university student, conducts an experiment in a classroom to test the effectiveness of bright light therapy on adolescent boys with a circadian phase disorder. She recruits nine 16-year-old boys from a suburban boys' school to participate in her experiment. Cora measures daytime sleepiness every morning for three days using the Karolinska Sleepiness Scale, which gives a score out of 9, with higher scores indicating greater sleepiness. On the fourth day, Cora asks the boys to wear bright light therapy glasses for two hours every morning from the time they wake up. After one week of using the bright light therapy glasses, Cora measures the adolescents' daytime sleepiness for another three days.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.36; © VCAA

Which one of the following is a possible hypothesis for this experiment?

A. Participants will not show symptoms of circadian phase disorder after wearing the bright light therapy glasses.
B. Participants will show an improvement in the symptoms of their circadian phase disorder after wearing the bright light therapy glasses.
C. Participants will show lower levels of sleepiness after wearing the bright light therapy glasses compared to before they started wearing the glasses.
D. Participants will show higher levels of sleepiness after wearing the bright light therapy glasses compared to before they started wearing the glasses.

Question 3 (1 mark)

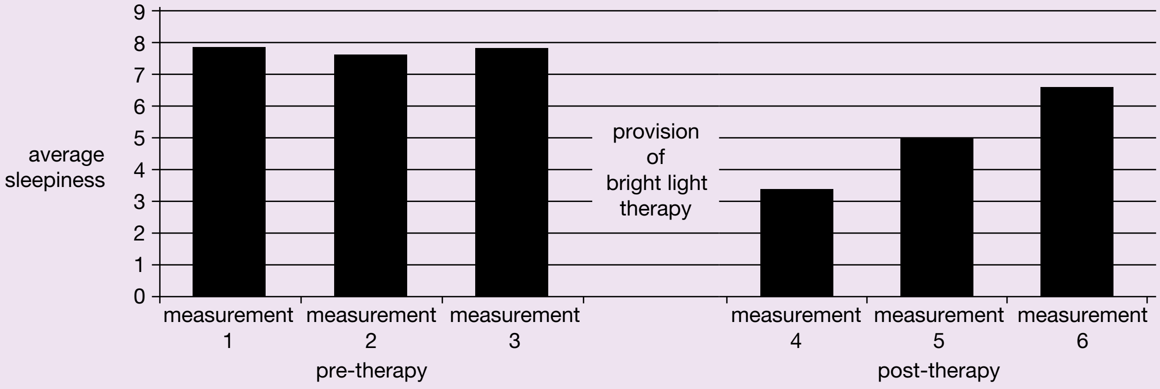
Source: VCAA 2019 Psychology, Section A, Q.37; © VCAA

Before commencing this experiment, Cora is ethically required to collect informed consent from

A. the adolescents.
B. a parent/guardian.
C. the adolescents and their teachers.
D. the adolescents and their parent/guardian.

Question 4 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.38; © VCAA



Based on these results, is a week of bright light therapy likely to be recommended for adolescents with a circadian phase disorder?

A. No, because bright light therapy had no effect on participants' levels of sleepiness.
B. Yes, because bright light therapy had an immediate effect on participants' levels of sleepiness.
C. Yes, because there is a clear pattern of improvement in the levels of sleepiness experienced by participants.
D. No, because despite an initial improvement in levels of sleepiness, participants' levels of sleepiness began to return to baseline levels.

Question 5 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.39; © VCAA

If Cora were to replicate the experiment, what could she do to improve the likelihood of being able to generalise her results?

A. Conduct the experiment in a controlled sleep clinic.
B. Use both male and female adolescents in the sample.
C. Use a control group to control for extraneous variables.
D. Include a larger sample of adolescent boys from both suburban and rural schools.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

7.5 Improving sleep hygiene and adaption to zeitgebers to improve sleep–wake patterns and mental wellbeing

7.5.1 Improving sleep hygiene

Sleep hygiene education is often used in conjunction with therapies to assist people with unwanted sleep–wake patterns or sleep disorders to change sleep-related activities that may be contributing to their sleep problems. **Sleep hygiene** involves practices that tend to improve and maintain good sleep and full daytime alertness. This includes behaviours and environmental factors that can be adjusted to help with a good night's sleep and waking feeling rested and ready to take on the day's activities.

The term *sleep hygiene* is often used interchangeably with *sleep habits* because it involves changing basic lifestyle habits that influence sleep onset, good quality sleep and alertness during the normal waking period.

Like all types of hygiene, the sleep hygiene practices used by an individual can be appropriate and support good sleep or inappropriate and inhibit good sleep. Inappropriate practices may include irregular sleep onset and wake times, stimulating and alerting activities before bedtime, and consuming stimulants too close to sleep time. These do not necessarily cause sleep disturbance in all people. For example, an irregular bedtime or wake time that produces a sleep disturbance in one person may not be important in another.

However, there is considerable research evidence that certain practices tend to be highly effective in the treatment of sleep disorders and helping people to establish and maintain a regular sleep–wake pattern

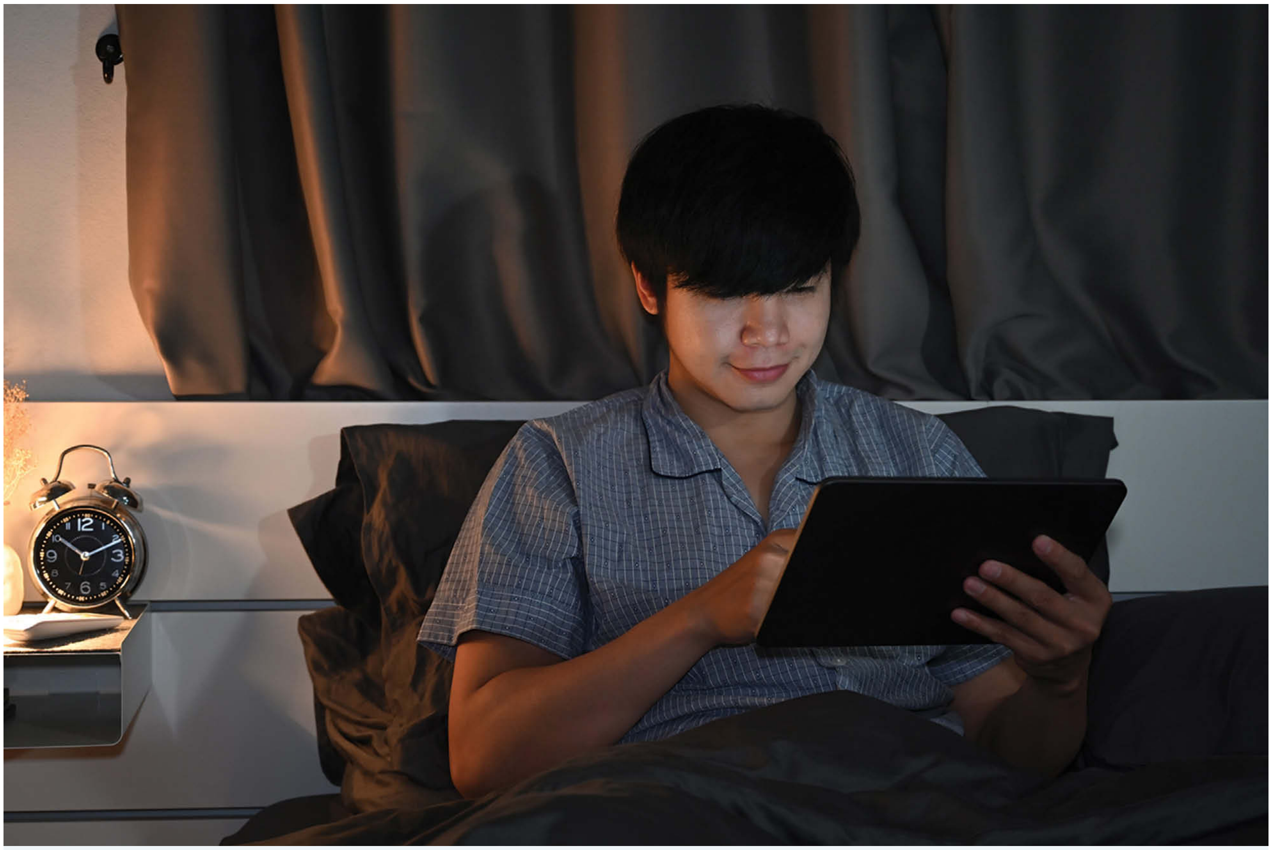


Figure 7.18 Using devices, watching television or eating in bed or just before sleep time are not considered good sleep hygiene practices.

seven days a week. Good sleep hygiene practices include the following:

- *Establish a regular relaxing sleep schedule and bedtime routine*. Maintain a regular sleep–wake schedule, particularly a regular wake-up time in the morning. Waking up late during weekends or days when you are off school or work can also disrupt the sleep–wake cycle. It is not possible to do the same thing every day, but it should be most days.
- *Associate your bed and bedroom with sleep*. It's not a good idea to use your bed to catch up on social media, watch TV, play video games, make phone calls, read or study. Such activities can not only inhibit sleep onset, but weaken the sleep and bed/bedroom association.
- *Avoid activities that are stimulating in the hour before bed.* This includes vigorous exercise, using digital devices or apps, and important discussions. These can be arousing and even inhibit melatonin (through light emission from devices). Similarly, try to avoid emotionally upsetting conversations and activities before trying to sleep. Don't dwell on, or bring worries, concerns or problems to bed.
- *When you cannot sleep get up.*
- *Avoid napping during the normal waking period.* It can disrupt the sleep–wake cycle, especially if longer than 20–30 minutes or occurs close to the major sleep episode.
- *Avoid stimulants such as caffeine, nicotine and alcohol too close to bedtime.* While alcohol can speed up sleep onset, it can disrupt the second half of the sleep episode as the body begins to metabolise the alcohol, thereby causing arousal and making it harder to stay asleep. Other stimulants can delay sleep onset.
- *Exercise can promote good sleep.* Exercise regularly for at least 20 minutes during the day, preferably more than 4–5 hours prior to bedtime if vigorous. A strenuous workout just before you go to bed will keep you awake for longer than normal because it creates arousal and should therefore be avoided. A relaxation technique such as progressive muscle relaxation or a relaxation exercise like mindfullness, meditation or yoga can be used before bed to help initiate sleep onset.
- *Food can be disruptive just before sleep.* Your digestive system also follows a biological rhythm. It is ready to digest food during the day, but not at night time. Stay away from large meals close to bedtime. Although it is important to not be hungry at bedtime, having a full stomach makes it difficult to sleep. The evening meal should be at least 2 hours before bedtime. Some people find that having a small snack at bedtime helps them to sleep better. Avoid foods that require more digestion time, such as red meat, raw vegetables, spicy foods and most take-away foods. Easy-to-digest foods include fish, poultry, cooked vegetables, soup and yoghurt.
- *Improve your sleeping environment.* Good sleep is more likely if your bedroom feels restful and comfortable. For example, make sure the room is at the right temperature. For most people this is between 17 to 19 °C. Also ensure the room is dark enough. An eye mask may be helpful if you are a shift worker and need to sleep during the day. If you can't control noise (such as barking dogs or loud neighbours), buy a pair of earplugs.
- *Ensure adequate exposure to natural light*. Exposure to natural light helps maintain a normal sleep–wake cycle.

There is no set of sleep hygiene practices that apply to every person. The basic concept of sleep hygiene — that an individual's sleep habits can be optimised for better sleep — applies to just about everyone, but what ideal sleep hygiene looks like depends on the person (Better Health Channel, 2022; SHF, 2022c; Suni, 2022c).

7.5.2 Adaptation to zeitgebers

The SCN is the biological clock that regulates the sleep–wake cycle and keeps it in-sync with the day–night cycle of the external environment (and other circadian rhythms). It is like a circadian pacemaker that adjusts its activity in response to internal and external cues to maintain synchrony as the earth rotates around its axis every 24 hours. Light is the predominant and strongest environmental stimulus used to achieve this because of its impact on melatonin. It is a zeitgeber (a German term meaning 'time giver').

Zeitgebers are environmental time cues. There are numerous zeitgebers in addition to light. These include clocks, alarms, school bells, timetables, workplace routines, eating and drinking patterns, social routines, newsfeeds and notifications, the noise of the weekly garbage truck activity, exercise routines, medications, temperature and other atmospheric conditions, and anything else that can signal time.

Zeitgebers in the external environment are used by the SCN to adjust circadian rhythms to a 24-hour day. The SCN is believed to do this on a daily basis. When the SCN adjusts or resets the sleep–wake cycle to match the environmental day-–night cycle through the influence of a zeitgeber, the circadian rhythm is said to be *entrained*, and the process is called **entrainment**. For example, all our circadian rhythms are entrained to the regular 24-hour, day–night cycle of our external environment.

In the previous topic we examined how circadian rhythms can get out of sync with the external day–night cycle and thereby adversely impact on our sleep–wake patterns and mental wellbeing. We now examine how zeitgebers can be used to make circadian rhythm adjustments to improve sleep–wake patterns and mental wellbeing.

We focus on the influence of light, temperature, and eating and drinking patterns. They have different strengths and therefore influences as individual zeitgebers, as well as a combined effect on the entrainment process.

Generally, when we need to change our sleep schedule using any of these zeitgebers, it's best to make adjustments little-by-little and over time with a maximum difference of 1–2 hours per night. This will help our body to get used to the changes so that following the new schedule is more sustainable (Suni, 2022c).

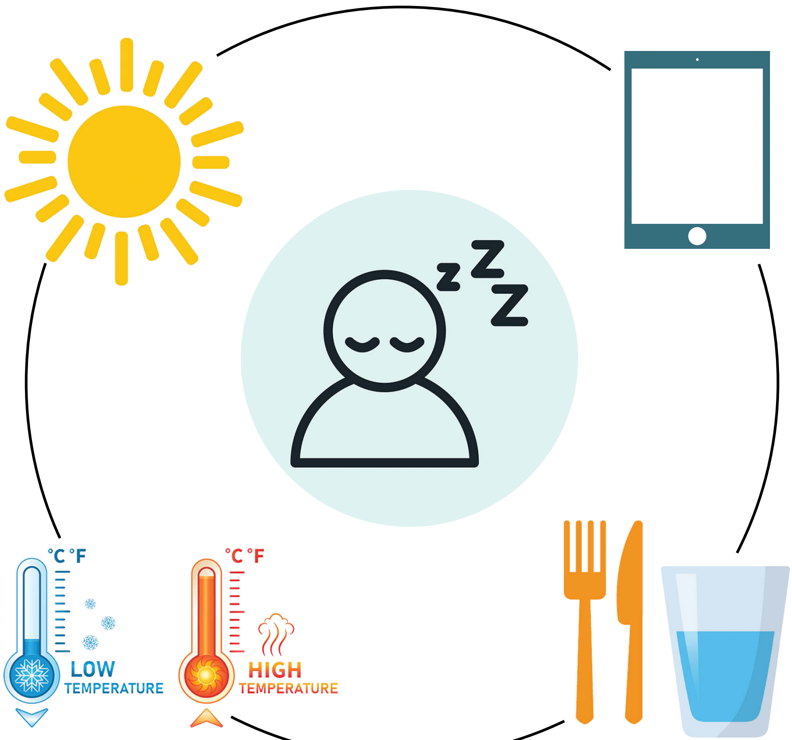


Figure 7.19 Zeitgebers are environmental time cues that can be used to improve sleep–wake patterns and consequently mental wellbeing.

Light

Light can affect sleep both directly, by making it difficult for people to fall asleep, and indirectly, by influencing the timing of SCN activity and consequently our preferred time to sleep.

Given that light exposure can cause our biological clock to advance or delay, thereby affecting the timing of our sleep–wake cycle, light can be used to help adjust or re-set the SCN and gradually shift someone's circadian sleep–wake cycle to a desired schedule.

Virtually all light can affect sleep, but not all types of light have the same impact. The type of light we see, its intensity, when we are exposed to it and how long we're exposed to it are important. The light may be natural light or artificial blue or white light. Each type can influence SCN activity and promote or suppress melatonin production in varying degrees at different times (Harvard, 2007; Peters, 2021; Suni, 2022d).

Daylight

When exposed to the natural light from the sun in the course of a typical day, our circadian sleep–wake cycle becomes closely synchronised with sunrise and sunset, keeping us awake during the day and sleeping when it's dark. The specific timing of the cycle, however, is influenced by the timing of the light exposure.

Researchers have found that exposure to daylight during the morning hours and early afternoon advances the sleep–wake cycle, pushing it forward to a slightly earlier time. Light exposure in the late afternoon and early evening has the opposite effect, delaying the sleep–wake cycle and pushing it back to a later time. In such a way, exposure to daylight can be used to shift the sleep–wake cycle and lead us to prefer earlier or later

Figure 7.20 Sunlight is the zeitgeber with the strongest influence on the sleep–wake cycle.

sleep times, especially when coordinated with other zeitgebers. The best way to do this is using sunlight outside, but direct exposure is not essential.

As a general rule, it is also best to sleep in as much darkness as possible, ideally pitch darkness. Sleeping in daylight, even at a low level (or with a light on), tends to interfere with the NREM–REM sleep cycle and adversely affects sleep quality. For example, it can cause an increase in the duration of NREM stage 1 sleep, less deep sleep and therefore more shallow sleep, and frequent arousals resulting in more fragmented sleep.

Furthermore, simply closing your eyes isn't effective for preventing light exposure. The eyelids can't block sufficient light to suppress melatonin production and prevent a sleep phase shift. The effects on the circadian rhythm can occur even with very low levels of indoor light and closed eyes. If required to sleep in daylight, wearing a close-fitting eye mask can help avoid the light effects and may even improve sleep quality (Cho et al., 2013; Tähkämö et al., 2019; Wahl et al., 2019; Suni, 2022d).

Blue light

While all types of visible light can affect circadian rhythms, blue light is considered to have the biggest impact. Most of our exposure to blue light comes from the sun. It is a portion of the visible light spectrum emitted by the sun and therefore plays an important role in the timing of our sleep–wake cycle and preparing us for a good night's sleep after the sun sets.

Blue light also helps keep us alert by suppressing the secretion of melatonin that makes us feel drowsy. While this may be helpful during the day, it becomes unhelpful at night when we're trying to sleep. Too much exposure to blue light in the evening disrupts our circadian rhythms leaving us feeling alert instead of drowsy and ready for sleep.

Blue light is not only emitted by the sun. It is also emitted by LED and fluorescent lights, as well as electronic back-lit devices such as mobile phones, tablets, computer screens, e-readers, TVs and video game consoles. When reading from an electronic device, for example, the light comes directly from the screen rather than from reflection, as happens when reading a printed source like a book or magazine.

Exposure to the low intensity blue light from these devices and household lighting in the evening affects our circadian rhythms in much the same way as more blue light from the sun. It reduces or delays the natural production of melatonin and decreases feelings of sleepiness. Using these devices in the period before the desired sleep time also keep us alert, especially if doing so actively, such as when texting, emailing, posting and gaming.

Blue light in the evening can also affect sleep quality and quantity. For example, it can prolong sleep onset, shorten total sleep time, reduce the amount of time you spend in NREM deep sleep and REM sleep, increase the frequency of night time awakenings and cause morning sleepiness, especially when awakening. Even a quick glance at an LED screen emitting blue light to check the time or a message can disturb the sleep phase and contribute to poor sleep.

Chronic exposure to blue light before the natural or desired sleep time may have more serious implications for the circadian sleep phase. In particular, it can cause a phase shift resulting in the delayed sleep syndrome. For instance, blue light associated with use of electronic devices when in bed is one of the contributory factors to the sleep–wake cycle shift experienced by about 7% of teenagers.

As with daylight, properly-timed exposure to blue light can be used to improve sleep–wake patterns and mental wellbeing. It is important to minimise the delay in melatonin production so as to not prolong sleep onset. Properly timed exposure to blue light can also help prevent a phase shift to a later schedule and its adverse effects when required to awaken before ready to do so.

In the hour or so before bed, exposure to blue light should be minimised. Dimming or reducing LED and fluorescent lighting and turning off electronic devices is advisable. The bedroom environment should be as dark as possible to promote sleep. Importantly, sleep researchers and experts are consistent with advice to not use electronic devices for at least 30–60 minutes before bedtime. Some suggest a minimum of 60 minutes without exposure to blue light. Although many phones, tablets and other devices have a 'night mode' to reduce blue light, the stimulation from screen time may still affect sleep.

If you must do something, reading an old-fashioned paperback or hardcover before bedtime will have less effect on the circadian rhythm and sleep. For example, in one study, researchers compared the biological effects of reading an e-book on a blue light emitting device with reading a printed book in the hours before bedtime. Participants who read the e-book took longer to fall asleep and had reduced evening sleepiness, reduced melatonin secretion, later timing of their circadian clock, and reduced next-morning alertness than when reading a printed book (Chang et al., 2015).

In the morning and early afternoon, blue light can have beneficial effects. The best way to get this is with morning light outside but it does not have to be direct exposure. Blue light exposure during this period suppresses melatonin secretion, making it easier to wake up and reducing daytime sleepiness. Studies that have compared effects of daytime blue light exposure to white light have found higher alertness, better concentration, more positive mood states, better daytime functioning and better sleep quality at night among the blue light participants (Breus, 2018; Wahl et al 2019; Harvard, 2020b; Dimitriu, 2021; Newsom, 2022; Pacheco, 2022c).

Figure 7.21 A range of blue light emitters that can affect circadian rhythms

on Resources

Weblink Video on how light can be used as a zeitgeber to adjust the sleep-wake cycle 8 m 35 s

Temperature

Our body's control of its core temperature (called *thermoregulation*) and sleep are closely connected. Core body temperature, which refers to the temperature of the body's internal organs and the blood, follows a 24-hour circadian rhythm linked with the sleep–wake cycle. It gradually falls during the night time sleep phase and rises during the wake phase, but stays within a narrow range.

Sleep is most likely to occur when core body temperature decreases, and much less likely to occur during the rises when the body is preparing for wakefulness. Generally, about two hours before falling asleep, our core body temperature starts to decrease under circadian control, coinciding with the secretion of melatonin.

Air temperature can therefore be used as a zeitgeber to signal and help get the body ready for sleep, but probably with a weaker strength than light. As well as being dark, the bedroom should be cool to promote sleep onset and better quality sleep. Timing for advance and delay of the sleep phase is similar to that of light.

Research evidence suggests that a temperature of around 18° celsius is best for sleep, but there is no ideal air temperature that would suit everyone. What is comfortable for one person isn't for another. Ensuring your bedroom is neither too hot nor too cold for you may help with thermoregulation and signal your body that it's time for bed and sleep. Similarly, your pyjamas and bedding should not make you too hot or too cold.

Figure 7.22 Sleep is associated with a progressive drop in core body temperature in the evening. Air temperature may be used as a zeitgeber to influence a change in core body temperature.

Other recommendations from various sleep authorities to take advantage of air temperature as a zeitgeber include taking a warm bath or shower prior to but not immediately before bedtime. This actually lowers the core body temperature because your body temperature will decrease after you leave the bath or shower as your body adapts to the cooler environment. As an added bonus, baths in particular promote feelings of relaxation that can help you fall asleep more quickly. It has also been found to promote shorter sleep onset times, longer initial sleep cycles and more NREM stage 3 deep sleep (Lok et al., 2019; Harding et al, 2020; Pacheco, 2022d).

Eating and drinking patterns

When and how we eat and drink are also zeitgebers that can be used to adjust the circadian sleep–wake cycle. It is desirable that our eating and drinking patterns and sleep and waking schedules are aligned with each other, with the light–dark cycle of the environment, and other relevant zeitgebers.

Simply changing meal times and what we eat and drink, in combination with light exposure in particular, has been found to reduce desynchronisation and shift the sleep–wake cycle in the desired direction. However, shifting one meal or drink does little or nothing. The entire eating and drinking pattern needs to be adjusted and aligned with the desired sleep–wake schedule to increase the likelihood of a corresponding circadian rhythm change. In addition, gradual adjustments to the new times over a week or more tend to be required.

The eating and drinking pattern then has to be maintained in a relatively stable way. Erratic eating and drinking patterns with highly variable times when meals and snacks are consumed that also vary from day to day have been found to have detrimental effects on the sleep–wake cycle. They can destabilise the cycle, disrupt its synchrony with other circadian rhythms and peripheral clocks, and change the timing of the sleep and wake phases. For cycle stabilisation, a well-timed eating and drinking routine is superior to a routine with occasional snacks throughout a 24-hour period (Vetter & Scheer, 2017; Wehrens et al., 2017; Lewis et al., 2020; Ruddick-Collins et al., 2020).

Food can be disruptive just before sleep. Our digestive system also follows a circadian rhythm linked to the day–night cycle. It is ready to digest food during the day, but not at night time. Although it is important to not be hungry at bedtime, it can be harder to fall asleep if we have a full stomach and our body is still digesting a big dinner.

There is also research evidence that what we drink can influence sleep, especially at certain times. For instance, it's also important to avoid caffeine in the late afternoon and evening. Caffeine is in energy drinks, coffee, tea, chocolate and cola. Caffeine makes it harder to sleep because it stimulates the central nervous system, increasing the heart rate and suppressing melatonin levels. It takes a long time for the body to break down caffeine (4–6 hours), so drinking caffeine during the afternoon in particular can affect sleep onset at night.

Alcoholic drinks can induce drowsiness and assist sleep onset, but alcohol can shorten overall sleep duration and affect sleep quality. Although alcohol can help people fall asleep, it impairs sleep quality during the second half of the night. In the second half of the night, sleep after drinking alcohol is associated with more frequent awakenings, night sweats, nightmares, headaches and is much less restful. It is also a diuretic which means that we may need to wake in the night to go to the toilet, disrupting the sleep pattern (MHF 2011; He et al., 2019; SHF, 2020c; Pacheco, 2022e; Suni, 2022c),

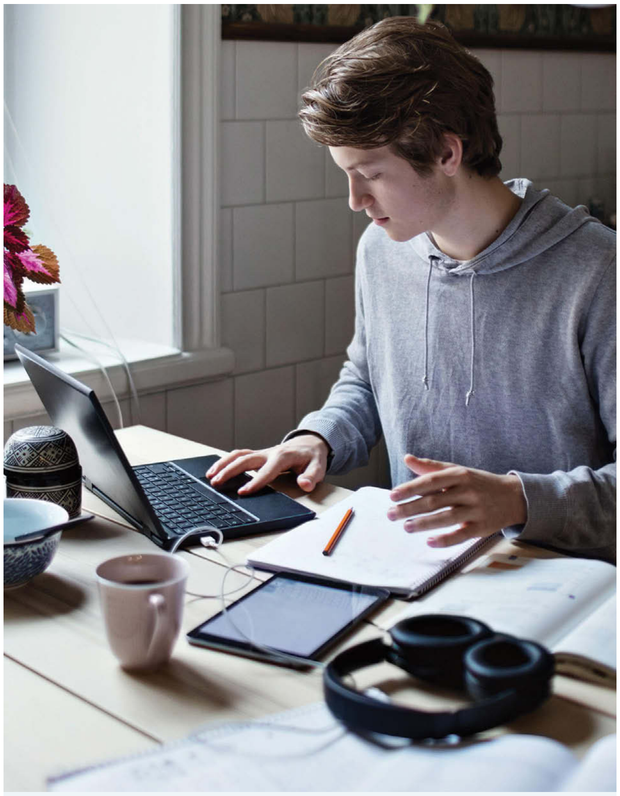


Figure 7.23 Drinking coffee while studying after school may affect sleep onset at night.

learnON

learnMORE | Pioneering research on the sleep–wake cycle in a time-free environment

Access learnON for a description of experiments in an underground bunker with no time cues and how this affects the sleep–wake cycle.

7.5 LEARNING ACTIVITY

Review

1. Explain the meaning of entrainment in relation to a circadian sleep–wake cycle.
2. Explain how sleep hygiene education could be used as part of a treatment plan for the sleep–wake cycle shift in adolescence, with reference to three practices of specific relevance to the disorder.
3. a. What is a zeitgeber?
   b. Give an example of a zeitgeber for each of the following, other than one used in the text.
      i. noise
      ii. social interaction
      iii. medication
   b. What role do zeitgebers play in the entrainment of circadian rhythms?

4. Complete the table below to summarise how different zeitgebers can be used to change a sleep–wake pattern.

Zeitgeber	Source in the environment	Example of how it may be used to adjust s/w patterns to a conventional schedule	Why this would have the desired effect
daylight			
blue light			
temperature			
eating and drinking patterns			

5. Light is the predominant and strongest zeitgeber influencing the circadian sleep–wake cycle.
   a. What three features of light usage are crucial to its effective use?
   b. Complete the table below to summarise how light could be used to change various circadian rhythm phase disorders.

Circadian rhythm phase disorder	Example	Features of desynchronised phase shift	Timing of light exposure to re-set sleep–wake cycle
Delayed Sleep Phase Syndrome	sleep–wake cycle shift in adolescence		
Advanced Sleep Phase Disorder	sleep–wake cycle shift in older adults		
Shift work disorder	a work schedule, such as night shift, takes place during the time when the body wants to sleep		

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

7.6 Review

Topic summary

- **Effects of partial sleep deprivation**
  - Affective functioning
  - Behavioural functioning
  - Cognitive functioning
- **Comparing effects of one night of full sleep deprivation vs blood-alcohol concentrations of 0.05 and 0.10**
  - Cognitive effects
  - Affective effects
- **Circadian rhythm sleep disorders**
  - Delayed Sleep Phase Syndrome (DSPS)
  - Advanced Sleep Phase Disorder (ASPD)
  - Shift work disorder
    - Rotating shift work schedules versus fixed schedules
  - Treatment of circadian rhythm sleep disorders through bright light therapy
- **Improving sleep hygiene and adaption to zeitgebers to improve sleep–wake patterns and mental wellbeing**
  - Improving sleep hygiene
  - Adaptation to zeitgebers
    - Light
      - Daylight
      - Blue light
    - Temperature
    - Eating and drinking patterns

Key terms

Advanced Sleep Phase Disorder (ASPD) p. 448
affective functioning p. 434
behavioural functioning p. 436
blood-alcohol concentration (BAC) p. 442
blue light p. 463
bright light therapy p. 455
circadian rhythm sleep disorder p. 446
cognitive functioning p. 438
daylight p. 462
Delayed Sleep Phase Syndrome (DSPS) p. 447
eating and drinking pattern p. 465
emotional reactivity p. 435
entrainment p. 462
fixed shift work schedule p. 449
microsleep p. 436
partial sleep deprivation p. 433
rotating shift work schedule p. 451
shift work disorder p. 451
sleep debt p. 434
sleep deprivation p. 432
sleep disorder p. 431
sleep disturbance p. 430
sleep hygiene p. 460
sleep inertia p. 436
sleep quality p. 432
sleep quantity p. 432
sleep–wake cycle shift p. 456
temperature (air, core body) p. 465
total sleep deprivation p. 433
zeitgeber p. 461

Note: The **References** for the entire title can be accessed in learnON and are also available as a downloadable PDF.

on Resources

Digital documents	Key terms glossary — Topic 7 (doc-38000)
	Topic summary — Topic 7 (doc-38001)
	Key diagrams PowerPoint — Topic 7 (doc-38003)
Exam question booklet	Exam question booklet — (eqb-0129)

7.6 Topic 7 test

Section A: 25 marks **Section B:** 35 marks **Total:** 60 marks

Access learnON to answer the following test questions online and receive **immediate feedback**.

Section A — Multiple-choice questions

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

Source: VCAA 2019 Psychology, Section A, Q.30; © VCAA

Phoenix and her friends drove to a music festival in Byron Bay. They arrived the night before the festival and they all slept in Phoenix's small car for the night. Phoenix and her friends all experienced very disturbed sleep.

At one point Phoenix was unable to remember the hair colour of the lead singer of her favourite band. Sleep deprivation is likely to contribute to her poor memory because

A. sleep deprivation can result in poor cognitive functioning.
B. affective functioning is compromised by sleep deprivation.
C. music festivals have a compounding effect on sleep deprivation.
D. the hallucinatory effects of sleep deprivation will cause memory problems.

Question 2

Source: VCAA 2007 Psychology 1, Section A, Q.41; © VCAA

After going without sleep for 4 days, a person is most likely to

A. find it very difficult to get to sleep.
B. suffer long-term physiological effects.
C. sleep for 24 hours or more.
D. suffer no long-term psychological effects.

Question 3

The most common behavioural effect of sleep deprivation is

A. sleeplessness.
B. restlessness.
C. excessive sleepiness.
D. emotional reactivity.

Question 4

Source: VCAA 2012 Psychology 1, Section A, Q.7; © VCAA

A researcher studied the effects of sleep deprivation on healthy adult participants. Each night, over a period of seven nights, participants were permitted to fall asleep naturally. The participants were then briefly woken by the researcher every 60 minutes. Each time they were woken, they were allowed to go straight back to sleep.

This procedure was followed for the eight hours that the participants were allowed to sleep each night of the study.

On the day **after** the seventh night of the study, the participants were required to complete a short set of simple tasks and a short set of complex tasks.

Which one of the following statements would describe the most likely findings of the study?

Participants performed

A. well on both the simple tasks and the complex tasks. They made few errors on both tasks.
B. poorly on both the simple tasks and the complex tasks. They made many errors on both tasks.
C. poorly on the simple tasks and made many errors. They performed well on the complex tasks and made few errors.
D. poorly on the complex tasks and made many errors. They performed well on the simple tasks and made few errors.

Question 5

Impairments in daily functioning associated with partial sleep deprivation are most likely to be caused by

A. proportions of REM and NREM sleep.
B. accrued sleep debt.
C. biologically induced hormones.
D. external cues in the environment.

Question 6

Shift work sleep disorder is more likely to occur if a person regularly works a roster that

A. is fixed for ongoing night shift work.
B. rotates slowly from one shift type to another.
C. rotates quickly from one shift type to another.
D. rotates every week rather than every three days.

Question 7

When the SCN adjusts the sleep–wake cycle to match the environmental day–night cycle through the influence of a zeitgeber, the circadian rhythm is said to be

A. set.
B. entrained.
C. out-of-sync.
D. biologically induced.

Question 8

Sleep inertia is most likely to be experienced during

A. awakening.
B. sleep onset.
C. REM sleep.
D. NREM sleep.

Question 9

Source: VCAA 2016, Psychology, Section A, Q.48; © VCAA

A study was conducted where subjects were selectively prevented from entering REM sleep over a period of five days. On the sixth night, they were allowed to sleep normally.

The most likely response in terms of the proportion of REM sleep on the sixth night would be

A. a decreased proportion of REM sleep.
B. an increased proportion of REM sleep.
C. an increased proportion of stage 2 sleep.
D. an increased proportion of stage 3 sleep.

Question 10

When using bright light therapy to treat Advanced Sleep Phase Disorder, light exposure will be most effective during the

A. early morning.
B. late morning.
C. early evening.
D. late evening.

Question 11

A zeitgeber is a/an

A. biological clock.
B. biological rhythm.
C. environmental time cue.
D. stimulus that induces sleep.

Question 12

Which of the following is considered a good sleep hygiene practice?

A. have a hot coffee about an hour before bedtime to adjust core body temperature and relax the body
B. a long nap during waking time is better than going to bed earlier that evening if still tired
C. ensure you have a full stomach before going to sleep so you don't wake up hungry during the night
D. when you cannot sleep, get up

Question 13

Which of the following statements about light exposure and sleep–wake patterns is correct?

A. Light can influence the timing of SCN activity and consequently our preferred time to sleep.
B. All types of light have the same impact on sleep–wake patterns.
C. Blue light is considered to have the least impact on sleep–wake patterns.
D. Long-lasting exposure to blue light before the natural or desired sleep time tends to assist sleep onset.

Question 14

Which of the following statements about sleep deprivation is correct?

A. Sleep deprivation has no psychological effects.
B. Sleep deprivation has lasting physiological effects.
C. Sleep deprivation temporarily affects performance on cognitive tasks.
D. The effects of sleep deprivation disappear only after the individual has slept for the same amount of time they were sleep deprived.

Question 15

Circadian rhythm phase disorders are best described as disturbances primarily involving

A. shift work.
B. difficulty initiating or maintaining sleep.
C. unwanted physical movements or actions during sleep.
D. a sleep pattern that is misaligned with lifestyle demands and social expectations.

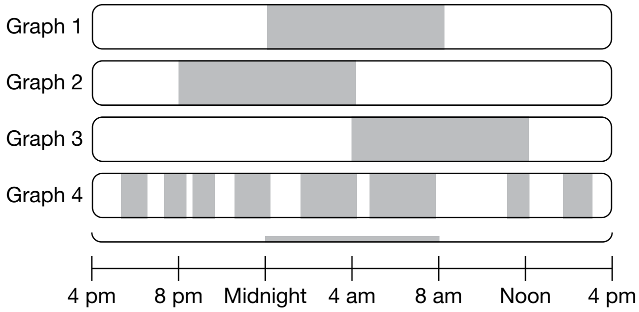
Section B — Short answer questions

Question 1 (2 marks)

The chart below shows four different sleep-wake cycles. Which of the four show:

a. delayed sleep phase disorder? 1 mark

b. advanced sleep phase disorder? 1 mark



Question 2 (2 marks)

Source: VCAA 2006, Psychology 1, Section B, Q.18; ©VCAA

Jack has not done much study for his psychology examination. He decides to stay up all night to study for two nights prior to the examination. In terms of the effects of sleep deprivation, give two reasons why this decision may negatively impact on Jack's examination performance.

Question 3 (2 marks)

Explain how one of the following zeitgebers can be adjusted to change a sleep–wake pattern in a desired way and why the change would have the desired effect.

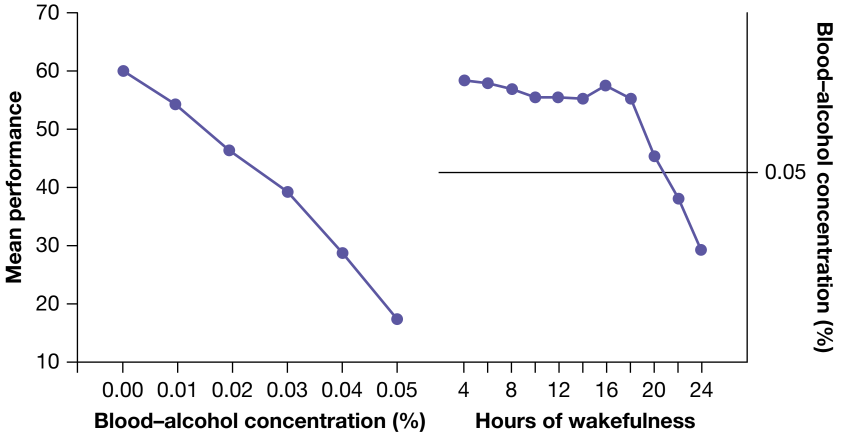
- blue light
- temperature
- eating and drinking patterns

Question 4 (2 marks)

What are two factors that can influence the speed of recovery from sleep deprivation?

Question 5 (3 marks)

a. Describe the effects on consciousness of one full night of sleep deprivation compared with the effects of legal blood-alcohol concentrations (BAC). Refer to the graph below showing results on a cognitive task requiring concentration. 2 marks



b. Suggest a reason why the experiment was designed so that the BAC of participants did not exceed 0.10%. 1 mark

Question 6 (7 marks)

a. Explain how shift work can disrupt a person's sleep–wake cycle and make them susceptible to a circadian rhythm sleep disorder. 2 marks

b. Give an example of a change to sleep timing, quantity and quality that may be caused by shift work. 3 marks

c. Give an example of how a shift worker may be able to readjust or compensate for a sleep–wake cycle shift and explain why this practice would be effective. 2 marks

Question 7 (6 marks)

Noah is approaching adolescence and even keener to assert his individuality and independence. He goes to bed and sleep at different times during the week, and these times vary even more on weekends when he can sleep in as much as wants to. Noah believes that it doesn't matter if he stays up late to study or socialise on Friday or Saturday night because he can sleep in as late as he wants the following day.

a. Explain why it is important for Noah to maintain a regular sleep–wake schedule even on weekends if he wants to limit or avoid a sleep–wake cycle shift. 2 marks

b. What three features of light usage are crucial to the effectiveness of bright light therapy? 1 mark

c. Explain how bright light therapy could be used to re-shift a circadian sleep–wake phase change during adolescence. 3 marks

Question 8 (6 marks)

An experiment to investigate treatment of insomnia with melatonin used 12-year-old children as participants, all of whom had persistently experienced sleep-onset insomnia for more than 12 months.

Each child was randomly allocated to one of two groups. The experimental group took a pill containing 5 mg of melatonin each night throughout a 4-week period. The control group was given a placebo throughout the same period of time.

In this experiment, neither the research assistants who distributed the medication nor the participants were aware of the treatment allocation — that is, which participants received the melatonin pill and which participants received the placebo.

The results showed that children treated with melatonin slept significantly better in relation to sleep quantity and quality, and had improved health during the period of treatment compared with children not treated with melatonin over the same period.

The researchers concluded that children with insomnia may be helped by melatonin treatment, at least in the short term.

The long-term effects of melatonin use for insomnia would be a target of future research.

a. Suggest a research hypothesis for the experiment that would be supported by the results obtained. 1 mark

b. Identify the independent and dependent variables. 2 marks

c. Explain whether a single- or double blind procedure was used and why it was used. 2 marks

d. Explain a potential limitation of the experiment. 1 mark

on Resources

Go to learnON to access answers to the Topic 7 test. A customisable Word version of the test can also be downloaded from the **Digital documents** tab of the Resources panel.

learnMORE | Case studies of total sleep deprivation

Research on the effects of prolonged total sleep deprivation in humans has tended to rely on convenience samples. Case studies of people who performed sleep deprivation stunts while monitored by psychologists or doctors are among the better-known investigations. These have mainly involved individuals who have deprived themselves of sleep for 10 or more consecutive days. In all cases, there were no long-lasting effects, either psychologically or physiologically. Most observed and self-reported effects of prolonged total sleep deprivation were temporary and disappeared after the individual slept uninterrupted and their sleep–wake cycle returned to normal.

One of the best-known sleep deprivation stunts is that of 17-year-old American Randy Gardner. In 1964 Gardner stayed awake for a world record of 264 consecutive hours (11 days and 11 nights) as part of a high school science project.

Unlike the previous world record holder, Gardner did not use stimulants to help him stay awake. There was a gradual onset of various impairments as the sleep loss period progressed. Overall, he became irritable and had difficulty concentrating, thinking clearly and remembering things. By the fourth day, he was experiencing hallucinations and delusions. For example, he saw fog that wasn't present, believed a street sign to be a person and imagined himself to be a famous football player. By the ninth day his thinking become fragmented, his speech was slurred and he often did not finish sentences. He was generally unsmiling and expressionless. His vision was blurred and his right eye was making involuntary sidewise movements, which caused him considerable bother.

Although Gardner experienced a range of debilitating effects in the sleep deprivation period, there were no significant lasting effects. For the first three days after the stunt, Gardner slept longer than his usual 8 hours (15 hours on the first night, 12 hours on the second night and 10.5 hours on the third night). His first night of sleep was predominantly slow wave and REM sleep. During the day, he continued his usual activities without difficulty. In all, it took Gardner about 3 days to resume his normal sleep–wake cycle. Follow-up tests 10 days after the stunt confirmed that Gardner had suffered no long-term harmful effects. However, it was apparent that he withstood prolonged total sleep deprivation better than others. This has been partly attributed to his younger age, not taking stimulants and the home setting in which the stunt was conducted (Dement, 1976).

In 1977, English woman Maureen Weston went without sleep for 18.7 days during a rocking chair marathon. This is recognised as the world record (Guinness) for the longest period without sleep. Weston was reported as having experienced hallucinations, paranoia, blurred vision, slurred speech and memory and concentration lapses, but no lasting effects. It is unclear whether she used stimulants.

Studies show that once a sleep-deprived person can catch up on a big chunk of the lost sleep and reset their sleep–wake cycle and other biological rhythms, the physiological and psychological effects tend to disappear.

Some psychologists explain the finding that there are usually few lasting effects of sleep deprivation as being due to the difficulty in ensuring that participants in sleep deprivation studies are, in fact, completely sleep deprived. *Total* sleep deprivation is difficult to ensure because after a period of prolonged sleeplessness people automatically drift into periods of microsleep over which they have no control.

Randy Gardner on a bed next to various household objects he later had to identify by memory as part of the sleep deprivation experiment he undertook as a high-school science project.

learnMORE | Follow-up research on links between sleep deprivation, BAC level and cognitive function

Australian psychologist Drew Dawson conducted further research to compare the effects of sleep deprivation and alcohol on a range of other cognitive tasks and concentration tasks.

In a repeated measures experiment conducted with colleague Nicole Lemond (1999), 22 participants aged 19–26 years were selected from a group of volunteers after screening for any type of sleep or health problems. Cigarette smokers, non-social drinkers (i.e. more than six standard alcoholic drinks per week) and anyone on medication known to interact with alcohol were also excluded.

There were three experimental conditions to which participants were randomly allocated and completed in a sequence:

Condition 1: alcohol intoxication — consume an alcoholic drink at half-hourly intervals until a BAC of 0.10% is reached; complete performance tests hourly

Condition 2: placebo — rim of drinking glasses were pre-dipped in ethanol to give the impression it contained alcohol; an equal number of participants drink the placebo or alcohol to help ensure participants remain blind to the treatment condition they are participating in

Condition 3: sustained wakefulness — deprived of sleep for one night; complete performance tests hourly

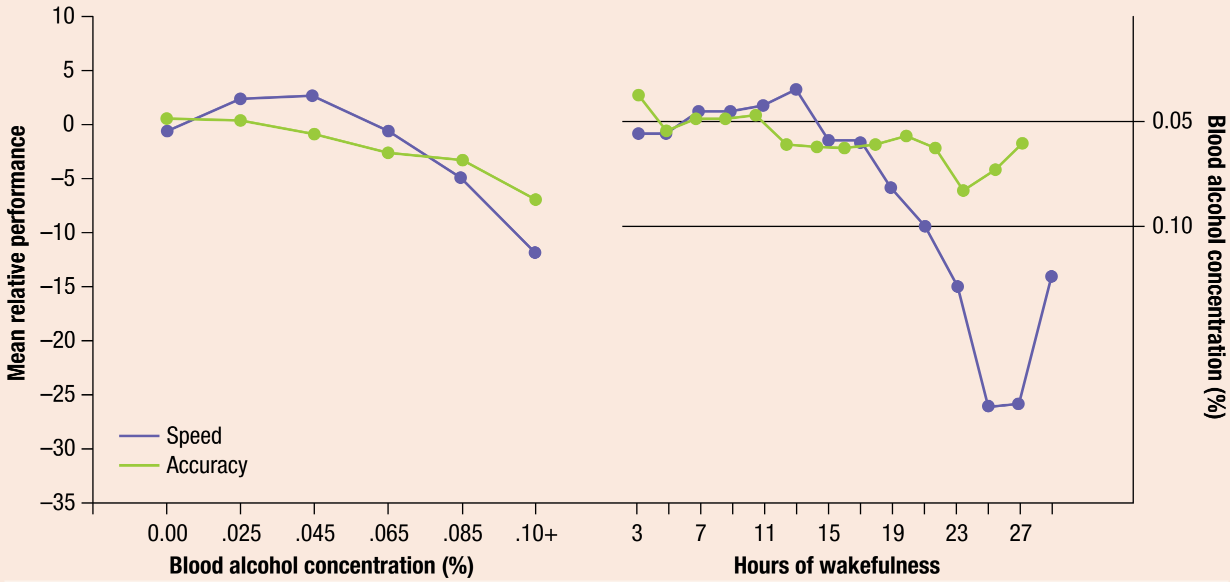
The performance tests completed by participants in each condition were all computer administered.

These included:

- *eye–hand coordination* — a tracking task using a joystick
- *concentration* — button pressing depending on a particular light being illuminated
- *sensory comparison* — identifying the correct visual stimulus from among alternatives
- *grammatical reasoning* — deciding whether logical statements are true or false.

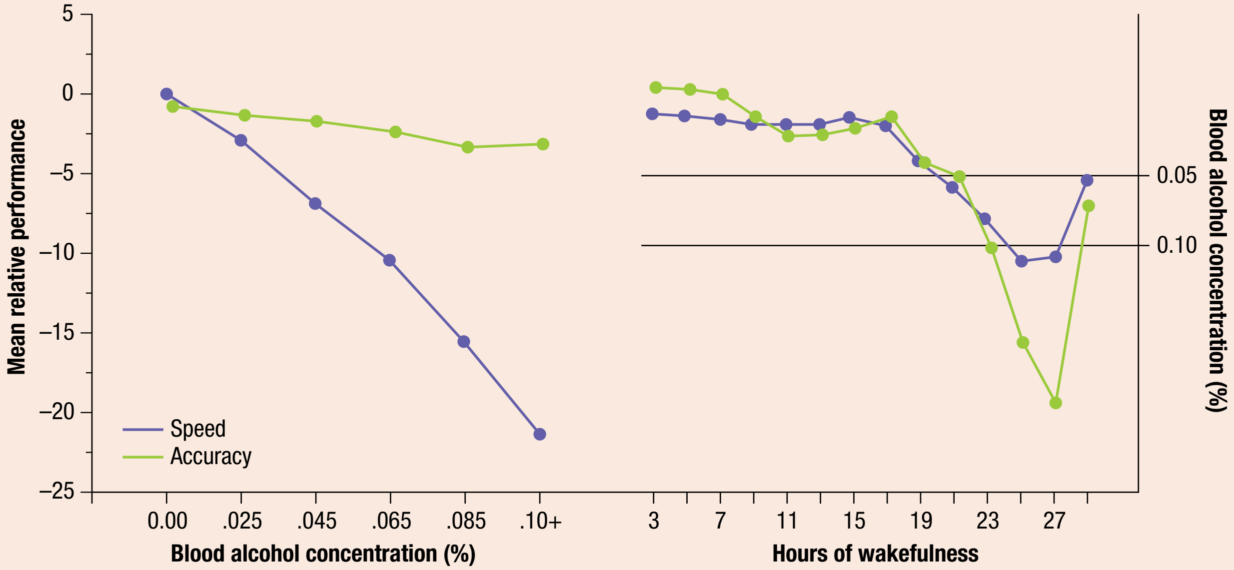
Each test session lasted for 15 minutes. Speed and accuracy were also measured and participants received no feedback on their performance to avoid knowledge of their scores affecting performance levels.

The results showed that as the blood-alcohol concentration reading or amount of sleep deprivation increased, performance on the tasks tended to decrease. The drink consumed in the placebo condition did not significantly affect performance. Results of some of the tests are shown in the figures below. Overall, the effects of one full day's sleep deprivation were similar to the effects of the legal blood-alcohol concentration of 0.05%. Note also the effects of less than one day's sleep deprivation were comparable to the effects of a BAC of less than 0.05%.



Mean performance levels for speed and accuracy tests component of grammatical reasoning in the alcohol intoxication and sustained wakefulness conditions.

Source: Lamond, N., & Dawson, D. (1999). Quantifying the performance impairment associated with fatigue. *Journal of Sleep Research, 8*, 255–262.



Mean performance levels for speed and accuracy tests of concentration in the alcohol intoxication and sustained wakefulness conditions

Source: Lamond, N., & Dawson, D. (1999). Quantifying the performance impairment associated with fatigue. *Journal of Sleep Research, 8*, 255–262.

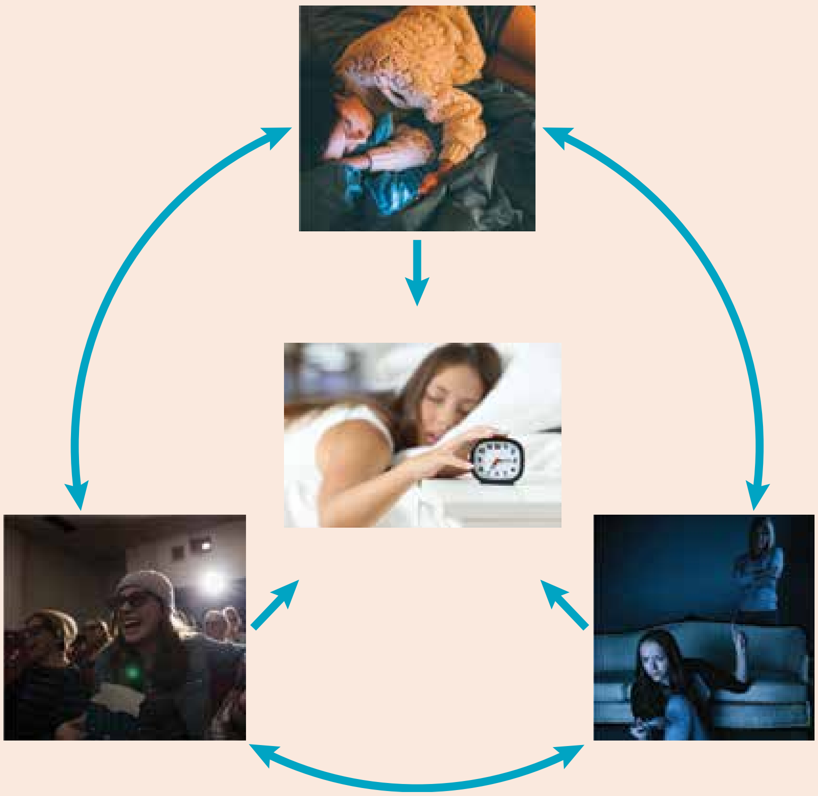
learnMORE | Sleep–wake cycle shift to a delayed sleep phase during adolescence

Numerous research studies have found that adolescents generally need about 9.25 hours of sleep a night to function at their best when awake, yet many males and females between the ages of 13 and 19 years sleep considerably less than this every night.

Studies of adolescent sleep patterns also indicate that it is a period of high sleep disturbance. The time around puberty is associated with an onset of a characteristic pattern of sleep problems. These problems are associated with the tendency to stay up longer in the evenings and include feeling sleepy at a much later time, insufficient night time sleep on weekdays and considerable difficulty waking in the morning.

Insufficient sleep can have significant effects on daytime alertness and normal daytime functioning. For adolescents at school, it can affect their ability to concentrate, think and learn. Daytime impairments can include excessive sleepiness; inattention and mentally 'drifting off' in class; problems with staying motivated to complete class work; lethargy; and difficulties with mood regulation and behaviour control.

Psychologists explain adolescent sleep patterns and problems in terms of biologically driven changes and psychological and social factors that interact to exert considerable pressure towards going to sleep at a later time than would naturally occur (Carskadon, 2002; Bruck, 2006; SHF, 2019b).



Biological, psychological and social (biopsychosocial) factors combine to influence the sleep–wake cycle during adolescence in a way that leads to the accumulation of a sleep debt.

Biological influences

Biological influences on an adolescent's sleep primarily involve the biological clock regulating the circadian sleep–wake cycle through melatonin secretions. During adolescence, there is a hormonally induced shift of the sleep–wake cycle forward by about 1 to 2 hours. More specifically, the timing of melatonin secretion that induces sleep onset peaks later in the 24-hour cycle and makes the adolescent sleepier 1 to 2 hours later. Their bodies are not ready to sleep when their real-world clock shows that it is time to sleep.

This change in the timing of the major sleep episode is known as a ***sleep–wake cycle shift*** and affects the adolescent's ability to fall asleep at the earlier times they did as a child. So a 10-year-old may have been sleepy and ready for bed at 9 pm every night but at, say, 15, doesn't feel at all sleepy at 9 pm.

The naturally occurring delay in the timing of sleep onset also means that there is a biologically driven need to sleep 1 to 2 hours longer given the changed sleep onset timing. That's not a problem if the time of getting up in the morning can be chosen. However, most adolescents do not have that luxury on most days of the week. School or work starts at a set time even if their biological clock makes them feel like it's 1 or 2 hours too early. This means that early school (or work) starts don't allow the adolescent to sleep in and get the additional sleep that would otherwise naturally occur (Bruck, 2006; Blunden, 2013).

In summary, the entire sleep–wake cycle is delayed by 1–2 hours in relation to the desired sleep and wake-up time. This type of sleep–wake cycle shift is called a *delayed sleep phase.*

Some people are more affected by melatonin delaying their evening wave of sleepiness than others. Many cope with the change in their hours of sleep but some do not. A significant problem is that nightly sleep loss due to having to wake up earlier than the body wants to can accumulate as sleep debt.

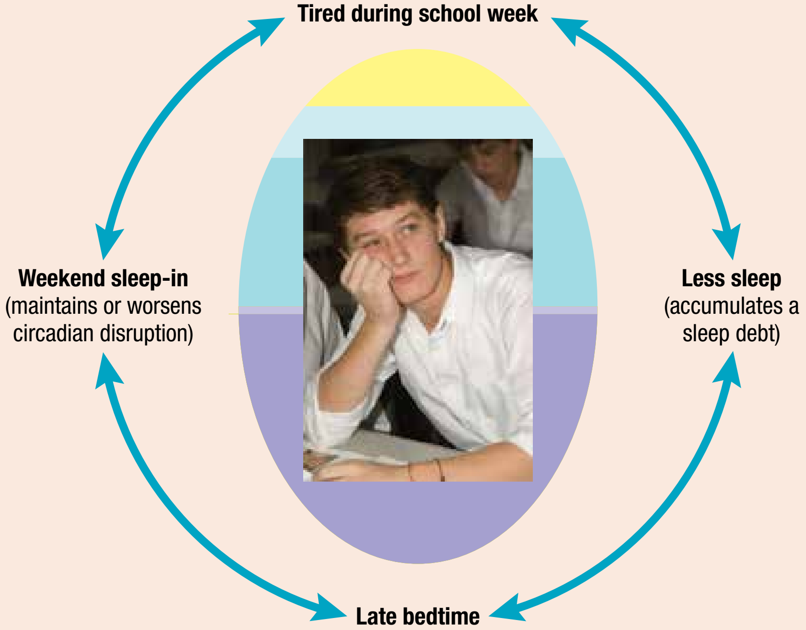
Psychological and social influences

Psychological and social factors also influence an adolescent's sleep habits, often in ways that contribute to their sleep–wake cycle shift and associated sleep problems. Adolescents typically like to exert their growing need for independence, which can include making decisions about when to go to bed or sleep. Many usually decide to go to bed or sleep later, particularly as early sleep times are associated with childhood.

Adolescents also experience increased demands on their time for socialising and increased academic or work demands compared to when they were children. Many have casual or part-time jobs. Adolescents who work long hours or who stay up late doing homework, studying, texting, catching up with others on social media, watching movies, playing on phone apps and listening to music are more likely to experience greater difficulty waking up in the morning than those who do not (Blunden, 2013).

Essentially, sleep seems to be a low priority for many adolescents. Research suggests that the 'typical' adolescent's natural time to fall asleep may be 11 pm or later. Despite this, many stay awake long after their biological clock has promoted sleep onset. This typically results in erratic sleep habits that compound sleep problems, build up an excessive sleep debt and result in sleep deprivation to an extent that functioning during waking time is significantly impaired.

If puberty is considered as marking the onset of adolescence, with its associated delay in evening sleepiness, it is relevant to question when adolescence ends. More specifically, when does the delay in sleepiness start to wear off and the adolescent feels like going to bed a bit earlier, more like the time of their parents? Research suggests that there is an abrupt change in the timing of sleep at around the age of 20 years, suggesting that this may be a biological marker of the end of adolescence (Bruck, 2006).



The cycle of activity in an adolescent student's world can perpetuate or worsen the biologically driven sleep–wake cycle shift involved a delayed sleep phase.

learnMORE | Pioneering research on the sleep–wake cycle in a time-free environment

German physiologist Jurgen Aschoff was one of the earliest researchers to conduct experiments on the sleep–wake cycle in a time-free environment. He first experimented with isolating humans in the early 1960s and coined the term zeitgeber to describe the environmental influences on sleep.

Aschoff (1965, 1967) built a special underground laboratory (like a bunker) in which participants could live in complete isolation from the external environment for an extended period. Living quarters were custom-built for this purpose. These consisted of small apartments fully equipped for long stays underground. Each apartment could house a group of participants who could also be isolated from other groups to study social factors that could influence their sleep–wake cycle.

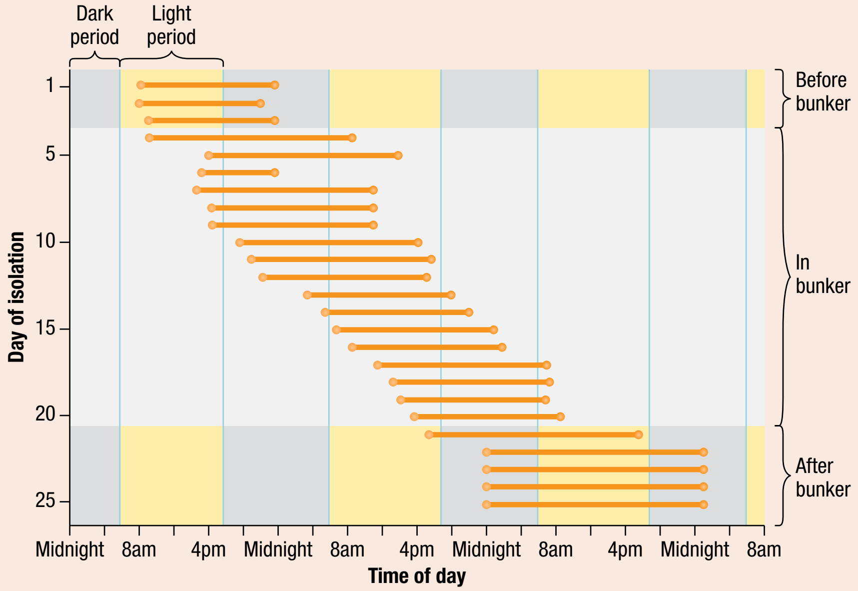
While living in the bunker, the participants had none of the environmental cues that would enable them to distinguish night from day. For example, they had no natural lighting or devices such as clocks and radios.

They could determine the periods when the lights were on or off and when they slept. They prepared their own meals and were asked to eat three meals a day and not take a nap after lunch. Other than completing some psychological tests, they were free to spend their time in whatever ways they wanted. In sum, they selected the length of their own day and night and therefore exerted control over their environmental light–dark cycle.

The results showed that participants continued to experience a sleep–wake cycle. This indicated that the cycle is produced and regulated internally and independently of external cues (called *endogenous*). However, on each successive day, participants tended to go to sleep and awaken a little later as they naturally drifted into a 25-hour or so sleep–wake cycle. Many were choosing to go to bed from 1 to 2 hours or so later every 'night'. Eventually, they were getting up at about the time the researchers outside the bunker were going to bed.

Aschoff's experiments found that our circadian sleep–wake cycle is 'free running' because it runs at a rate of the body's own devising when environmental cues are absent. However, our body maintains harmony with the external environment.

Although out of sync with the environment after their isolation, participants quickly shifted back to their normal sleep–waking cycles after they were exposed to environmental time cues such as the natural day–night cycle. More recent research has found that our natural circadian sleep–wake cycle is slightly more than 24 hours at around 24.2 hours and therefore closer to 24 hours in duration than 25 hours (Czeisler et al., 1999).



The sleep–wake cycle of a research participant who lived removed from all time cues for four weeks. The orange circles at either end of the lines indicate the times when the participant went to bed and woke up, respectively. Days 1–3 show the daily sleep period under normal day-night conditions. During days 4–20 when isolated from environmental cues, the free running circadian rhythm developed and the participant shifted to a 25-hour sleep-wake cycle. During days 21–25 when the participant was once again exposed to normal day-night conditions, the sleep-wake cycle returned to 24 hours.

Based on Hobson, A.J. (1989). *Sleep*. New York: Scientific American Library p. 33.

8 Defining mental wellbeing

TOPIC CONTENT

8.1 Overview

KEY KNOWLEDGE

- ways of considering mental wellbeing, including levels of functioning; resilience, as the ability to cope with and manage change and uncertainty; and social and emotional wellbeing (SEWB), as a multidimensional and holistic framework for wellbeing that encapsulates all elements of being (body, mind and emotions, family and kinship, community, culture, country, spirituality and ancestors) for Aboriginal and Torres Strait Islander people
- mental wellbeing as a continuum, with an individual's mental wellbeing influenced by the interaction of internal and external factors and fluctuating over time, as illustrated by variations for individuals experiencing stress, anxiety and phobia

Source: © VCAA, *VCE Psychology Study Design: 2023–2027.* p.40.

Wellbeing refers to our sense of 'wellness' or how well we feel about ourselves and our lives. The term may be used globally in relation to our overall mental and/or physical state or in relation to a specific domain or area of functioning, such as social or emotional wellbeing.

Mental wellbeing refers to our mental health and the term is sometimes used interchangeably with mental health. **Mental wellbeing** involves our state of mind, our enjoyment of life, and our ability to cope with the normal stresses of everyday life and develop to our potential.

When we are in a positive state of mental health, we are mentally healthy. We feel good about ourselves and are functioning well. We think, feel and behave in ways that enable us to cope with change and the challenges arising in the course of everyday life. We are enjoying life and have a sense of connection to others and the community in general. We are also more likely to enjoy our relationships with others, strive to fulfil our goals, benefit from opportunities, and contribute productively to society.

Mental wellbeing is also commonly described as 'more than the absence of mental illness'. But this does not mean a lack of problems, challenges or adversity. Nor does it mean we are always happy or unaffected by our experiences. In fact, difficulties in life often shape or support our development of mental wellbeing.

Not feeling sad, stressed, anxious or fatigued does not mean that we will automatically feel good about ourselves and ready to deal with any challenge in life. But when in a state of mental wellbeing, we can usually cope with and 'bounce back' when life's changes and challenges come along.

Mental wellbeing is just as important as physical wellbeing, and a vital part of overall health and wellbeing. It is a dynamic state that doesn't always stay the same. It can vary over time as circumstances change and as we move through different stages of our life. Its different components may also vary and be more or less apparent in different individuals at different times. For Aboriginal and Torres Strait Islander people in particular, there are important cultural determinants of mental wellbeing and overall being (MHF, 2016; RCVMHS, 2021; Santini et al., 2021; ReachOut, 2022a).

8.1 LEARNING ACTIVITY

Multiple-choice questions

1. Mental wellbeing may be defined as
   A. a lack of mental health problems.
   B. not having a mental illness.
   C. a state of mental health.
   D. a mental state in which we are unaffected by everyday life challenges.
2. *Source: VCAA 2014 Psychology, Section A, Q.12; ©VCAA*

   From a psychological perspective, being mentally healthy is best described as
   A. the absence of a mental illness.
   B. being popular and having lots of friends.
   C. rarely experiencing negative emotions, such as anger.
   D. using one's cognitive, emotional and social abilities effectively.
3. *Source: VCAA 2017 Psychology, Section A, Q.39; ©VCAA*

   Glen lost his job just after his third child was born. Glen felt overwhelmed by the demands of being a parent while also being unemployed. The local council had also closed the park closest to his house. Glen really missed the opportunities that the park had provided for his older children to play and for him to spend time with other fathers. Despite these challenges, Glen had strong support from his family and friends, and he was able to enjoy daily events related to being a father. He also actively looked for new employment opportunities and organised a surprise party for his own father's 70th birthday.

   Glen would be considered mentally healthy because he
   A. avoided stressful situations.
   B. was unable to focus on the needs of his family.
   C. received social and psychological support from his family and friends.
   D. worked towards goals in the face of stressors and disappointments in his life.
4. Which one of the following examples demonstrates a positive state of mental wellbeing?
   A. A person whose partner breaks up their romantic relationship when attracted to someone else becomes bitter and resentful and plots 'payback' rather than moving on with their life.
   B. A person who loses their job when their workplace goes through a restructure stops looking for another job, becomes withdrawn, takes up smoking and starts drinking excessively to deal with their stress and anxiety.
   C. A basketballer who is very disappointed when they lose their place on the team trains harder to improve their fitness and skills to make the team the next season.
   D. A person confronted by a disturbing problem constantly mulls over the problem, dwelling on negative thoughts and feelings, but does nothing to change anything.

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8.2 Ways of considering mental wellbeing

There are different ways in which mental wellbeing can be considered. These include mental wellbeing in terms of levels of functioning in everyday life, resilience to cope with and manage change and uncertainty, and the Social and Emotional Wellbeing (SEWB) for Aboriginal and Torres Strait Islander peoples' mental health and wellbeing. Mental wellbeing can also be considered in terms of variability along a continuum and as fluctuating over time due to the interactive influence of internal and external factors.

8.2.1 Levels of functioning

In relation to mental wellbeing, the term **functioning** generally refers to how well an individual independently performs or 'functions' in their environment. It is most evident in observable behaviour when meeting the ordinary demands of everyday life. This includes underlying cognitions and emotions as they are considered critical to daily functioning.

A person's functioning may vary in a number of ways. It is commonly described as varying in level or degree and can be represented on a continuum. As shown in Figure 8.1, functioning may range from a high level (e.g. superior functioning, functioning competently or very well) at one extreme through a moderate level of functioning (e.g. which may be due to a temporary mental health problem) to a low level (e.g. poor or impaired functioning) at the other extreme.

Level of functioning tends to correspond with how well or adaptively a person is meeting the challenges of living across a range of areas such as the following:

- *daily living skills* e.g. participation in self-care and independent living activities such as personal hygiene, dressing, eating, remembering to take any prescribed medications, fulfilling household responsibilities, management of personal resources, ability to access private and public transportation and travel/commute safely
- *interpersonal relationships* e.g. ability to interact with and get along with other people (such as family, friends, peers/colleagues, neighbours, unknown people in the community)
- *emotions* e.g. self-regulation of a range of emotions, dealing with positive and negative emotions, keeping effects of daily worries, hassles and other stressors under control
- *cognitive skills* e.g. learning and applying knowledge, understanding and communicating, logical and clear thinking, planning and decision-making
- *school and work/occupational settings* e.g. productive and achieving goals
- *leisure/recreational activities* e.g. participation in extracurricular activities at school, hobbies/interests/structured or unstructured activities in 'free' time outside school/work, engagement in sports or community activities.

Mentally healthy people typically have a high level of functioning in most of the above areas. They tend to:

- be able to cope effectively with living independently in everyday life and in meeting the challenges of living
- actively engage and cooperate with others, develop and maintain warm and trusting relationships
- get involved in a range of activities inside and outside of the home
- have a balance of work, rest and recreation in their life
- have a desire for activity
- be positive, flexible and productive in how they approach challenges and what they do
- be emotionally stable and deal with temporary difficulties and everyday worries and stressors effectively
- see themselves as developing into better people
- have a direction in life
- feel they belong to and accepted by their communities
- seek to develop, belong and contribute to society in meaningful ways
- have a degree of self-determination.

The behaviour of someone with a high level of functioning is primarily adaptive. *Adaptive behaviour* is any behaviour that enables the individual to adjust to the environment appropriately and effectively. Basically, the individual is able to 'adapt' to the demands of daily living in age-appropriate ways and

Figure 8.1 An example of a continuum of functioning. Mental wellbeing is associated with a high level of overall functioning, and a high level of functioning across a range of the domains or areas of functioning.

do so relatively independently in a variety of settings.

In contrast, *maladaptive behaviour* is any behaviour that is detrimental, counterproductive or otherwise interferes with the individual's ability to successfully adjust to the environment and fulfil their typical roles in society. Maladaptive behaviour is sometimes called *dysfunctional* behaviour because it disrupts or impairs everyday functioning. There is a reduced ability to do the things one normally does each day.

Most people have engaged in maladaptive behaviour at some time in their life. An occasional incident is not uncommon. However, persistent maladaptive behaviour is commonly associated with a low level of overall functioning.

Similarly, mental illnesses or disorders typically involve a significant impairment in one or more areas of everyday functioning and are therefore associated with a low level of functioning in one or more areas. For example, schizophrenia and depression often significantly affect a person's ability in each of the areas described above, such as socially connecting with others, attending to self-care and daily living tasks, and engaging in school, work and leisure activities.

- Intellectual wellbeing — the ability to learn, grow from experience and utilise intellectual capabilities
- Physical wellbeing — the ability to carry out daily tasks with vigour
- Emotional wellbeing — the ability to control emotions and express them appropriately and comfortably
- Spiritual wellbeing — a guiding sense of meaning or value in life
- Social wellbeing — the ability to have satisfying relationships and interactions with others
- Vocational wellbeing — having interests, employment, volunteer work or other activities that provide personal satisfaction and enrichment in daily life

Figure 8.2 The Australian Psychological Society (2015) has described six different but inter-related 'wellness' domains, each of which contributes to a person's overall sense of mental wellbeing.

on Resources

Teacher digital document World Health Organization questionnaire designed to measure levels of functioning

8.2.2 Resilience

As described previously, mental wellbeing, or being mentally healthy, does not mean we do not go through bad times or fail to experience disappointment, sadness, anger, fear, anxiety or other unsettling reactions to daily hassles, stressors and other difficulties or disturbing events. Instead, mental wellbeing is linked to our resistance to adversity and how well we cope with difficulties. This involves resilience.

Resilience is the ability to successfully cope with and manage change and uncertainty. It means 'bouncing back' from adversity or difficult experiences — such as family and relationship problems, school or workplace stressors, rejections, failures, threats or even tragedy — and restoring positive functioning.

Some people have more or less resilience than others. In particular, people who are mentally healthy are commonly described as 'resilient' because they tend to have a high level of resilience, whereas people who are mentally unwell tend to have a low level of resilience and may therefore be described as 'not resilient'.

Resilience is one reason why people perceive and respond or adapt differently to change and uncertainty arising from life's challenges. For example, a mentally healthy person tends to be 'resilient' and therefore more likely to perceive a major life stressor as an opportunity to excel because they have the resources to cope, whereas a mentally unwell person tends to be 'not resilient' and therefore more likely to feel significantly challenged or even overwhelmed, possibly to the point of breakdown.

Researchers have found that resilience is not an unusual or extraordinary characteristic. Many people demonstrate resilience when faced with significant adversity. For example, resilience is apparent in the numerous Australians who rebuild their lives and bounce back after devastating natural disasters such as floods and bushfires.

Our resilience is the product of a range of personal skills, especially our coping strategies and how we view and engage with the world. It is also significantly influenced by external factors, particularly the availability and quality of social resources (APA, 2022).

Psychologists have studied resilience in adolescents and adults when dealing with life stressors. On the basis of this research, they have identified a number of characteristics that enable someone to 'bounce back' and get back on track when faced with adversity.

These characteristics include:

- a strong belief in their abilities to accomplish tasks and succeed (i.e. high self-efficacy)
- high self-esteem
- approaching adversity with a sense of optimism, opportunity and hope
- being adaptable and flexible
- being organised
- having problem-solving skills
- having the ability to make realistic plans and carry them out.

Resilient people also tend to have good social support systems, or know other people they can talk to or get help from in difficult times. In particular, they tend to have caring and supportive relationships within and outside the family. Relationships that create love and trust, provide appropriate role models for problem solving, and offer encouragement and reassurance, help bolster a person's resilience.

Figure 8.3 Refugees and asylum seekers tend to have a high level of resilience which helps them to adapt and recover from the adversity they experience in seeking a new life in a new country.

Having a lot of resilience does not mean that a person never experiences difficulty or distress or is always untroubled or endlessly happy. Every single person experiences adversity and other challenges to varying degrees in their lives. Through resilience, we interpret, respond and either overcome or adapt to that adversity.

Importantly, resilience is not a 'fixed' ability that cannot be developed or enhanced. It is possible to learn knowledge and skills that can promote or build resilience (APA, 2020; Health Direct, 2021).

8.2 LEARNING ACTIVITY 1

Multiple-choice questions

1. Level of functioning generally refers to
   - **A.** observable behaviour.
   - **B.** covert behaviour.
   - **C.** maladaptive behaviour.
   - **D.** how well an individual independently operates in their environment.
2. Which of the following terms best describes a person with a high level of functioning?
   - **A.** impaired
   - **B.** adaptive
   - **C.** strong
   - **D.** mental
3. Which of the following characteristics would be attributed to a person with a low level of functioning?
   - **A.** confident
   - **B.** resilient
   - **C.** weak social wellbeing
   - **D.** expressing a sense of positivity
4. Resilience is best described as the ability to
   - **A.** successfully cope with and manage change and uncertainty.
   - **B.** identify a stressor that is adversely impacting on mental wellbeing.
   - **C.** function well in everyday life despite mental unwellness.
   - **D.** effectively achieve tasks without social support.
5. Someone with a high level of resilience can _____ after having been challenged by a difficult experience.
   - **A.** respond
   - **B.** breakdown
   - **C.** be overwhelmed
   - **D.** restore positive functioning
6. Which of the following is an external factor that has been found to influence an individual's resilience?
   - **A.** self-esteem
   - **B.** coping strategies
   - **C.** access to quality social support
   - **D.** being adaptable and flexible
7. Which of the following characteristics is associated with a high level of resilience?
   - **A.** mental wellness
   - **B.** mental illness
   - **C.** lack of adversity
   - **D.** maturity
8. The correlation between level of resilience and level of mental wellbeing is likely to be
   - **A.** positive.
   - **B.** negative.
   - **C.** low.
   - **D.** zero.

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8.2.3 The Social and Emotional Wellbeing (SEWB) view of mental wellbeing for Aboriginal and Torres Strait Islander peoples

Many Aboriginal and Torres Strait Islander people consider mental wellbeing from the perspective of the social and emotional wellbeing concept or 'framework' of understanding.

The term **social and emotional wellbeing (SEWB)** is used by Aboriginal and Torres Strait Islander people to describe the physical, social, emotional, spiritual and cultural wellbeing of a person.

It is based on a holistic, multidimensional view of health that recognises their connection to Country, culture, spirituality, ancestry, family and community, which are important to their people and impact on their wellbeing.

The SEWB holistic concept refers to the wellbeing of the individual and the wellbeing of their family and community. More specifically, the *holistic* view focuses on the physical, social, emotional, spiritual and cultural wellbeing of the individual, their family and the entire community to which they belong, thereby bringing about the total wellbeing of their community. This reflects the collectivist culture of Aboriginal and Torres Strait Islander peoples and encapsulates all elements of being an Aboriginal and Torres Strait Islander that are not evident in the mainstream view of mental health and wellbeing.

These elements are interrelated and overlap. All have been represented within the seven interrelated domains of the SEWB conceptual model shown in Figure 8.4. The domains are:

Connection to body and behaviours. Involves all aspects of physical health and wellbeing, especially feeling a strong and positive connection to one's body and appreciating everything it allows us to do and experience in life. This domain is interrelated with all other domains. For example, a strong and positive connection for this domain can help one feel stronger and more closely connected mentally, culturally and spiritually.

Connection to mind and emotions. Emphasises the individual's personal experience of their mental wellbeing (or mental ill-health) and their ability to manage thoughts and feelings. Intimately linked with spirituality.

Connection to family and kinships. Recognises that family and kinship systems have always been central to the functioning of traditional and contemporary Aboriginal and Torres Strait Islander peoples' lives. These systems are complex and diverse, maintain interconnectedness through cultural ties and caring relationships, and provide a strong sense of belonging.

Connection to community. Emphasises a connection to a communal space that can take many forms and provides opportunities for individuals and families to connect with each other, support each other, and work together.

Connection to culture. Refers to one's secure sense of cultural identity and cultural values through connection to Aboriginal and Torres Strait Islander heritage. Includes all knowledge systems, ways of knowing, and cultural traditions and practices. Provides a sense of continuity with the past and helps underpin a strong identity.

Connection to Country. Country refers to an area where Aboriginal and Torres Strait Islander people have a traditional or spiritual association and the deep sense of belonging this brings. This domain recognises that the relationship with Country underpins all other forms of relational wellbeing. Being on and caring for Country has positive physical and mental health outcomes for Aboriginal and Torres Strait Islander people.

Connection to spirit, spirituality and ancestors. Recognises the sacred and interconnective relationship between Country, human and non-human beings, as well as the past, present and future. Includes knowledge and belief systems, and the Dreaming. Aboriginal and Torres Strait Islander peoples' world views are grounded in spirituality and connection to ancestors. These connections also provide a sense of purpose and belonging.

In the SEWB framework, the term *connection* refers to the diverse ways in which Aboriginal and Torres Strait Islander people experience and express the various domains throughout their lives.

SEWB may change throughout a person's life span and therefore also varies according to the needs of different age groups. For example, what is important to a child or adolescent may be quite different to what is important to an Elder. The understanding of SEWB may also vary between different Aboriginal and Torres Strait Islander cultural groups and individuals.

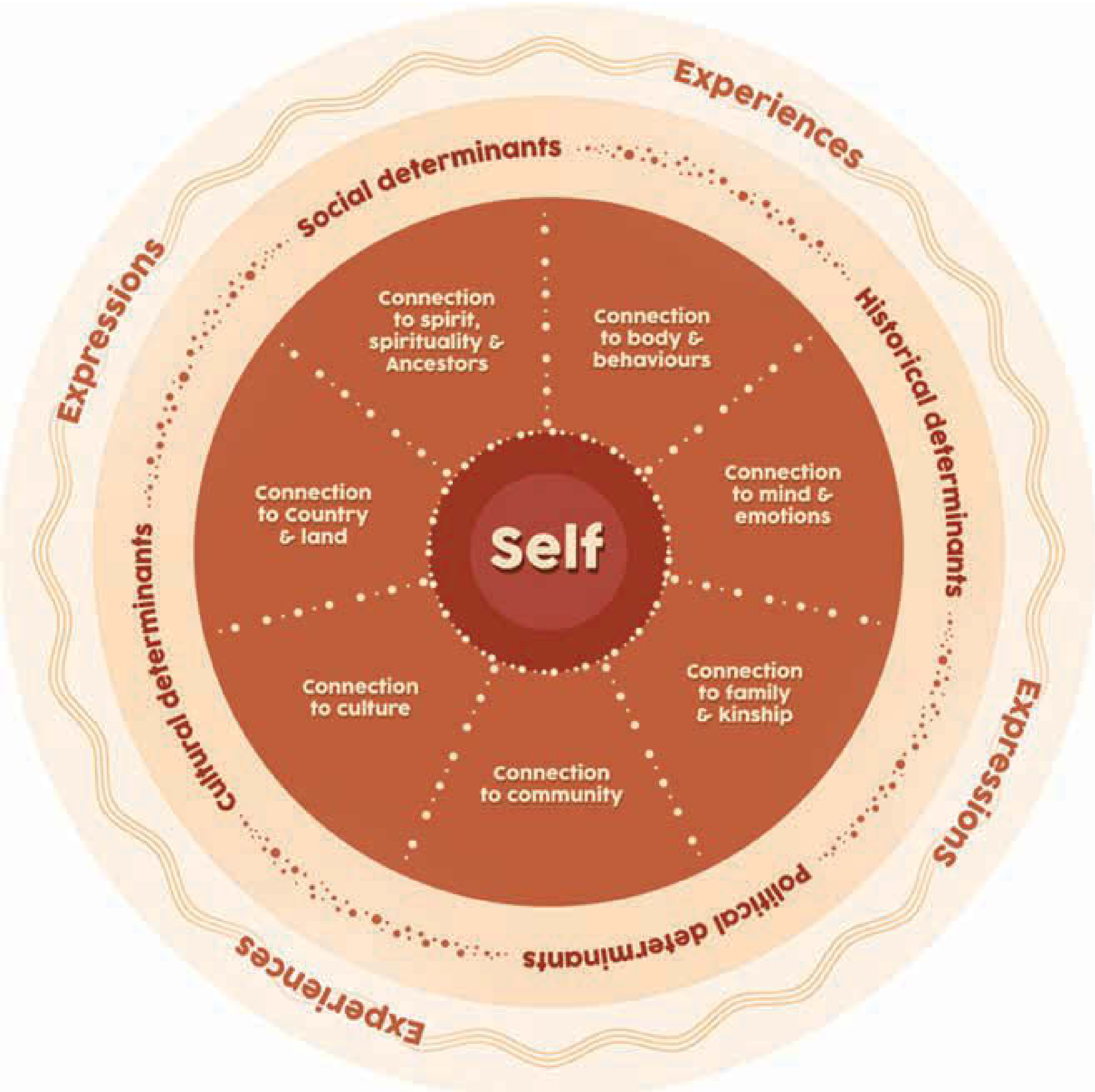

Figure 8.4 This diagram is a representation of the SEWB — a multidimensional and holistic framework of social and emotional wellbeing with domains that encapsulate all elements of being an Aboriginal and Torres Strait Islander person. Outside of these domains are overlapping cultural, social, political and historical 'determinants' that influence the domains. For example, social determinants are factors such as education, employment, income and housing which contribute to an individual's health and wellbeing status. Political determinants include government policies such as legislation that has affected wellbeing by restricting the rights of self-determination and sovereignty. Historical determinants include the impact of past government policies and the oppression and cultural displacement experienced by individuals, families and communities since colonisation. We consider cultural determinants in topic 10.

Source: Adapted from Gee, G., Dudgeon, P., Schultz, C., Hart, A., & Kelly, K. (2014). Aboriginal and Torres Strait Islander Social and Emotional Wellbeing. In P. Dudgeon, H. Milroy, & R. Walker (Eds.), *Working Together: Aboriginal and Torres Strait Islander Mental Health and Wellbeing Principles and Practice* (2nd ed., pp. 55–58). Commonwealth Government of Australia

Mental wellbeing is an important component of SWEB, but needs to be viewed as only one component of health that is inextricably linked to the social, emotional, physical, cultural and spiritual dimensions of wellbeing.

Many Aboriginal and Torres Strait Islander people consider 'mental health' and 'mental illness' as medical terms that focus too much on problems and do not properly describe all the factors that make up and influence wellbeing.

Mental health problems, however, are recognised as real experiences that influence how people think, feel and behave, but they are considered parts of a person's social and emotional wellbeing.

There is an interactive relationship between SEWB and mental wellbeing. The two may influence each other and a person can experience relatively good SEWB and yet still experience mental health problems, or vice-versa.

People may experience healthy connections in some domains, while experiencing difficulty and/or the need for healing in others. For example, mental health difficulties and illnesses may result from imbalances or disruptions in one or more SEWB domains that weakens connections.

Treatment interventions should therefore consider all domains and target the strengthening or restoration of connections to them to help the individual increase SEWB and achieve optimal wellbeing rather than symptom reduction alone (Gee et al., 2014; Sutherland & Adams, 2019; Dudgeon et al., 2022).

8.2 LEARNING ACTIVITY 2

Multiple-choice questions

1. The social and emotional wellbeing framework is
   - **A.** a concept describing the wellbeing of a person.
   - **B.** a model describing the wellbeing of a person.
   - **C.** a way of considering mental wellbeing.
   - **D.** a description of the mental health of all Aboriginal and Torres Strait Islander people.
2. The SEWB framework has a _____ approach to understanding mental wellbeing.
   - **A.** conventional
   - **B.** traditional
   - **C.** functional
   - **D.** holistic
3. Which of the following is of most importance in considering the mental wellbeing of Aboriginal and Torres Strait Islander people?
   - **A.** songlines
   - **B.** cultural influences
   - **C.** oral communication
   - **D.** social and emotional wellbeing
4. When compared with the mainstream view of mental health and wellbeing, the SEWB framework is
   - **A.** multidimensional.
   - **B.** narrowly based.
   - **C.** low in validity.
   - **D.** low in reliability.
5. According to the SEWB framework, treatment interventions for a mental wellbeing concern should primarily consider
   - **A.** symptom reduction alone.
   - **B.** use of CBT.
   - **C.** the need for hospitalisation.
   - **D.** the strength of connections to all domains.

6. In relation to the SEWB framework, mental wellbeing is considered to be
   A. determined by the individual.
   B. the spiritual part of wellbeing.
   C. the cultural part of wellbeing.
   D. one of a number of parts of wellbeing.
7. The SEWB framework has _____ domains that are not evident in the mainstream view of mental health and wellbeing.
   A. 5
   B. 6
   C. 7
   D. 8
8. The domains of the SEWB framework are
   A. overlapping.
   B. independent.
   C. neutral.
   D. equally relevant to all age groups.
9. Which SEWB domain emphasises physical health and wellbeing?
   A. Connection to spirit, spirituality and ancestors
   B. Connection to body and behaviours
   C. Connection to mind and emotions
   D. Connection to family and kinships
10. Which of the following is not an SEWB domain?
   A. Connection to culture
   B. Connection to Country
   C. Connection to self
   D. Connection to community
11. In relation to the SEWB framework, 'connection' refers to
   A. the quantity and quality of support from friends, family and community.
   B. the number of domains to which a person is connected.
   C. the specific domains to which a person is not connected.
   D. how a person experiences and expresses the various SEWB domains throughout their life.
12. The model representing the SEWB domains shows four outer influences on the domains called
   A. understandings.
   B. determinants.
   C. oppressions.
   D. experiences.

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8.3 Mental wellbeing as a continuum

Mental wellbeing is not considered in an arbitrary way as something we either have or do not have. Nor is it as simple as being well or unwell. Instead, we may be more or less mentally well (or unwell) as there are varying levels of mental wellbeing. Therefore, mental wellbeing, like mental health or its elements, is often represented as a continuum.

Although there appears to be widespread support for the continuum concept, there is no universal agreement on the type of continuum or the most appropriate words to use within the continuum or at different ends or extremes of the spectrum or scale.

As shown in the examples in Figure 8.5a and b below, a continuum may range from *mentally well*, when we are feeling positive and functioning well in everyday life, through to *mentally unwell* when we may have a mental illness requiring treatment. Figure 8.5a uses distinctive end points, whereas 8.5b does not, instead using arrow heads to suggest that there are no boundaries.

Figure 8.5c includes a distinctive third category in a continuum ranging from *mentally well*, when we are feeling positive and functioning well in everyday life, through to a *mental health problem* that interferes with functioning but is relatively moderate in severity and tends to be temporary, to a diagnosable *mental disorder* that tends to be more serious, longer-lasting and may require treatment. The term *mental disorder* is commonly used interchangeably with *mental illness*. Figure 8.5d also emphasises levels or degrees of wellbeing but does not use terms such as mental illness or mental disorder.

Although all four examples show mental wellbeing to worsen from left to right and different categories of wellbeing may be used, there are no absolute or clear-cut dividing lines between different points along the continuum.

Similarly, mentally well/healthy and mentally unwell/ill are represented at different ends of the continuum, but this does not mean that they are entirely separate, can be compartmentalised or that a continuum cannot extend beyond the end points when there are no arrow heads.

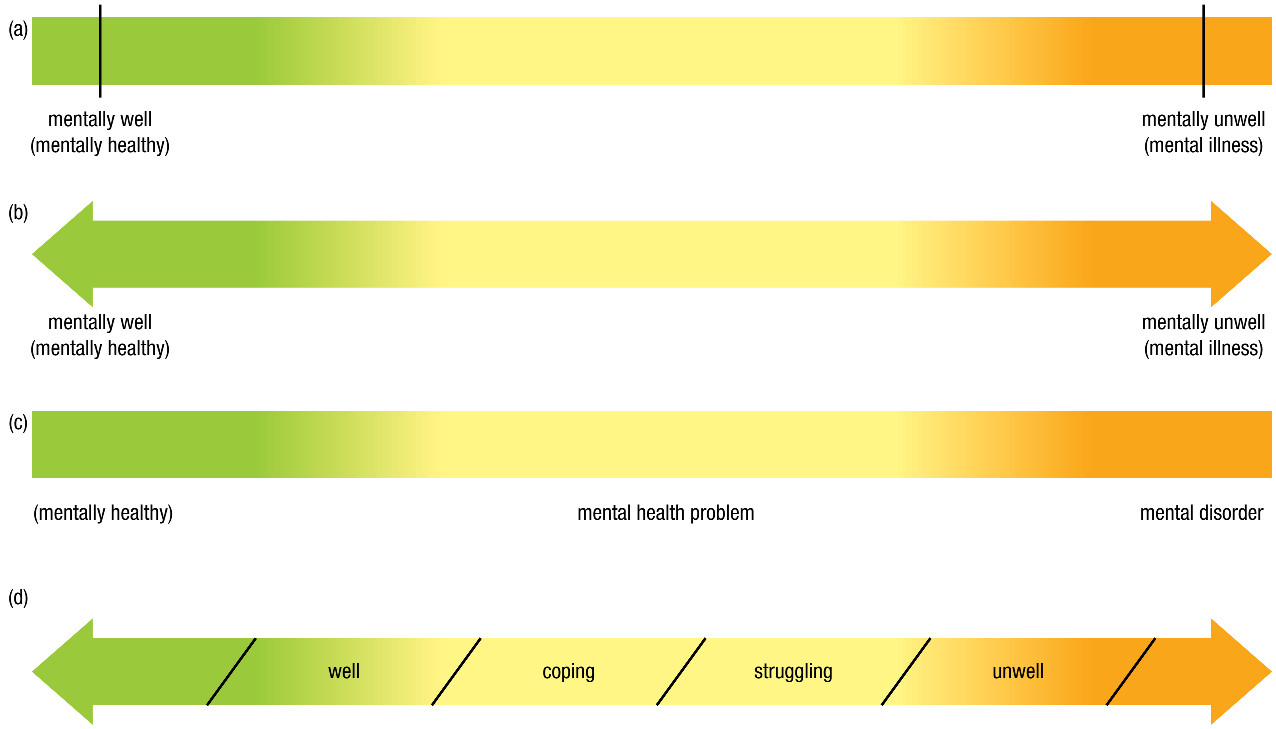

Figure 8.5 Mental wellbeing may be represented as a continuum in different ways, as shown by these examples. Some psychologists prefer two continua, as in Figure 8.6.

Source: Example (d) is based on a National Mental Health Commision (2022) model.

Despite being located at the end of a continuum, this does not mean that mental unwellness or illness cannot vary in severity. Any type of mental illness will involve variable amounts of impairment and distress to the individual. Not everyone diagnosed with the same mental illness has the same experience. It is also possible for a person to feel 'mentally ill' even though a mental health professional cannot find evidence of any known mental health disorder. Similarly, someone may have a diagnosed mental illness but cope socially and at school or work.

The location of an individual's mental wellbeing on a continuum is also unstable. This means that it is not fixed because it may fluctuate over time, from day-to-day or week-to-week, depending on circumstances. We can shift back and forth along the continuum, like a needle that can shift up and down a dial.

An interplay of internal and external factors combine to influence our mental wellbeing at different points in time. For example, the mapping of an individual's mental wellbeing on a continuum may shift from the left to right side following exposure to a major stressor, then back to the left side when the stressor passes or following intervention such as use of a suitable coping strategy. This may occur within the course of single day or over a prolonged period. Furthermore, over the life span, a person may move through different points between optimal mental wellbeing, to being unwell, and through to recovery.

An individual's mental wellbeing may also have many different possible values on a continuum at varying points in time if its different elements were mapped separately.

One of the main features of the continuum concept of mental wellbeing is that everyone has mental wellbeing. The continuum approach also promotes a consideration of mental wellbeing as a positive state, allows for early signs of mental health difficulties to be identified, and highlights that there are opportunities to promote improved wellbeing and possibly intervene before a person develops a serious mental illness or disorder.

The continuum approach also aligns well with the Aboriginal and Torres Strait Islander concept of social and emotional wellbeing, which focuses on a holistic approach to supporting mental wellbeing rather than mental illness in itself.

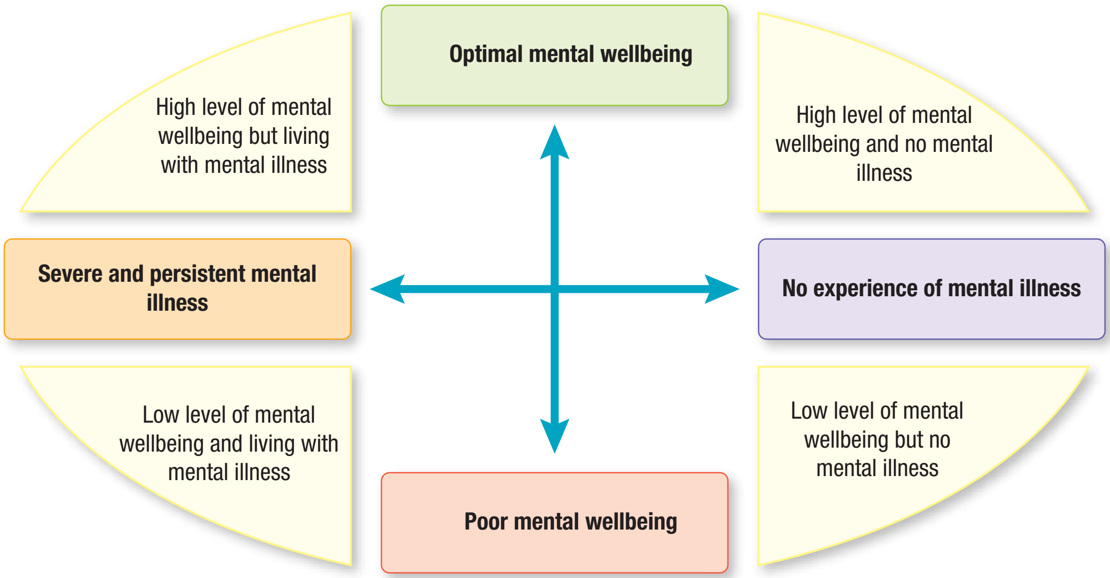

Figure 8.6 An example of a dual continua model of mental wellbeing. This model is designed to avoid representing mental well/healthy and mentally unwell/ill at opposite ends of a single continuum. The model emphasises that mental wellbeing is not simply the absence of mental illness. For example, a person diagnosed with a mental illness can still experience a high mental wellbeing, while a person with no diagnosed mental illness can still experience low mental wellbeing.

8.3 LEARNING ACTIVITY

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.39; ©VCAA

Glen lost his job just after his third child was born. Glen felt overwhelmed by the demands of being a parent while also being unemployed. The local council had also closed the park closest to his house. Glen really missed the opportunities that the park had provided for his older children to play and for him to spend time with other fathers. Despite these challenges, Glen had strong support from his family and friends, and he was able to enjoy daily events related to being a father. He also actively looked for new employment opportunities and organised a surprise party for his own father's 70th birthday.

Glen would be considered mentally healthy because he

A. avoided stressful situations.
B. was unable to focus on the needs of his family.
C. received social and psychological support from his family and friends.
D. worked towards goals in the face of stressors and disappointments in his life.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.41; ©VCAA

Mental health continuum

mental health ◄———————————————————► mental illness
X

Sasha, a university student who also works part-time in a cafe, is placed at 'X' on the mental health continuum based on her mental health status.
Which one of the following scenarios most likely reflects Sasha's current situation?

A. Sasha has been experiencing a consistently low mood, she is not engaged in her course and has not attended lectures for the past few months.
B. Sasha deferred her course because she could not manage both work and study. This has resulted in sleeping problems for the last few weeks.
C. Sasha is coping with the workload at university and is happy to have met someone she is interested in, but she is stressed about her decision to transfer to another course next year.
D. Sasha needs a driver's licence to travel to university but she keeps failing her licence test. This is really frustrating her but she continues to take driving lessons and books another test.

Question 3 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.34; ©VCAA

What are the typical characteristics of a mentally healthy person in terms of their levels of functioning and social and emotional wellbeing?

	Functioning	Social wellbeing	Emotional wellbeing
A.	successfully accomplishes tasks	shows respect for other people	manages stress reactions
B.	manages stress reactions	spends time with family	works independently and with others
C.	overcomes problems	demonstrates self-confidence when alone or with others	respects the cultural identity of others
D.	demonstrates self-confidence when alone or with others	undertakes everyday social interactions	displays a positive attitude

Question 4 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.41 (adapted); ©VCAA

Which of the following describes the strength of representing mental health on a continuum?

A. shows the distinction between mental health and mental illness
B. allows for variations in the severity of a mental illness
C. reduces the stigma of mental disorder as everyone is represented on the continuum
D. allows for early signs of mental health problems to be identified

Question 5 (2 marks)

Source: VCAA 2018 Psychology, Section B, Q.7a; ©VCAA

Shari moved interstate for her first job at an advertising company. She quickly found it difficult to work with the other people at the company as she considered them untrustworthy. A month after Shari started, the company underwent a restructure and Shari's job became more demanding. She struggled to meet deadlines and to think clearly. She became increasingly stressed and doubted her ability to do her job effectively. Concerned about her mental health, Shari organised an appointment with the company's psychologist.

Identify where the psychologist might place Shari on the mental health continuum. Justify your response.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

8.4 Mental wellbeing as a product of internal and external factors

An individual's mental wellbeing is influenced by the interaction of internal and external factors and this helps account for why we shift back and forth along the mental wellbeing continuum at different points in time. There are many factors that affect where someone generally sits on the continuum, and also where they sit at any given point in time.

Internal factors are influences that originate inside or within a person. These can be organised as biological and psychological factors.

Biological factors involve physiologically based or determined influences, often not under our control, such as the genes we inherit, whether we are male or female, balances or imbalances in specific neurotransmitters, our physiological response to medication, brain and nervous system functioning, hormonal activities and fight-or-flight-or-freeze and other bodily responses to stress. There are also biological factors that may be under our control, if not entirely, at least to some extent, such as our diet and sleep hygiene.

Psychological factors involve all those influences associated with mental processes such as our ways of thinking, beliefs, attitudes, our skills in interacting with others, prior learning, perceptions of ourselves, others and our external environment, how we learn, make decisions, solve problems, understand and experience emotions, respond to and manage stress, and reconstruct memories.

External factors are influences that originate outside a person. These can include school- and

Figure 8.7 An individual's mental wellbeing may shift back and forth along the mental wellbeing continuum at different points in time and can be influenced by the interaction of internal and external factors.

work-related factors, the range and quality of our interpersonal relationships, the amount and type of support available from others when needed, exposure to stressors, level of education, employment history, level of income, housing, risks of violence, access to health care and other community resources, exposure to social stigma, and specific cultural background influences such as our values and traditions.

Internal and external factors affect and are affected by one another. For example, internal factors may combine with other internal factors as well as external factors to influence a person's mental wellbeing.

This complex interaction of multiple factors helps account for individual differences in mental wellbeing, as well as the onset or experience of mental health problems and disorders. For example, depression could be explained by the combined effects of genes and brain chemistry (biological), negative ways of thinking and prior learning experiences (psychological) and the death of a loved one (social).

However, it is recognised that certain factors may have more or less influence on an individual's mental wellbeing at a given time. For example, being rejected by a boyfriend or girlfriend on its own may not cause depression, but if it occurs at a time when a person who lacks authentic social support from others has also been made redundant from their job, the combination of these three factors at that point in that person's life may be enough to precipitate the onset of depression.

8.4 LEARNING ACTIVITY 1

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.40; ©VCAA

Which of the following accurately describes the impact on mental health of both external factors and resilience?

	External factors	Resilience
A.	The effect depends on the number and the nature of the external factors.	Growth can occur even though setbacks occur.
B.	External factors will not have an impact on the development of a mental health problem.	Resilience allows an individual to 'bounce back'.
C.	Internal factors are likely to have a bigger impact than external factors.	The number of setbacks is likely to determine the level of resilience.
D.	Social factors are likely to have a greater impact than emotional factors.	External factors do not influence resilience.

Question 2 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.43; ©VCAA

Theodore lost his job two years before he intended to retire and it had a negative impact on his mood and ability to cope. He did not pay two electricity bills despite having sufficient funds. He became withdrawn while at his golf club and soon stopped playing. When he also started complaining of sleeping problems, his daughter encouraged him to see his family doctor with her.

Theodore might be showing signs of a mental health problem because

A. not paying bills indicates a mental health problem.
B. both internal and external factors are contributing to his behaviour.
C. internal factors rather than external factors are influencing his behaviour.
D. his behaviour is uncharacteristic and has had a negative impact on his wellbeing.

Question 3 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.43; ©VCAA

Over a few months, Marguerite experienced significant issues with her boss at work. Marguerite is usually very optimistic and positive but her problems with her boss were making her very unhappy. She could not think of any solution. Marguerite discussed the situation with her partner, who had noticed a significant change in her attitude. Her partner suggested that she join him at the gym to help manage her stress.

Which of the following identifies the internal and external factors interacting to put Marguerite's mental health at risk?

	Internal	External
A.	physical health	family relationships
B.	genetic predisposition to anxiety	lack of solutions
C.	emotional state	interactions with her boss
D.	low self-esteem	conflict resolution skills

Question 4 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.40; ©VCAA

Glen lost his job just after his third child was born. Glen felt overwhelmed by the demands of being a parent while also being unemployed. The local council had also closed the park closest to his house. Glen really missed the opportunities that the park had provided for his older children to play and for him to spend time with other fathers. Despite these challenges, Glen had strong support from his family and friends, and he was able to enjoy daily events related to being a father. He also actively looked for new employment opportunities and organised a surprise party for his own father's 70th birthday.

Glen's situation is an example of how mental health can fluctuate

A. depending on internal and external factors.
B. when external factors outweigh internal factors.
C. depending on internal rather than external factors.
D. depending on external rather than internal factors.

Question 5 (2 marks)

Source: VCAA 2018 Psychology, Section A, Q.7b; ©VCAA

Shari moved interstate for her first job at an advertising company. She quickly found it difficult to work with the other people at the company as she considered them untrustworthy. A month after Shari started, the company underwent a restructure and Shari's job became more demanding. She struggled to meet deadlines and to think clearly. She became increasingly stressed and doubted her ability to do her job effectively. Concerned about her mental health, Shari organised an appointment with the company's psychologist.

Describe how one relevant internal factor may have increased Shari's susceptibility to developing a mental health disorder.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

8.5 Variations for individuals experiencing stress, anxiety and phobia

The idea of a continuum can be applied to specific types of symptoms, mental illnesses, or any other type of human experience. This may be illustrated by variations for individuals experiencing stress, anxiety and phobia.

Everyone experiences stress and it is considered a normal part of life. As described in topic 3, **stress** is a psychobiological response produced by internal or external stressors. Potential stressors may range from daily hassles which tend to be perceived as challenges that can usually be overcome, through to traumatic events which are very disturbing and far more challenging. In addition, the stress response that is experienced may be acute and short-lasting or chronic and long-lasting.

Anxiety is also a common human response, often accompanied by physiological changes like those that occur when we are stressed. **Anxiety** is a state of arousal involving feelings of apprehension or uneasiness that something is wrong or something unpleasant is about to happen. The body often mobilises itself to meet the perceived threat; for example, the heart beats more rapidly, breathing is faster, and muscles become tense.

Anxiety is considered a future-oriented response because we anticipate impending misfortune, danger, or even catastrophe. Some people use the term anxiety interchangeably with fear. However, psychologists distinguish anxiety from fear. Fear is an appropriate, present-oriented and short-lived response to a clearly identifiable and specific threat (APA, 2022).

This does not mean that anxiety is never appropriate or cannot be experienced in response to a stimulus that is present. It is normal to experience anxiety in certain situations. For example, many students will experience a short burst of anxiety just before making an oral presentation in front of others or when an unexpected test is announced. Or we may feel anxious on the way to a job interview, or when travelling on an aeroplane that starts to rattle as it enters a pocket of air turbulence.

Feeling anxious in these situations is appropriate, and usually we feel anxious for only a limited time. In everyday life, short-term anxiety tends to be an adaptive response. For example, a heightened anxiety response can be very useful to deal with immediately threatening, dangerous or emergency situations. Physiologically, it is like a fight-or-fight-or-freeze response to a perceived threat and therefore makes us more alert and our reactions faster.

Mild to moderate levels of anxiety can also make us more alert and improve our ability to cope. For example, it is anxiety that can prompt us to slow down when running on a slippery surface, to avoid other dangerous situations, to study for an exam or to have a medical check-up when feeling ill.

Although we can all experience anxiety in certain situations, it should generally be brief and temporary, and its intensity ought to be related to the significance of the situation. If anxiety is severe or exaggerated and does not subside, it can be counterproductive and disabling. It can reduce our ability to concentrate, learn, remember, think clearly, logically plan, make accurate judgments and perform motor tasks such as crossing a busy road or shooting for goal from a difficult angle. While most people feel mild to moderately anxious from time to time, some people experience severe anxiety most of the time.

Figure 8.8 Anxiety should be brief and temporary, and at an intensity related to the significance of the situation. If it is not, anxiety can become counterproductive and disabling. For example, excessive anxiety may impair performance on a classroom presentation.

Severe anxiety is generally accompanied by intense physiological sensations and responses, such as shortness of breath, sweating, trembling, nausea, stomach cramps, dizziness, feelings of suffocating, feelings of losing control and/or feelings of impending doom, depending on the stimulus and the individual involved. For people experiencing severe anxiety that is unwanted and persistent, anxiety is not an adaptive response. It can affect the way a person thinks, feels and behaves, and, if not managed effectively, can cause considerable distress and disruption to the person's life.

Experiencing anxiety for a prolonged period can indicate the presence of an anxiety disorder. The term *anxiety disorder* is used to describe a group of mental health disorders that are characterised by chronic feelings of worry, excessive apprehension or fear about the future, with an overall negative effect on their lives.

Anxiety disorders are not so severe that individuals are always highly anxious, or that they lose touch with reality or consistently behave in inappropriate ways. Instead, an individual is likely to be diagnosed with an anxiety disorder when their anxiety is so persistent that it significantly interferes with their daily life and stops them doing what they want to do. Many different types of anxiety disorders have been identified, one of which is phobia.

A **phobia** is a persistent and irrational fear of a particular object, activity or situation, which is consequently either actively avoided or endured with marked distress. Fear is a rational response when confronted by some things or when in certain situations. It can serve to protect us from harm when there is a real risk. In this way, ordinary fear may be considered adaptive and a part of good mental health. However, a fear response by someone with a phobia is typically out of proportion to the actual danger posed by the object or situation. There is also a compelling desire to avoid the object, activity or situation. Sometimes, even the thought of the feared stimulus is enough to cause a phobic reaction APA, 2022.

The term 'phobia' is Greek for 'fear' or 'dread'. People with a phobia often become fearful even when they think about the object, activity or situation they dread. However, they can usually keep their fear reactions at a manageable level as long as they avoid the object or situation, including not thinking about it.

The specific object or situation producing the fear associated with a phobia is commonly referred to as the *phobic stimulus*. There is considerable variation between individuals in how they react to a phobic stimulus. An individual's reaction may also vary at different times under different conditions. However, the experience of a phobia typically involves both stress and anxiety at significant levels.

Stress, anxiety and a phobia have a number of psychological and physiological characteristics in common and are therefore often difficult to distinguish in real-life contexts. There are many variations in how they are experienced by individuals and they seldom fit neatly within precise categories with clear dividing lines between them. For example, a phobia has a mix of stress and anxiety, stress often causes anxiety and stress may also be considered a type of anxiety response. In addition, as shown in Figure 8.9, all three can vary in amount or degree within and between individuals at any point in time.

Some psychologists represent stress, anxiety and a phobia on continua like the ones used for mental wellbeing to describe how they can vary independently and collectively in relation to one another.

For example, when we 'feel' stressed this may be with some anxiety, but our coping strategies may ensure there is not enough of either stress or anxiety to be of any significant mental health or wellbeing concern. At these times, we can still function effectively in everyday life, so our mental wellbeing would be mapped somewhere on the left of a continuum, such as that in Figure 8.9.

If, however, we experience stress and do not manage it effectively, we may become increasingly anxious and more vulnerable to developing a mental illness or disorder. When this occurs, our mental wellbeing would be mapped somewhere on the right of a continuum.

Similarly, if we experience excessive fear or anxiety whenever exposed to some stimulus and find that this encounter or the possibility of an encounter is interfering with daily functioning, then our mental wellbeing may be plotted towards the far right of the continuum in Figure 8.9a where mental illness is located.

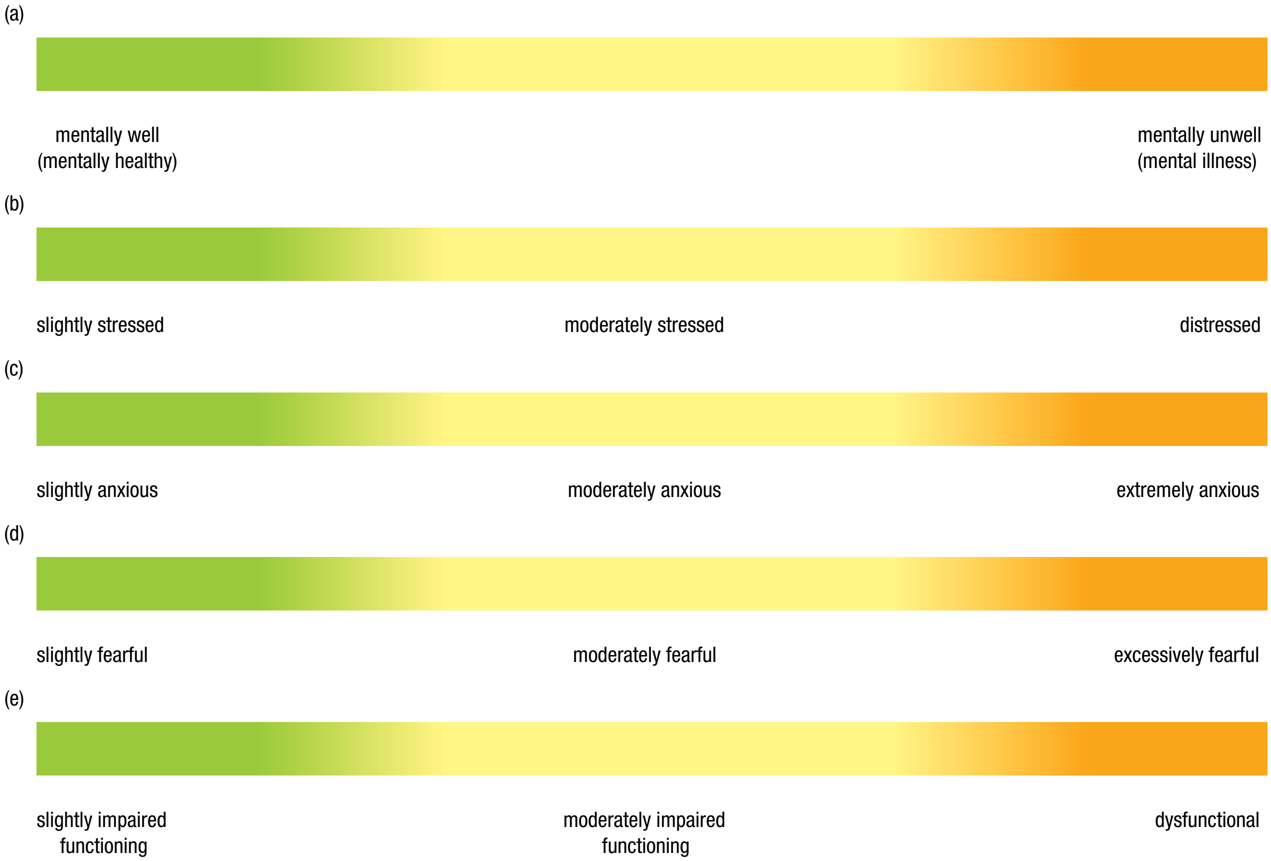

Figure 8.9 Examples of continua for mental wellbeing, and other human experiences

Although stress, anxiety and phobias share characteristics and may co-occur in varying degrees, they can be distinguished in a number of ways, as shown in Table 8.1.

One important distinction is that stress and anxiety can independently or in combination contribute to the development of a mental health disorder, but they are not in themselves considered to be mental illnesses or disorders. In contrast, any type of phobia is considered a mental health disorder (assuming it meets the diagnostic criteria). Furthermore, both stress and anxiety are generally considered normal human responses that are usually adaptive and beneficial (unless excessive and chronic). Phobias, however, inevitably cause distress and interfere with a person's day-to-day functioning through avoidance behaviour and other responses associated with fear. Having a phobia is therefore never beneficial.

Figure 8.10 Stress and anxiety can be adaptive and beneficial, whereas having a phobia is never beneficial.

Table 8.1 Comparison of stress, anxiety and phobia

Stress	Anxiety	Phobia
Considered 'normal' to experience stress in certain situations and everyone experiences it at some time	Considered 'normal' to experience anxiety in certain situations and everyone experiences it at some time	Not considered 'normal'
Potential contributory factor to mental health disorder	Potential contributory factor to mental health disorder	A diagnosable mental disorder
Can develop into a mental health disorder if not managed	Can develop into a mental health disorder if not managed	A diagnosable mental disorder
Can impact on a person's functioning if not managed	Can impact on a person's functioning if not managed	Significantly impacts on a person's functioning
Mild amounts can be adaptive and helpful	Mild amounts can be adaptive and helpful	Not considered adaptive or helpful
Can be experienced in response to a wide range of stimuli	Can be experienced in response to a wide range of stimuli	Typically only experienced in response to specific stimuli
Accompanied by physiological changes; may involve fight–flight–freeze	Accompanied by physiological changes; may involve fight–flight–freeze	Accompanied by physiological changes; may involve fight–flight–freeze
May be associated with avoidance of certain objects or situations	May be associated with avoidance of certain objects or situations	Characterised by avoidance of certain objects or situations
Source/cause of a stress response is usually present and known (e.g. a specific stressor)	Source/cause of an anxiety response is not always present or apparent	Source/cause of a phobic response is usually known (e.g. feared object or situation) but not always present (e.g. avoided but may be endured)
Influenced by biological, psychological and social factors	Influenced by biological, psychological and social factors	Influenced by biological, psychological and social factors

8.5 LEARNING ACTIVITY 1

Review

1. List three characteristics which you believe best distinguish stress, anxiety and phobia.
2. Give an example of how stress, anxiety and phobia may interact in response to the same stimulus.
3. Explain why a continuum is a useful and appropriate way of representing stress, anxiety and phobia.
4. Can stress, anxiety and phobia all be mapped on the same single continuum? Explain your answer.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

8.5 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.37; ©VCAA

Anxiety can be distinguished from phobia because only anxiety

A. involves distress.
B. can be helpful in mild amounts.
C. triggers the fight–flight–freeze response.
D. is influenced by biological, psychological and social factors.

Question 2 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.43 (adapted); ©VCAA

Phil slept for only four hours on the night he lost his new running shoes. He was worried about how he would participate in the race without them. He continued to have only four hours of sleep each night leading up to the race.

When Phil arrived at the race wearing tennis shoes, another competitor lent him a spare pair of running shoes. When Phil put the shoes on, he felt excited and nervous.

This feeling is characteristic of

A. phobia.
B. anxiety.
C. stress.
D. mental illness.

Question 3 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.36; ©VCAA

One difference between stress and anxiety is that

A. stress is arousal when a person fears they cannot cope, whereas anxiety is the fear of being stressed.
B. stress is a response to a stressor that may occur in the future, whereas anxiety is the worry about the current stressor.
C. stress is a rational response to something that has happened, whereas anxiety is an irrational response to something that has happened.
D. stress occurs when a person perceives they cannot cope with a current stressor, whereas anxiety occurs when a person perceives they cannot cope with a stressor that may occur in the future.

Question 4 (3 marks)

Source: VCAA 2019 Psychology, Section B, Q.6b; ©VCAA

Psychiatrists in the Hopewell Flats area wanted to educate the public about issues related to mental health in order to help people identify when they should seek treatment. The psychiatrists prepared a pamphlet that included a number of scenarios, such as the one below.

> When Ambreen was a young child, she developed a fear of the dark. She started using a night light as a child and continued to use one as an adult. When Ambreen was 20 years old, she moved into a share house with new housemates. Her housemates noticed after a few months that Ambreen always watched movies with the lights on and would not leave the share house in the evening, even to visit friends. One night, the power went out in the share house while Ambreen was home alone. Several hours later, her housemates returned home from a party to find Ambreen sitting on the couch in a highly distressed state.

Is Ambreen likely to be suffering from a phobia or from anxiety? Justify your response by comparing phobia and anxiety in relation to Ambreen.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

8.6 Review

Topic summary

- **Ways of considering mental wellbeing**
  - Levels of functioning
  - Resilience
  - The Social and Emotional Wellbeing (SEWB) view of mental wellbeing for Aboriginal and Torres Strait Islander peoples
- **Mental wellbeing as a continuum**
  - Mentally well (mentally healthy) to mentally unwell (mental illness)
- **Mental wellbeing as a product of internal and external factors**
  - Internal factors: biological or psychological
- **Variations for individuals experiencing stress, anxiety and phobia**

Key terms

anxiety p. 492
continuum p. 479
external factor p. 489
internal factor p. 489
mental wellbeing p. 476
phobia p. 493
resilience p. 480
social and emotional wellbeing (SEWB) framework p. 482
stress p. 492
level of functioning p. 478
holistic framework (in SEWB) p. 483
connection (in SEWB) p. 482
multidimension (in SEWB) p. 482
mental illness p. 479
mental disorder p. 486
mental health problem p. 484

Note: The **References** for the entire title can be accessed in learnON and are also available as a downloadable PDF.

on Resources

Digital documents
Key terms glossary — Topic 8 (doc-38024)
Topic summary — Topic 8 (doc-38025)
Key diagrams PowerPoint — Topic 8 (doc-38027)

Exam question booklet
Exam question booklet — (eqb-0131)

8.6 Topic 8 test

Section A: 10 marks **Section B:** 25 marks **Total:** 35 marks

Access learnON to answer the following test questions online and receive **immediate feedback**.

Section A — Multiple-choice questions

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

Which of the following is a characteristic of mental wellbeing when defined as a positive state?

A. feeling good
B. always sad
C. always the same
D. stable

Question 2

A mentally healthy student with a high level of functioning is likely to

A. be socially disconnected from others.
B. participate fully in school and leisure activities.
C. avoid extracurricular activities at school.
D. have negative feelings about themself and life in general.

Question 3

A mental illness is best described as

A. maladaptive or dysfunctional behaviour.
B. a mild and temporary change in the way a person thinks, feels and behaves.
C. a mental condition that will usually resolve itself without treatment.
D. a diagnosable psychological condition that significantly disrupts how a person usually thinks, feels and behaves.

Question 4

Which of the following individuals is most likely experiencing a significant mental health problem, rather than a mental illness?

A. A. H., who has been experiencing changes in appetite, motivation and mood but is still managing to get to work each day and be quite productive.
B. R. P., who became annoyed when someone crashed into her car, but got over it quickly.
C. D. M., who is a manager at a local fast food outlet and has a good group of friends.
D. S. L., whose anxiety about coming into contact with other people is causing a lot of distress and preventing him from leaving his house.

Question 5

A mental wellbeing continuum can be used to show

A. the stability of mental health.
B. the variability of mental health.
C. internal and external factors influencing mental health.
D. impairments in the ability to function effectively in everyday life.

Question 6

O. M. has developed satisfying interpersonal relationships with a diverse range of people, which makes her feel good about herself. It is likely that O. M. has a _____ level of _____ wellbeing.

A. low; psychological
B. high; behavioural
C. low; behavioural
D. high; psychological

Question 7

Which of the following is a cultural influence on mental wellbeing?

A. adequate sleep
B. negative thoughts
C. shift work
D. traditions passed on by ancestors

Question 8

The social and emotional wellbeing (SEWB) framework is _____ of Aboriginal and Torres Strait Islander people.

A. a way of considering the mental wellbeing
B. a description of the mental health
C. an explanation of the mental health
D. an explanation of the social and emotional wellbeing

Question 9

The SEWB framework views mental wellbeing as

A. functional.
B. comprising six domains.
C. multidimensional.
D. socially and emotionally determined.

Question 10

What type of correlation is likely to exist between resilience and mental wellbeing?

A. zero
B. low
C. positive
D. negative

Section B — Short answer questions

Question 1 (4 marks)

Source: VCAA 2019 Psychology, Section B, Q.7b,c; ©VCAA

Six people were selected to undertake intense training in order to travel to Mars in 2030 to start a human colony on the planet. The training process is very rigorous as the astronauts must be able to cope with a variety of stressful situations during the journey to Mars and when they arrive on the planet. Prior to selection, a team of psychologists interviewed potential astronauts carefully to find out if they would be able to cope with the demands of the mission.

a. Identify one characteristic of good mental health that the psychologists might be looking for in the potential astronauts and how this characteristic might be observed in their behaviour during the interview process. 2 marks

b. It is planned that the psychologists will observe the astronauts throughout the mission to investigate the effects of space travel on the astronauts' mental health.
Why would an observational study be used for this investigation rather than an experiment? 2 marks

Question 2 (3 marks)

Source: VCAA 2015 Psychology, Section B, Q.5; ©VCAA

One year ago, Toby's wife died. For the past six months, Toby has been acting out of character. Despite being physically in good health, he has not left the house for several weeks and has asked his parents to shop for groceries for him. Whenever his parents visit, they notice that he has not showered for days and is often wearing the same clothes. He lost his job because of extended absences and his friends are concerned as Toby is no longer responding to their text messages or telephone calls. He has also shown a lack of interest in physical activity despite previously completing many marathons.

Give three reasons why these behaviours may cause Toby's psychologist to conclude that he has a mental illness.

Question 3 (3 marks)

Source: VCAA 2014 Psychology, Section B, Q.10; ©VCAA

Drew is usually a confident, funny and friendly man. However, when his grandfather died, Drew started spending most of each day in bed, stopped going out with his friends and ate very little. This continued for two weeks.

Could the information above be used to determine if Drew was experiencing a mental illness? Why or why not?

Question 4 (3 marks)

Explain the meaning of resilience with reference to a characteristic that distinguishes someone with low resilience.

Question 5 (3 marks)

Suppose Jack's mental wellbeing has been mapped on a mental health continuum. What three conclusions could be drawn about Jack's mental health?

Question 6 (5 marks)

a. Explain the meaning of holistic in relation to the social and emotional wellbeing (SEWB) framework. 2 marks

b. Name three of the SEWB domains. 3 marks

Question 7 (4 marks)

Explain the difference between internal and external factors that can influence a person's mental wellbeing, with reference to an example of each type of factor.

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on Resources

Go to learnON to access answers to the Topic 8 test. A customisable Word version of the test can also be downloaded from the **Digital documents** tab of the Resources panel.

learnMORE | WHO Assessment of functioning

The *World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0)* is a questionnaire designed to measure level of functioning in adults aged 18 and older. Level of functioning is assessed in relation to the following six domains.

- *Self-care* e.g. ability to attend to personal hygiene, dressing and eating, and to live alone
- *Getting along* e.g. ability to interact with other people
- *Life activities* e.g. household responsibilities, leisure, school and work
- *Participation in society* e.g. engaging in community activities
- *Cognition* e.g. understanding and communicating
- *Mobility* e.g. ability to get around

Individuals are asked to answer a number of questions in each domain, rating how much difficulty they had doing various activities using a 5-point scale. For example:

In the past 30 days, how much difficulty did you have in:					
maintaining a friendship?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
getting out of your home?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
joining in community activities (e.g. church) in the same way as anyone else can?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
starting and maintaining a conversation?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
getting all the work done that you needed to do?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
getting dressed?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
concentrating on doing something for 10 minutes?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
taking care of your household responsibilities?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*

There are two versions of the WHODAS 2.0 — a 36-item version that takes about 20 minutes to complete and a shorter 12-item version that takes about 5 minutes to complete. Responses can be scored simply. For example, the individual's answer for each question is converted to a rating score, with a score of 0 assigned to 'None' and a score of 4 to 'Extreme/Cannot do'. The scores are then totalled and mapped on a continuum ranging from 0 to 100, where 0 = high level of functioning and 100 = extremely poor level of functioning/disability.

Summary scores for each domain can also be calculated and high scores in a particular domain may indicate functional impairments requiring further assessment or intervention.

The WHODAS 2.0 has been adopted as a measure of function by the DSM-5 — the manual most commonly used in Australia by mental health professionals for diagnosis of mental health disorders.

Source: World Health Organization (2010). *Manual for WHO Disability Assessment Schedule: WHODAS 2.0.* Geneva: Publisher.

9 Biopsychosocial approach to explain specific phobia

TOPIC CONTENT

9.1 Overview

KEY KNOWLEDGE

- the relative influences of factors that contribute to the development of specific phobia, with reference to gamma-amino butyric acid (GABA) dysfunction and long-term potentiation (biological); behavioural models involving precipitation by classical conditioning and perpetuation by operant conditioning, and cognitive biases including memory bias and catastrophic thinking (psychological); and specific environmental triggers and stigma around seeking treatment (social)
- evidence-based interventions and their use for specific phobia, with reference to the use of short-acting anti-anxiety benzodiazepine agents (GABA agonists) in the management of phobic anxiety and breathing retraining (biological); the use of cognitive behavioural therapy (CBT) and systematic desensitisation as psychotherapeutic treatments of phobia (psychological); and psychoeducation for families/supporters with reference to challenging unrealistic or anxious thoughts and not encouraging avoidance behaviours (social)

Source: © VCAA, *VCE Psychology Study Design: 2023–2027.* p.40.

We all have fears and experience anxiety from time to time, but our fears or anxiety are not necessarily severe enough to cause distress and possibly interfere with everyday life. For example, we may not feel comfortable at most times when around bees, spiders or dogs, but 'some discomfort' is quite different to the experience of a phobia.

Specific phobia is an anxiety disorder characterised by a marked and persistent fear or anxiety about a specific object, activity or situation. For example, a specific phobia may involve spiders, dogs, flying, receiving an injection, dental treatment or seeing blood. It is not uncommon for an individual to have multiple phobias.

Figure 9.1 There is virtually no limit to what people may fear or get very anxious about. Being at the beach or in any kind of watercraft on the ocean may be a phobic stimulus, with any type of exposure or even a thought triggering intense fear or anxiety.

In cases of specific phobia, however, the phobic stimulus almost always triggers immediate fear or anxiety and is avoided or endured with intense fear or anxiety if avoidance is not possible. In addition, the fear or anxiety that is experienced is out of proportion to the actual danger posed by the phobic stimulus or to its context. For example, excessive fear of loud noises would be considered understandable if experienced in the context of a war zone and would therefore not qualify as a specific phobia (APA, 2022).

The fear or anxiety also tend to be irrational, which often leads to avoidance behaviour whenever possible. For example, one type of specific phobia involves intense fear of being in an elevator. Some people will not enter an elevator despite the inconvenience or hardship they experience as a result, such as walking up many flights of stairs. They tend to unreasonably believe that they may be exposed to a tramatic event; for example, that the elevator's cables could break, that the ventilation could fail or that they could get stuck mid-air waiting for repairs. These problems are possible, but highly unlikely and it does not make sense to walk up and down several flights of stairs on every occasion to avoid elevators.

Numerous types of specific phobia have been described, each with a different type of stimulus. Generally, the phobias fall within one of the following five categories (APA, 2013):

- *animal*: e.g. spiders, snakes, mice, cats, dogs, insects, birds, fish
- *situational:* e.g. flying/aeroplanes, driving/cars, elevators, bridges, tunnels, enclosed spaces
- *natural environment:* e.g. heights, storms, darkness, thunder, lightning, being near water
- *blood–injection–injury:* e.g. seeing blood, having blood taken, having an injection, getting a cut, any invasive medical procedure
- *other phobias:* e.g. choking, vomiting, loud noises, costumed characters, falling down, becoming ill, dying.

Traditionally, specific phobias are named using Greek prefixes that stand for the phobic stimulus; for example, *xeno*phobia (fear of foreigners), *necro*phobia (fear of death) and *acro*phobia (fear of heights). However, there is almost no limit to what may cause people to become fearful or anxious, so such a list could be very long.

TABLE 9.1 Types of phobic disorders

Name of phobic disorder	Description
Specific phobia	Marked and persistent fear or anxiety about a specific object, activity, or situation, such as spiders, flying, heights, dental treatment, receiving an injection and seeing blood. The phobic stimulus almost always triggers fear or anxiety and is intentionally avoided or endured with intense anxiety or stress if avoidance isn't possible. The level of fear or anxiety is out of proportion to the actual danger posed and causes significant distress.
Social Anxiety Disorder (Social phobia)	Marked fear or anxiety about a social situation in which the individual is exposed to possible scrutiny by others, primarily due to fear of being negatively judged (e.g. as anxious, weak, stupid, boring, unlikeable) or behaving in a way that offends others or is embarrassing or humiliating (e.g. sweating, trembling).
Agoraphobia	Marked fear or anxiety about being in a situation in which it is believed something bad may happen and that escape might be difficult or help might not be available if needed. Such situations may include using public transport, being in an open space area (e.g. in a car park, on a bridge), being in an enclosed space (e.g. shop, movie theatre), standing in a line or being in a crowd, and being outside of the home alone (e.g. in the backyard). These situations are avoided, require the presence of a companion or are endured with intense fear and anxiety.

Source: American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, Virginia: Author.

When someone has a specific phobia*,* exposure to a phobic stimulus typically triggers an acute stress response involving physiological changes like those of the fight-or-flight-or-freeze response. Young children may express their fear and anxiety by crying, tantrums, clinging and freezing (APA, 2013). In some cases, the person's reaction is so intense that it takes the form of a panic attack.

A *panic attack* is period of sudden onset of intense fear or terror, often associated with feelings of impending doom. During the attack, there are physiological or psychological changes such as shortness of breath or smothering sensations; a racing or pounding heart; sweating; trembling; tightness in the chest; feeling dizzy, unsteady, lightheaded or faint; nausea; and feelings of going crazy, losing control or even dying. An attack may be expected (i.e. an obvious cue or 'trigger') or unexpected (i.e. not associated with an obvious cue and seems to occur 'out of the blue'). Furthermore, a panic attack can occur when in a calm state or an anxious state (APA, 2013).

Adolescents and adults with a specific phobia are usually able to recognise that their fear or anxiety is excessive or unreasonable (but children may not be able to). They usually know that it is grossly in excess of any real danger posed by the phobic stimulus. Consequently, they are often embarrassed and feel 'stupid' because of their fear or anxiety, and the way it interferes with their lives.

The experience of a phobia can be contrasted with that of watching a very scary horror movie. This type of movie can frighten us, but, deep down, we know that we are safe. When a phobic stimulus frightens someone with a phobia, deep down they feel unsafe, despite the fact that they know their fear and insecurity are irrational (Butler & Hope, 2007).

As described previously, fear or anxiety also typically result in a need to avoid any phobic stimulus. Someone with a phobia will usually organise their life around avoiding the phobic stimulus; for example, they will catch a train to avoid flying or not enter a park where there may be bees. When it is not possible to avoid a feared object or situation, it is endured with intense anxiety or distress. Moreover, avoidance behaviour can in itself be distressing.

The possibility of encountering a phobic stimulus also causes a type of phobic anxiety called anticipatory anxiety.

Anticipatory anxiety is worry or apprehension about the possibility of being exposed to a phobic stimulus in the future. The worry or apprehension is often accompanied by somatic (bodily) symptoms of tension. Most people have experienced a mild form of anticipatory anxiety when they have an 'attack of nerves' before making a presentation to an audience. For many, it is handled with little worse than 'rubbery knees' or a slight quavering of the voice. For those with a phobia, however, their anxiety may rise to a level where they are severely distressed and incapacitated by it.

As with any other mental health issue, the development and progression of specific phobia is influenced by a combination of biological, psychological and social factors, and the best treatment interventions are also based on a biopsychosocial approach.

The **biopsychosocial approach**, or model, is a way of describing and explaining how biological, psychological and social factors combine and interact to influence a person's mental health and wellbeing. The approach is based on the idea that mental health is best understood by considering specific factors from within each domain (area) and how these factors may combine and interact to influence our mental health and wellbeing (WHO, 2018).

The biopsychosocial approach reflects a holistic view of mental health and wellbeing — the individual is considered as a unique 'whole person' functioning in their unique environment. The focus is not just on the individual's mental condition ('within the individual'), but also on their wider social setting and circumstances ('outside the individual'). In addition, focusing on the influence of factors from one or two domains, rather than all three, is likely to give an incomplete and therefore inaccurate picture of a person's mental health and wellbeing. This also applies to a mental health problem, phobia or any type of mental illness or disorder an individual may have and the treatment that may be required.

In this section, we examine the relative influences of contributing factors to the development of specific phobia. We then consider evidence-based interventions for its treatment. The contributing factors and interventions are shown in Figure 9.2.

Figure 9.2 Application of biopsychosocial approach to development and treatment of specific phobia

9.1 LEARNING ACTIVITY 1

Review

1. List three common characteristics of specific phobia.
2. Distinguish between specific phobia and ordinary fear.
3. Explain the meaning of each of the following in relation to specific phobia:
   a. irrational
   b. avoidance behaviour
   c. panic attack
   d. anticipatory anxiety

4. 37-year-old B. L. has been haunted by a fear of illness for as long as he can remember. His father died of a heart attack when B.L. was quite young and B.L. also had to nurse his mother through a terminal brain cancer when he was in his twenties. His wife is four years younger and in generally good health. B.L. frequently consults his doctor with complaints of erratic heart activity, sudden attacks of breathlessness, various pains, rashes, small swellings, and so on. He is not actually suffering from any diagnosable physical illness, but is continually afraid that he will have a heart attack or contract cancer or some seriously disabling illness at some time. He is especially afraid of having a heart attack when out walking or driving alone. This often confines him to his home and also means that he cannot hold a job. Although his doctor tries to reassure him with frequent examinations and blood tests, B.L. will go back again whenever a symptom draws attention to the possibility of an illness.

   Explain whether B. L. may have a phobia of becoming ill with reference to key characteristics of specific phobia.

5. 5-year-old J.M. was very apprehensive and distressed on his first day of school. This was the first time he had been separated from his mother and he was particularly anxious about how he would cope without her and the possibility that she could became ill or forgetful and therefore unable to pick him up after school. He was also anxious about how he would fit in with a new teacher and classmates. It is now three weeks into term 1 and J.M. has been increasingly reluctant to attend school. He is irritable and weepy, getting poor sleep because of difficulty falling asleep, and complaining about nausea and abdominal pain in the mornings before school. His mother has to drag or carry him to the car each school morning, then struggle to get him out of the car and into the school grounds when they get there.

   Explain whether J.M. may have a phobia of school with reference to key characteristics of specific phobia.

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9.1 LEARNING ACTIVITY 2

VCAA exam questions

The following information relates to questions 1 and 2.

Shane has an intense and irrational fear of snakes, which has been identified as a phobia. He thinks snakes will attack him and that he will get bitten by a venomous snake. He experiences fear even when he is exposed to a harmless image of a snake in a book or on television. His heart beats faster, he feels sweaty, his mouth feels dry and he leaves the room. To overcome his phobia of snakes, Shane seeks the advice of a clinical psychologist.

Question 1 (1 mark)

Source: VCAA 2017 Psychology sample exam, Section A, Q.20 (adapted); ©VCAA

Shane's reaction to the image of a snake is called the

A. flee-confront response.
B. simple phobia response.
C. fight or flight or freeze response.
D. parasympathetic arousal response.

Question 2 (1 mark)

Source: VCAA 2017 Psychology sample exam, Section A, Q.21; ©VCAA

Which nervous system is activated during Shane's reaction to the image of a snake?

A. parasympathetic nervous system
B. sympathetic nervous system
C. central nervous system
D. somatic nervous system

Question 3 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.57; ©VCAA

The key assumption underlying the biopsychosocial framework is that

A. psychologists alone cannot diagnose mental illness.
B. factors from several domains may combine to influence mental health.
C. social factors are more important than psychological factors in determining mental health.
D. biological factors are not as important as psychological factors in determining someone's degree of mental health.

Question 4 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.18; ©VCAA

According to the biopsychosocial framework, which one of the following would best be described as a biological factor?

A. grief
B. genetics
C. education
D. family interactions

Question 5 (1 mark)

Source: VCAA 2002 Psychology 2, Section B, Q.9i; ©VCAA

What is meant by the term phobia?

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9.2 Biological factors

The origin of any phobia is a complex phenomenon and to designate a single factor as the sole cause is rarely possible. Various biological factors that may contribute to the development, progression or perpetuation of specific phobia have been proposed. Each one of these may interact with each other as well as psychological and social factors.

In this section, we initially examine how dysfunctional GABA neurotransmission may make an individual more vulnerable to developing a specific phobia. We then examine how brain plasticity through long-term potentiation can neurologically strengthen the association between a phobic stimulus and a fear or anxiety response.

9.2.1 GABA dysfunction

Several neurotransmitters have been identified as playing a role in the experience of anxiety and one of these is GABA. As described in Topic 2 on nervous system functioning, GABA (gamma-amino butyric acid) is an inhibitory neurotransmitter, therefore making postsynaptic neurons less likely to be activated. Moreover, one of its roles is to fine-tune neurotransmission in the brain and maintain neurotransmission and associated neuronal activity at an optimal level.

Without the inhibitory effect of GABA, activation of postsynaptic neurons might get out of control. Their uncontrolled activation could spread throughout the brain, causing seizures like those of epilepsy. For example, glutamate is the primary excitatory neurotransmitter in the CNS. It works throughout the brain to make postsynaptic neurons *more likely* to fire. It is involved in fast-acting neuronal transmission throughout the brain (and also aids learning and memory by strengthening synaptic connections). The inhibitory action of GABA counterbalances the excitatory activity of glutamate and vice versa. Consequently, GABA (and glutamate) has important roles in regulating CNS arousal.

GABA also plays a role in anxiety because it acts like a calming agent or 'brake' to the excitatory neurotransmitters that contribute to anxiety.

There is evidence that some people experience the anxiety associated with phobias because the neurotransmission of GABA becomes dysfunctional. For example, there may be a failure to produce, release or receive the correct amount of GABA needed to regulate neuronal transmission in the brain. GABA dysfunction can therefore result in low levels of GABA in the brain, as shown by studies of people diagnosed with specific phobia (and other anxiety disorders) who are more likely to have a significantly lower GABA level than control group placebo participants with no specific phobia (Sadock et al., 2007; Nuss, 2015; Srivastava & Kumar, 2021).

Some psychologists have proposed that individuals with a low level of GABA are more vulnerable to anxiety. In addition, their fight-or-flight-or-freeze response may also be more easily triggered by a variety of stimuli, which in turn may presdispose them to developing a specific phobia when compared with people who do not have a low level of GABA (Andrews et al., 2003).

The level of GABA in a person's brain may be affected by a wide range of factors. For example, research studies have implicated factors such as genetic inheritance, CNS damage, exposure to prolonged stress, nutritional deficiencies in vitamin B6 and citric acid, and high caffeine intake. These types of influences have been found in some studies to either inhibit GABA release, inhibit its ability to bind to GABA receptors on postsynaptic neurons, or to stimulate overproduction of glutamate in some way.

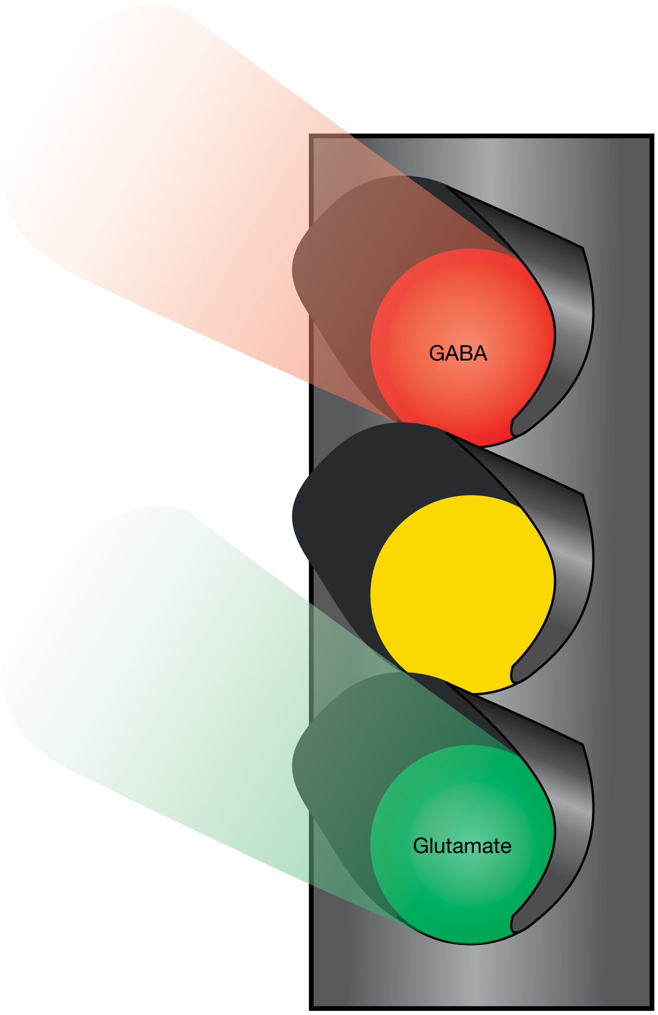

Figure 9.3 GABA and glutamate are like traffic lights regulating neuronal activity in the brain. GABA is an inhibitory neurotransmitter and makes postsynaptic neurons less likely to fire. It is like a red traffic light for the excitatory neurotransmitters that contribute to anxiety. Glutamate is an excitatory neurotransmitter and makes postsynaptic neurons more likely to fire. It is like a green traffic light for excitatory activity.

9.2.2 Long-term potentiation

As described in Topic 2 on nervous system functioning, neurons and the connections between them change in response to our experiences. This type of plasticity occurs at neural synapses and enables learning and memory.

Given the neurological mechanisms of memory formation, the acquisition and retention of fearful or anxiety provoking experiences, either real or imagined, are significantly influenced by changes to connections between neurons. Long-term potentiation (LTP) at the neural synapse therefore contributes to the development and maintenance of any type of specific phobia that is experience-based.

An important contributory of LTP in the learning and memory of fear or anxiety associated with a phobia involves strengthening synaptic connections in the neural pathway that is formed during the learning process. This results in enhanced or more effective synaptic transmission within that pathway. In turn, this makes activation of the pathway more efficient and likewise retrieval and recollection of the relevant memory.

As with other learning, LTP can therefore neurologically strengthen the association between a phobic stimulus and a fear or anxiety response through its activity at the synapse. The more that the connection is activated through each encounter or anticipated encounter with a phobic stimulus, the more the connection is strengthened. The more the connection is strengthened, the more the relevant neural pathway is strengthened, increasing the efficiency in transferring fear or anxiety information along the pathway and decreasing the likelihood that what has been learnt will be forgotten.

Similarly, whenever someone thinks about a phobic experience stored in memory, they bring it into conscious awareness. This retrieval process also has the effect of activating and strengthening relevant neural pathways through LTP, as does re-encoding or reconsolidating it in long-term memory. Given the emotional significance attached to actual or potential phobic experiences, in combination with LTP, neural pathways underlying a phobia tend to be stronger and more enduring than less fearful or anxiety laden long-term memories (Dityatev & Bolshakov, 2005; LeDoux, 2007; Sigurdsson et al., 2007).

9.2 LEARNING ACTIVITY 1

Review

Complete the following table to summarise biological factors contributing to the development and/or maintenance of a specific phobia.

Biological factor	What is it?	How it may contribute
gamma-amino butyric acid (GABA) dysfunction		
long-term potentiation		

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9.2 LEARNING ACTIVITY 2

VCAA exam questions

The following information relates to questions 1 and 2.

Eleanor's family goes to the beach once a year for their family holiday. One year, Eleanor, five, and her sister Janet, seven, were playing when their father scared the girls by pretending to be a sea monster covered in seaweed. Janet laughed at their dad for being silly but Eleanor got a dreadful fright. Two days later, the girls had an argument and Janet threw seaweed at Eleanor, who covered her face with her hands and became distressed. The following year, Eleanor cried each time the family discussed going back to the beach for a holiday. Her mother was concerned about her behaviour and a consultation with a psychologist revealed that Eleanor had developed a phobia of seaweed.

Question 1 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.46; ©VCAA

Eleanor got such a dreadful fright when she saw her father pretending to be a sea monster that she felt transfixed and unable to move or act.

Which of the following identifies what was initially released into Eleanor's bloodstream at the time of the incident and its function?

	Released into bloodstream	Function
A.	glutamate	Help Eleanor form a fearful memory.
B.	GABA	Return Eleanor's body to homeostasis.
C.	cortisol	Energise Eleanor's body to be able to deal with the sudden threat.
D.	adrenaline	Activate various organs in the body for the 'fight-flight-freeze' response.

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.47; ©VCAA

Which one of the following best describes the effect of long-term potentiation in the development of Eleanor's phobia?

A. The memories of her experiences with seaweed have the potential to affect her in the long-term.
B. The memories of her holidays at the beach have been encoded into her episodic long-term memory.
C. The neural signals representing the connection between the seaweed and her fear of it have been strengthened.
D. The neural signals that fired when she experienced the sensation of being hit with seaweed have continued to fire in the long-term.

Question 3 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.15; ©VCAA

Sophia has developed a specific phobia of dogs and cries whenever she sees one.

With reference to gamma-amino butyric acid (GABA), it is most likely that Sophia has

A. an excess of this excitatory neurotransmitter.
B. an excess of this inhibitory neurotransmitter.
C. a deficiency of this excitatory neurotransmitter.
D. a deficiency of this inhibitory neurotransmitter.

Question 4 (1 mark)

Source: VCAA 2018 Psychology, Section A, Q.36; ©VCAA

A researcher was investigating the effects of a gamma-amino butyric acid (GABA) agonist in the treatment of a specific phobia. Group A, the experimental group, received the GABA agonist. Group B, the control group, received a placebo. Concerned about experimenter bias, the researcher used a double-blind procedure with the help of a research assistant who worked directly with the participants.

Which one of the following identifies the double-blind procedure used in this investigation?

A. Only the researcher knew who would receive the placebo.
B. Only the research assistant knew who would receive the GABA agonist.
C. Only the researcher and the control group knew who would receive the placebo.
D. Only the researcher and the research assistant knew who was in the experimental group and the control group.

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9.3 Psychological factors

A number of different models and theories have been proposed to describe and explain how a specific phobia can develop or be perpetuated due to psychological factors. These include behavioural models which emphasise the role of learning and experience, and cognitive models which emphasise the roles of memory bias and other distorted ways of thinking.

9.3.1 Behavioural models

According to **behavioural models**, phobias are learned through experience and may be acquired, maintained or modified by environmental consequences, such as reinforcement and punishment. In particular, a specific phobia may be acquired through classical conditioning and maintained by operant conditioning. This two-part process was originally called *two-factor learning theory*. It was first proposed in the 1940s to explain avoidance learning like that occurring with phobias and continues to be applied to phobias (Mowrer, 1947, 1951).

Traditional behavioural models are based on the learning theories of Pavlov, Watson and Skinner. It should therefore not be surprising that these models assume that phobias — like most other maladaptive ways of thinking, feeling or behaving — are learned through classical and operant conditioning processes in much the same way as 'normal', adaptive ways of thinking, feeling and behaving are learned.

Generally, explanations of phobias by behavioural models propose that classical conditioning processes play a role in the precipitation (or development) of a specific phobia and operant conditioning processes play a role in the perpetuation (or maintenance) of a specific phobia.

Precipitation by classical conditioning

Many people cringe at the sound of the dentist's drill. This is not a naturally occurring response to the noise. One reason for the fear of the sound of the dentist's drill is the association we make between the sound and potential pain through classical conditioning. In this case, the sound of the dentist's drill has become a conditioned stimulus, which, through association with the unconditioned stimulus (the drilling of the tooth), produces a conditioned response (fear).

Classical conditioning of a fear response was first demonstrated in a controversial series of experiments reported in 1920 by behaviourist John B. Watson and Rosalie Rayner (a graduate student who later became his wife). Their sole participant was Albert B., an 11-month-old infant who has since come to be known as 'Little Albert'.

After pre-testing Albert to ensure he was actually capable of producing a fear response, Watson and Rayner placed him on a mattress in a room where a white laboratory rat was within reaching distance. Albert showed no initial fear of the furry animal and reached for it. As soon as his hand touched the rat, one of the experimenters stood behind him and bashed an overhanging metal bar with a hammer. This produced a loud noise that startled Albert and made him fall over and bury his face in the mattress. In the next trial, the bar was again struck as soon as Albert touched the rat. This achieved the same result, with Albert now starting to whimper.

In the next procedure, conducted one week later, the loud noise was again sounded every time Albert reached for the rat or the rat touched him. After seven pairings, Albert showed a distinct fear (CR) in response to the rat (CS) being placed anywhere near him.

Figure 9.4 Watson and Rayner introduce Albert to the white rat as he sits placidly on a mattress.

on Resources

Weblink Video about the 'Little Albert' experiment, including footage from the experiment 6 m 20 s

Watson and Rayner had conditioned Albert to be terrified of a white rat (initially a neutral stimulus that did not produce fear) through repeated association with an unpleasant loud noise (an aversive unconditioned stimulus). Albert's fear had become a conditioned response to a conditioned stimulus (the white rat).

Watson and Rayner also conducted 'tests' to find out if Albert's fear response would be generalised ('emotionally transferred') to other stimuli that were similar in some way to the white laboratory rat. They reported that Albert produced quite fearful reactions to a white rabbit, a dog and a sealskin coat. He showed slightly less fearful reactions to cottonwool balls and a Santa Claus mask, but showed reactions nonetheless.

Classical conditioning has been used to explain the acquisition of all types of phobias. The development of a specific phobia in this way is essentially the process by which a stimulus with no particular significance (i.e. a neutral or unconditioned stimulus) becomes, by association, a sign of impending threat, danger or some other unpleasant event (i.e. a conditioned stimulus). The innate, naturally occurring fear response (UCR) eventually becomes a conditioned fear response (CR).

Due to the ethical issues surrounding the use of humans in fear conditioning research, experiments since the Albert study have mostly been conducted with animals in laboratory situations to further understanding of the role of classical conditioning.

In a typical experiment, a rat is placed in a cage where small electrical shocks can be administered to its feet through the floor. The researchers briefly expose the rat to a light or sound (NS), then immediately administer a slight shock to its feet (UCS). After only a few repetitions of this procedure, the rat associates the light or sound with the shock and becomes afraid (CR) when it is only exposed to the stimulus (now a CS). For the rat, the initially neutral stimulus of the light or sound has become a conditioned fear. After conditioning, the new learned fear response that is automatically and involuntarily produced by the CS is called the conditioned response (CR) because it is the result of experiencing the dependent relationship between the CS and UCS.

These types of laboratory experiments have shown that conditioned fear can be acquired very quickly in a variety of species, ranging from flies and molluscs to fish and monkeys. In addition, the conditioned fear response can last a very long time. It is therefore considered to involve a very strong association that is unlikely to be forgotten or disappear (i.e. extinguished) without intervention.

The development of a specific phobia in the real world can occur in much the same way as it does in the laboratory. For example, consider 23-year-old Sam who has a specific phobia of spiders (arachnophobia). He initially developed his fear at the age of four when he saw a photo of a big hairy spider in a book and his father used it to scare him. He subsequently became quite fearful and anxious whenever exposed to a spider in books and other media.

One day, Sam unexpectedly came across a live spider while playing in the sandpit in his backyard. It moved so quickly in his direction and gave him such a fright that he jumped up and ran away in terror. Since then, Sam has never intentionally gone near any sandpit and will not even go to the beach for fear that there may be a spider in the sand. He also avoids any other situation in which there may be a spider, even if the spider is likely to be harmless, fake or dead. For example, Sam will never read a book that may have a picture of a spider. Nor will he watch any television program, movie or social media post if he believes there is any chance whatsoever of a spider appearing.

In effect, Sam developed a conditioned response (fear) to a conditioned stimulus (the spider) that had been associated with fear-inducing unpleasant events (UCS), then generalised to similar stimuli — any spider. Many people feel scared or anxious around spiders, but Sam's fear is disproportional to any actual risk and his fear has imposed unwanted restrictions on his life.

Psychologists have also found that fear conditioning can occur in people after only a single pairing if the UCS is sufficiently intense or traumatic; for example, in the case of being viciously attacked by a dog (Fanselow & Sterlace, 2014).

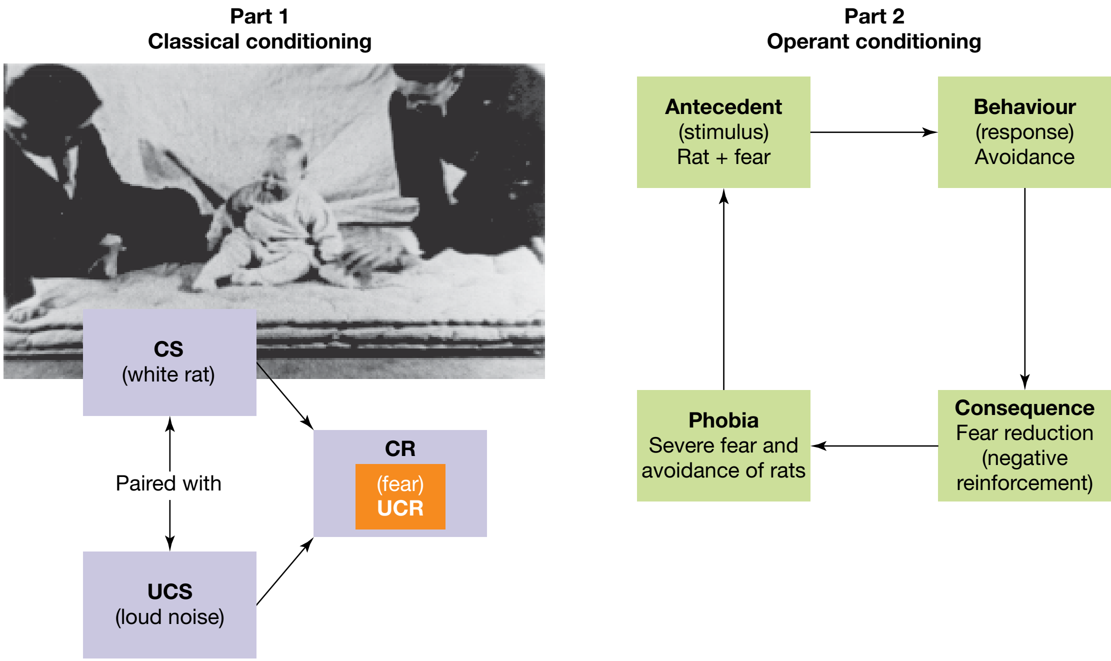

Figure 9.5 Explanation of a rat phobia by the two-factor learning theory. Part 1: Albert B. developed a specific phobia of rats through classical conditioning (i.e. precipitation by classical conditioning). Part 2: By avoiding the feared stimulus (the rat), the fear is successfully reduced and the phobia is 'rewarded' (negative reinforcement), which maintains the phobia (i.e. perpetuation by operant conditioning).

9.3 LEARNING ACTIVITY 1

VCAA exam questions

The following information relates to questions 1–3.

Bobbi, a 1-year-old child, is playing with red balloons when suddenly one bursts, making a loud noise. Bobbi is startled by the loud noise. She continues playing with the balloons and another one pops. Again, Bobbi demonstrates the startle reflex in response to the balloon bursting. After five balloons popping and Bobbi being startled at each pop, Bobbi now startles whenever she sees a balloon.

Question 1 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.33; ©VCAA

In terms of classical conditioning of Bobbi's fear of a red balloon, the unconditioned stimulus and the conditioned stimulus were, respectively, the

A. red balloon, loud noise.
B. loud noise, red balloon.
C. startle reflex, red balloon.
D. red balloon, startle reflex.

Question 2 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.34; ©VCAA

Prior to conditioning, the red balloon and the startle reflex were, respectively

A. unconditioned stimulus, conditioned response.
B. conditioned stimulus, unconditioned response.
C. neutral stimulus, unconditioned response.
D. neutral stimulus, conditioned response.

Question 3 (1 mark)

Source: VCAA 2015 Psychology, Section A, Q.35; ©VCAA

After conditioning, the conditioned stimulus and the conditioned response were, respectively

A. Bobbi, the loud noise.
B. Bobbi, the startle reflex.
C. the loud noise, the startle reflex.
D. the red balloon, the startle reflex.

Question 4 (5 marks)

Source: VCAA 2006 Psychology 2, Section B, Q.5; ©VCAA

Elise is walking along a busy street listening to her favourite song on her MP3 player. She accidentally steps on to the road and is narrowly missed by a bus driving past. Elise is very upset, and for several days afterwards her hands shake, and she finds herself bursting into tears. A week later, after these symptoms have subsided, Elise is listening to the radio while lying in bed. She hears her favourite song again and her hands start shaking and she starts crying.

a. What sort of conditioning has occurred to cause Elise to cry when she hears the song a week after the near accident? 1 mark

b. In this scenario, what is the

i. conditioned stimulus?
ii. conditioned response?
iii. unconditioned stimulus?
iv. unconditioned response? 4 marks

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Perpetuation by operant conditioning

After acquisition through classical conditioning, the phobia can be maintained and therefore perpetuated by operant conditioning. In the spider phobia example, Sam begins to avoid the fear- and anxiety-producing phobic stimulus (spiders). Avoidance reduces or removes the unpleasant feelings of fear and anxiety, so avoidance is negatively reinforced. In the future, any response that reduces or removes fear or anxiety will also be negatively reinforced. Consequently, any avoidance response to any phobic stimulus will continue to be reinforced through operant conditioning.

Consider also the case of 32-year-old Hayley who has claustrophobia (a fear of enclosed spaces or of being confined) and has started a new job on the fifth floor of an office building. Hayley uses the stairs to get to her office in order to avoid the terrifying experience of being in the elevator. Using the stairs reduces the unpleasant feelings of fear and anxiety (negative reinforcement) and increases the likelihood that her avoidance behaviour of using the stairs will occur again. In this way, the operant conditioning process of negative reinforcement is contributing to the persistence of her avoidance behaviour and therefore her phobic response.

Operant conditioning can also contribute to the acquisition of a phobia. For example, consider the experience of 8-year-old Samir when on a camping holiday with his parents. One day, Samir and his parents went for a walk and came across a small lake. Samir 'saw something moving' in the lake and reacted with terror. He started crying, screaming and shaking all over. Samir's parents promptly reassured, hugged and kissed him. In addition, to help him 'feel better', Samir's father gave him a piggy-back all the way back to their camping ground and then drove him into town to buy Samir his favourite chocolate ice-cream.

Although well-intentioned, Samir's parents may have inadvertently provided positive reinforcement for his fear response in the form of reassurance, kisses, hugs, a piggy-back and a chocolate ice-cream. The positive reinforcement could therefore strengthen Samir's fear response or increase the likelihood that he behaves fearfully the next time he encounters a lake or body of water.

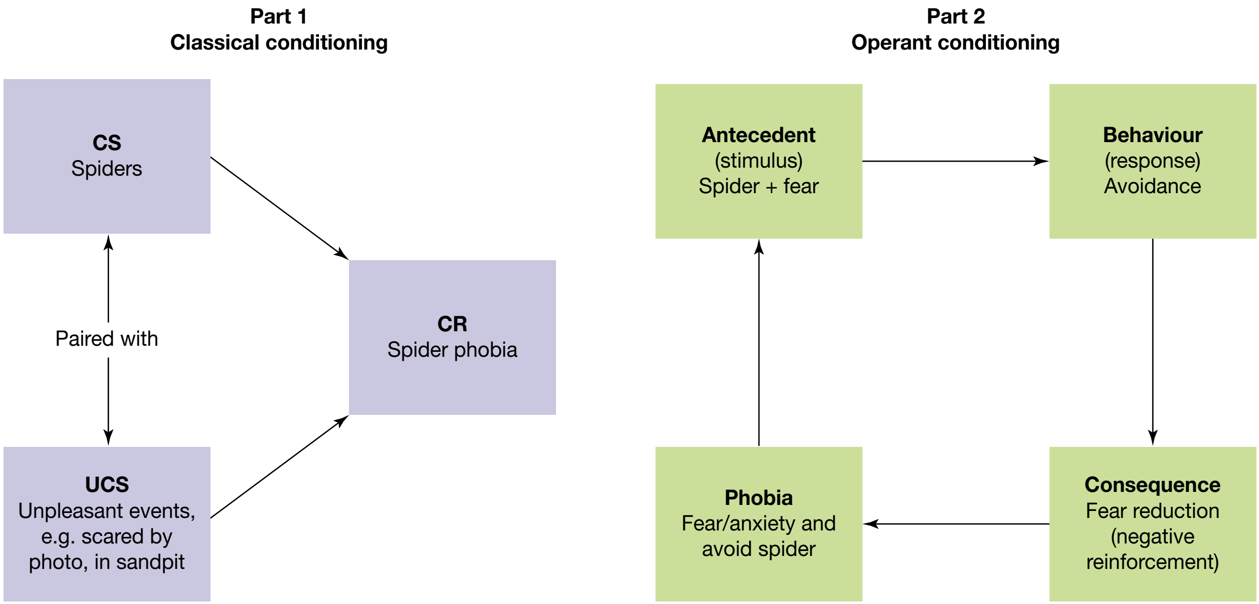

Figure 9.6 Explanation of Sam's spider phobia by the two-factor learning theory. Part 1. Sam associates the spider with unpleasant events that induce fear/anxiety and develops a specific phobia through classical conditioning (i.e. precipitation by classical conditioning). Part 2. By avoiding the feared stimulus (spider), the fear is successfully reduced and Sam's phobia is 'rewarded' (negative reinforcement), which maintains the phobia (i.e. perpetuation by operant conditioning).

9.3.2 Cognitive biases

People with a specific phobia often have one or more cognitive biases. **Cognitive bias** is a systematic error of thinking that affects decisions and judgments, usually leading to inaccurate or unreasonable conclusions.

Cognitive bias is considered to be a systematic error in thinking because it is flawed thinking attributable to the *person* who thinks in a biased way (like an inbuilt fault); tends to occur naturally, often without their conscious awareness of its use; and, because it occurs constantly and predictably under certain circumstances (rather than randomly). In sum, people tend to think in the same kind of erroneous way when confronted with the same type of judgment or decision-making situation.

The flawed mode of thinking associated with cognitive bias has been explained in terms of a number of different contributory factors. These include limitations in the cognitive abilities of the individual involved, underlying motivational factors, over-confidence, social influence, or because information has been interpreted according to the individual's personal likes, dislikes and experiences. As with systematic errors that may be found in research investigations, cognitive bias can be detected and corrected (Wilke & Mata, 2012; Maclean & Dror, 2016).

Although cognitive bias is a 'normal' psychological process that can occur in all people to a greater or lesser extent, it can become a habitual way of distorted thinking and make someone more prone or vulnerable to experiencing fear or anxiety in response to a phobic stimulus and/or to react to it in a dysfunctional way.

Several different types of cognitive bias have been identified as being associated with the development and/or perpetuation of a specific phobia. Two of these include memory bias and catastrophic thinking.

Memory bias

Memory bias refers to the distorting influences of present knowledge, beliefs and feelings on the recollection of previous experiences. Often, this results in what is commonly called 'selective memory'.

Eminent American psychologist Daniel Schacter (1999) has defined different types of memory bias. These include:

- *consistency bias:* memories of past experiences are distorted through reconstruction to fit in with what is presently known or believed; e.g. current fears of specific objects or situations influence memory reconstruction of those objects or situations in ways that incorporate those fears
- *change bias:* whenever we recall a past experience we exaggerate the difference between what we knew or felt then and what we currently know or feel, which can lead our phobic fears to grow over time, disproportionately from what they are in reality.

In relation to specific phobia, these types of biases result in a tendency for memory recall of a phobic stimulus or experience to focus on or to be better for negative or threatening information than for positive or neutral information. For example, a person with a phobia of horses will tend to remember the one and only time they were chased by a horse, but forget all of the other times when horses showed no response to their presence. Similarly, someone with a spider phobia will tend to reconstruct their memory of a past experience with a spider in a way that describes it as bigger, faster or more frightening than it actually was (Eliasz et al., 2005).

Catastrophic thinking

Catastrophic thinking is a thinking style which involves overestimating, exaggerating or magnifying an object, activity or situation and predicting the worst possible outcome. For example, a person with a specific phobia may assume that they will go crazy, lose control or even die if exposed to a relevant phobic stimulus. In the case of someone with a dog phobia, they may think that any dog they encounter will attack them and leave them with permanent facial disfigurement, or a person with spider phobia may think that it would be completely unmanageable to have a spider touch them. In the case of a person with a phobic fear of driving, they may think that if they get into a car they will definitely have a crash and die.

When catastrophic thinking occurs, individuals experience heightened feelings of helplessness and grossly underestimate their ability to cope with the situation. For example, a person may think, 'if this rat turns towards me, there is nothing I can do to stop it biting me'. Equally, they may believe that they will be completely unable to cope with the symptoms of anxiety they may experience; for example, 'if I have a panic attack while driving, I might crash the car and kill someone'.

As shown below in Figure 9.7, catastrophic thinking can maintain a fear or anxiety response and therefore contribute to the development and perpetuation of a specific phobia.

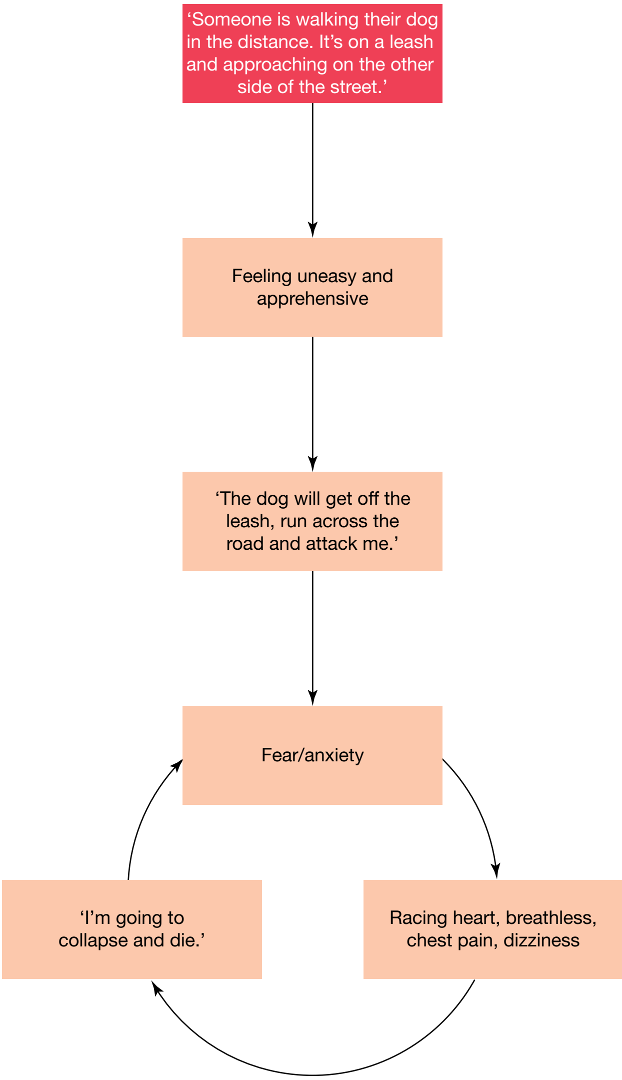

Figure 9.7 An example of how catastrophic thinking can contribute to the development and perpetuation of a phobia of dogs

9.3 LEARNING ACTIVITY 2

Review

Complete the following table to summarise psychological factors contributing to the development and perpetuation of specific phobia.

Psychological factor	What is it?	How it may contribute
Behavioural models • classical conditioning • operant conditioning		
Cognitive biases • memory bias • catastrophic thinking		

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9.3 LEARNING ACTIVITY 3

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.48; ©VCAA

Eleanor's family goes to the beach once a year for their family holiday. One year, Eleanor, five, and her sister Janet, seven, were playing when their father scared the girls by pretending to be a sea monster covered in seaweed. Janet laughed at their dad for being silly but Eleanor got a dreadful fright. Two days later, the girls had an argument and Janet threw seaweed at Eleanor, who covered her face with her hands and became distressed. The following year, Eleanor cried each time the family discussed going back to the beach for a holiday. Her mother was concerned about her behaviour and a consultation with a psychologist revealed that Eleanor had developed a phobia of seaweed.

Which one of the following describes the likely role of memory bias in the development of Eleanor's phobia?

A. Eleanor is unable to recall the events accurately due to a fallible memory system.
B. Each time Eleanor thinks of the events, they seem more threatening than they actually were.
C. Eleanor's encoding of the events at the beach has been distorted by Janet's retelling of the story.
D. Each time Eleanor talks about the events that happened at the beach, she incorporates new information.

Question 2 (1 mark)

Source: VCAA 2017 Psychology sample exam, Section A, Q.22 (adapted); ©VCAA

Shane has an intense and irrational fear of snakes, which has been identified as a phobia. He thinks snakes will attack him and that he will get bitten by a venomous snake. He experiences fear even when he is exposed to a harmless image of a snake in a book or on television. His heart beats faster, he feels sweaty, his mouth feels dry and he leaves the room. To overcome his phobia of snakes, Shane seeks the advice of a clinical psychologist.

Shane's thoughts about snakes being likely to attack him and about getting bitten by a venomous snake are examples of

A. the biopsychosocial approach.
B. memory bias.
C. catastrophic thinking.
D. GABA dysfunction.

Question 3 (1 mark)

Source: VCAA 2017 Psychology sample exam, Section A, Q.49; ©VCAA

Leanne plays the drums in a band with her friends. The band was asked to perform at her cousin's 21st birthday party. Leanne felt very stressed about performing in front of an audience and, on the evening of the party, she felt sick and asked the band members to perform without her. Leanne stayed at home instead of going to the party. The next time the band performed at a party, Leanne began playing with the band but immediately experienced sweaty palms, an increase in her breathing rate and a rapid pulse as she stood in front of the audience. She stopped playing with the band, said that she felt sick and went home. Leanne has subsequently continued to make excuses and stay at home every time she has been asked to perform with the band at a party because, every time she thinks of playing in public, she experiences feelings of intense fear and worry, shortness of breath, sweating, trembling, nausea and dizziness.

According to behavioural models, it is likely that Leanne has

A. anxiety associated with performing in public that involves precipitation by operant conditioning and perpetuation by classical conditioning.
B. stress associated with performing in public that involves precipitation by classical conditioning and perpetuation by operant conditioning.
C. enjoyment when performing in public that involves precipitation by operant conditioning and perpetuation by classical conditioning.
D. a phobia of performing in public that involved precipitation by classical conditioning and perpetuation by operant conditioning.

Question 4 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.58 (adapted); ©VCAA

Jane has to walk down a long, dark corridor from her bedroom to get to the bathroom at night. Often, her brother, John, jumps out from behind one of the doors along the way and frightens her. After this happens a few times, Jane's heart races and she feels very fearful as soon as she steps into the corridor at night, even when John is not there.

Which one of the following best describes Jane's experience?

A. operant conditioning
B. classical conditioning
C. observational learning
D. social cognitive learning

Question 5 (5 marks)

Source: VCAA 2020 Psychology, Section B, Q.6a, c; ©VCAA

When she turned four, Maxine received a medium-sized red box out of which popped a clown figure making a loud noise. When the box opened, Maxine ran away from it, towards her parents, screaming in fear. Her parents comforted her by playing with her. As a teenager, Maxine still runs away whenever she sees a similar box and her parents continue to comfort her. Maxine's parents have decided to consult a psychologist with Maxine to try to manage her phobia.

a. In terms of operant conditioning, outline how Maxine's parents' response could be considered to be perpetuating her phobia of red boxes. 3 marks
b. The psychologist also indicated that memory bias may be contributing to Maxine's phobia. Explain how memory bias could be a contributing factor in Maxine's phobia. 2 marks

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

9.4 Social factors

Many different factors sourced in the environment may contribute to the development of a phobia and perpetuate its occurrence. Two of these social contributing factors involve:

- specific environmental triggers — developing a specific phobia after a direct negative experience with an object or situation
- stigma around seeking treatment — embarrassment or shame about symptoms and concerns about being negatively judged by others may discourage people with a phobia from seeking treatment.

9.4.1 Specific environmental triggers

Many people diagnosed with a specific phobia report having a direct, negative and traumatic experience with a particular phobic stimulus at some time in the past and attribute this encounter as the cause of their phobia. For example, a phobia of heights may be attributed to a ride on a chairlift on a very windy day, a phobia of injections after unexpected pain when immunised at school and a phobia of the ocean after being knocked over by a big wave when wading in shallow water as a child.

These 'specific' objects or situations in the 'environment' most likely produced, or 'triggered', an extreme fear response at the time, hence the use of the term *specific environmental trigger* to describe this type of factor contributing to the development of a phobia.

Figure 9.8 The specific environmental trigger for a phobia of flying may be a single experience of having been on a flight during severe turbulence or an electrical storm.

Often, an initial fear response to a specific environmental trigger becomes a conditioned fear response through classical conditioning processes and is produced whenever the stimulus (or a generalised version) is subsequently encountered. For example, 17-year-old Vanh has had an extreme fear of dogs ever since he was bitten by a neighbour's poodle when he was 5 years old. Vanh will not even go shopping at the local convenience store because it is next to a pet shop, which often displays pups for sale in the front window. In effect, Vanh developed a conditioned response (fear) to a conditioned stimulus (the poodle) that has been generalised to similar stimuli — any dog.

Research findings indicate that the more severe the trauma associated with an unpleasant or harmful initial fear experience, the more likely it is that a phobia will develop. In addition, if the experience is sufficiently traumatic, one encounter may be enough to produce and maintain the fear response. For example, a single experience of being bitten by a dog might be sufficient to produce and maintain a dog phobia even if the person is never bitten again, whereas barking might not lead to a dog phobia until after a number of subsequent exposures to a barking dog (Beck, 1976).

People who develop a phobia after a single traumatic encounter with a phobic stimulus (i.e. a specific environmental trigger) are usually able to identify that particular traumatic event as causing their phobia. For example, an 8-year-old child developed a strong fear and fainting reaction triggered by hospitals, doctors and smells of anaesthesia after he had a very serious operation, and a 23-year-old woman with a phobia of high places developed her phobia when she fell from a high diving board and seriously injured herself (Sue et al., 2005).

A single traumatic experience does not, however, explain the origin of all phobias through direct experience. It is possible that two individuals may have a traumatic experience with the same object or situation and one subsequently develops a specific phobia while the other does not. For example, an individual who has grown up with dogs may be less likely to develop a phobia of dogs after being bitten, compared to an individual who is bitten the first time they encounter a dog.

Subsequent exposure to the object or situation after the negative or traumatic experience occurs can also influence development of a phobia. For example, an individual who resumes driving as soon as possible after a car accident will be less likely to develop a phobia of driving than someone who avoids driving for a time after the accident.

9.4.2 Stigma around seeking treatment

All mental health problems and disorders tend to attract some degree of stigma. However, the nature of specific phobia and its symptoms mean that individuals with a phobia are particularly vulnerable to experiencing stigma, which in turn affects their willingness to tell family and friends, let alone to seek treatment from a professional.

Stigma is a sign of social disapproval or social deficiency, often involving shame or disgrace. **Social stigma** refers to the negative attitudes and beliefs held in the wider community that lead people to fear, exclude, avoid or unfairly discriminate against people with a mental health problem or disorder. It can influence how people with a phobia think and feel about themselves and the way they believe they are viewed by others in the community. For example, individuals can develop self-stigma.

Self-stigma occurs when an individual accepts the negative views and reactions of others, internalises them, and applies them to themself, thereby affecting how they feel about themself and leading to low self-esteem and low self-confidence in their abilities (called low *self-efficacy*). Self-stigma can inhibit people from seeing a mental health professional for assessment and diagnosis, or from seeking any type of help, thereby increasing the troublesome impact of their phobia by increasing the duration of the untreated affects.

For example, consider 17-year old Jackson who has had a phobia of thunder for as long as he can remember. Jackson feels very anxious during a thunderstorm even though he knows that the threat is actually minimal. His reactions are worse when lightning accompanies thunder. As well as feeling scared and uneasy, his heart pounds as if it will burst out of his chest, he trembles, often breaks out into a sweat and sometimes has what he believes is a panic attack, especially if he is caught in the open where he can't easily escape, hide or find shelter, or if the thunder is persistent or so loud that he can't smother its sound by covering his ears. As a child, he often cried, hid under his bed or in a cupboard, and sometimes wet himself whenever there was persistent thunder.

Jackson typically avoids going outside without checking the weather first. He does this visually and through the three different weather apps he has downloaded to his mobile phone. If it looks like being a 'bad (weather) day' and he must go out, he will constantly monitor the weather forecast via his phone apps.

Despite his long-standing phobia, Jackson has not sought any treatment. When he told some friends about his fear of thunder, they ridiculed and made fun of him and his fear. Once, he couldn't hide his fear or anxiety when the sky suddenly blackened during a sports day and he felt embarrassed and ashamed. That experience keeps haunting him. He feels like no-one believes his fear is real, even his family, who think he is 'overreacting', 'exaggerating' and should just 'grow up' or 'snap out of it'. Jackson is not sure he'll ever work up the courage to talk to anyone about it again as he doesn't think he can trust anyone to take him seriously and not think he's just 'being childish'.

All specific phobias are based on fears, that are, by definition, 'irrational'. This is one reason why it can be difficult to understand or empathise with people who have them. This is more likely for people with a phobia involving objects, activities or situations that are known to be harmless, such as balloons, buttons, butterflies, feathers, flowers, walking in a park on a sunny day and travelling on an escalator. Despite their terrifying fear of such objects or situations, telling someone may result in ridicule, belittling comments, not being taken seriously and sometimes discrimination through differential treatment.

Furthermore, because the fear associated with specific phobias is typically limited to the phobic stimuli and many people with a phobia seem to function 'normally' outside of the phobic situation (as long as their phobia stimuli are avoided), it is common to believe that specific phobias are 'less severe' than other anxiety disorders and may not even be a real 'disorder' at all. These beliefs may be held by people with and without a phobia. In addition, some people have personal or cultural beliefs that inhibit them. For example, they may feel strong enough to cope on their own or they may feel that the treatment process in itself may be humiliating.

In one study of stigma associated with phobias, a significant number of participants reported that attitudes towards them were profoundly detrimental and the anticipation of such reactions made them wary of disclosing their phobia or seeking treatment. Of those who did reveal their phobia to others, most found that few actually *understood* what a phobia is, and what it means for the sufferer's life.

Participants in this study also reported that due to the extent of the negative reactions they routinely face, many disguise the reality of their disorder and explain their avoidance of particular objects in other non-phobic terms. For example, one participant with a phobia of jewellery felt unable to reveal this so she publicly claimed to suffer from an allergic reaction to jewellery, rather than expose herself to the ridicule and loss of respect she anticipated would accompany an admission of the source of her fear, particularly in her workplace (Davidson, 2005).

Figure 9.9 People with a specific phobia involving an object, activity or situation that is apparently harmless to others, such as an encounter with a butterfly, are particularly vulnerable to stigma.

9.4 LEARNING ACTIVITY 1

Review

Complete the following table to summarise social factors contributing to the development of a specific phobia. After you have done so, you may combine information in the table with that completed for biological and psychological factors to create a single table.

Social factor	What is it?	How it may contribute
specific environmental trigger		
stigma surrounding treatment		

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

9.4 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.40 (adapted); ©VCAA

Which one of the following does not explain why stigma is viewed as a social risk factor in the development and progression of specific phobia?

A. People with a specific phobia avoid seeking support.
B. People with a specific phobia perceive themselves as different.
C. People with a specific phobia perceive having a mental illness as shameful.
D. Stigma supports negative stereotypes about specific phobia in the community.

Question 2 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.40 (adapted); ©VCAA

Which of the following accurately categorises both a contributing factor in the development of a specific phobia and an evidence-based intervention used to treat a specific phobia?

	Contributing factor	Evidence-based intervention
A.	GABA dysfunction	CBT (social)
B.	classical conditioning (biological)	challenging unrealistic thoughts (psychological)
C.	catastrophic thinking (psychological)	psychoeducation (social)
D.	stigma around seeking treatment (psychological)	breathing retraining (biological)

Question 3 (2 marks)

Source: VCAA 2017 Psychology, Section B, Q.6d (adapted); ©VCAA

Zac lives with his parents and contributes financially to the household by paying all of the rent. Zac was quite stressed about the expectations placed on him to provide financially for the family. Recently, Zac's fear of being in open or unfamiliar places (agoraphobia) has worsened to the extent that he can no longer leave the house and has quit his job to avoid going outside. Zac was quite stressed and tried to manage his distress through substance use. He subsequently isolated himself within the house from friends and family.

Identify **one** possible source of stigma and how this stigma could be a barrier to Zac accessing treatment for his agoraphobia.

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9.5 Evidence-based interventions in the treatment of specific phobia

Evidence-based interventions are treatments that have been found to be effective on the basis of scientific evidence; more specifically, peer-reviewed research studies. These are crucial to the delivery of mental health care in Australia and internationally.

Treatments are based on a thorough evaluation of evidence from published research studies, rather than based solely on theory. This helps ensure treatments are beneficial, while minimising the risk of harm (APS, 2018).

Treatments are typically supplied by professionally qualified and competent people; for example, qualified and trained to properly administer the treatment, monitor the client's progress, recognise any adverse effects and adjust or stop the treatment when required.

Evidence-based interventions also help ensure specific treatments are appropriate and vary according to the particular disorder and the individual's ('client's') specific symptoms. For example, just as treatment for tonsillitis differs from that for a heart disorder, treatments for a specific phobia will differ from those for an eating disorder.

Finally, evidence-based interventions help ensure treatments lacking scientific evidence of effectiveness are recognised and avoided. For example, it is important to recognise the difference between evidence-based interventions and 'fringe' or pseudoscientific interventions because the latter can prevent people from getting effective treatment and in some cases may be dangerous.

In this section, we examine evidence-based interventions used in the treatment of specific phobia from a biopsychosocial perspective. These include biological interventions involving the use of benzodiazepine medications and breathing retraining, psychological interventions involving the use of cognitive behavioural therapy and systematic desensitisation, and a social intervention involving psychoeducation for families and others who may be close to or provide social support for someone with a specific phobia.

9.5.1 Biological interventions

Biological interventions target bodily ('biological') mechanisms believed to be contributing to a phobia or its symptoms. These can involve the use of medications that target GABA dysfunction and can minimise the onset or severity of symptoms, and/or relaxation techniques involving an activity such as breathing retraining that is under the control of the individual and which can also help in the management of symptoms.

Use of anti-anxiety benzodiazepine agents

Benzodiazepines (pronounced 'ben-zoh-die-AZ-a-peens') are a group of drugs ('agents') that work on the central nervous system, acting selectively on GABA receptors in the brain to increase GABA's inhibitory effects and make postsynaptic neurons resistant to excitation. While psychological interventions are usually the first option for the treatment of specific phobia, the effectiveness of benzodiazepines in the treatment of anxiety in general provides evidence for the role of GABA in phobic anxiety.

Benzodiazepines have both anti-anxiety and sleep-inducing properties. They are commonly referred to as sedatives, mild tranquillisers or depressants, because they slow down CNS activity. Generally, they relieve symptoms of anxiety by reducing physiological arousal and promoting relaxation. However, they also induce drowsiness, can be highly addictive and their long-term use is not recommended.

As shown in Table 9.2 on the next page, there are many different types of benzodiazepines, each of which is sold under a different brand name. The most common benzodiazepines prescribed in Australia are temazepam, nitrazepam, diazepam, oxazepam and alprazolam. These have brand names such as Valium, Serepax and Xanax, and are usually taken orally (Beyond Blue, 2022a).

Generally, drugs and other medications work either by stimulating a neurotransmitter's activity (called *agonists*) or by inhibiting a neurotransmitter's activity (called *antagonists*). Benzodiazepines are **GABA agonists**. This means they stimulate activity at the site of a postsynaptic neuron where GABA is received from a presynaptic neuron. In this way, benzodiazepines have inhibitory effects on postsynaptic neurons throughout the brain and reduce the symptoms of anxiety by imitating GABA's inhibitory effects.

When a benzodiazepine attaches to a GABA receptor, it changes the shape of the receptor to make it more receptive to the activity of GABA and consequently more resistant to excitation. Reducing the excitability of neurons reduces the communication between neurons and, therefore, has a calming effect on many of the functions of the brain.

If there is no GABA at a receptor on a postsynaptic neuron, a benzodiazepine has very little effect on the neuron. If GABA is present, then the benzodiazepine will usually amplify the impact of GABA (Diamond, 2009).

Table 9.2 Some of the different generic and brand names of benzodiazepines prescribed and sold in Australia

Generic name	Brand name	Type of benzodiazepine
diazepam	Valium®, Ducene®	long-acting
oxazepam	Alepam®, Murelax®, Serepax®	short-acting
nitrazepam	Alodorm®, Mogadon®	intermediate-acting
temazepam	Normison®, Euhypnos®	short-acting
alprazolam	Xanax®, Kalma®, Alprax®	short-acting

Source: Adapted from: Brands B, Sproule B & Marshman J. (eds) (1998) *Drugs & Drug Abuse* (3rd ed.) Ontario: Addiction Research Foundation.

Studies of antagonists have found them to have the opposite effect on phobic anxiety. Antagonists reduce GABA activity and can therefore produce or increase the severity of anxiety symptoms. For example, studies with apes and other primates have found that physiological symptoms of anxiety can be induced when a benzodiazepine antagonist is administered. This provides further evidence of the role of GABA in anxiety (Sadock et al., 2007).

Different benzodiazepines are processed by the digestive system and eliminated from the body at different rates. Therefore, as shown in Table 9.2, a benzodiazepine may be described as short-acting, intermediate-acting or long-acting.

Short-acting means that benzodiazepine remains in the bloodstream and is cleared from the body in a short period of time. In contrast, a *long-acting* benzodiazepine may accumulate in the bloodstream or take a much longer period of time to leave the body. For example, the effects of one of the more common short-acting benzodiazepines, temazepam (e.g. Normison), reach a peak after two or three hours, and the drug ceases to be effective after about six to eight hours. The effects of diazepam (e.g. Valium), however, peak after 30 to 90 minutes, while the drug remains in the blood for up to three days.

Some people use a benzodiazepine intermittently to help cope with an occasional, unavoidable encounter

Figure 9.10 Benzodiazepines are effective in reducing anxiety symptoms by reducing physiological arousal and having an overall calming effect. They are useful for treating the symptoms but do not ‘cure’ a specific phobia or any other anxiety disorder. When use is discontinued, symptoms can return if other significant contributory factors have not been addressed.

with a phobic stimulus. For example, an individual with a fear of flying, who must travel interstate for a business meeting, may be prescribed a short-acting benzodiazepine with a rapid onset of action to take an hour or so before they board to help tolerate a flight. Or, a person with a dental phobia may take a short-acting, rapid onset benzodiazepine before an appointment to enable them to endure the necessary dental procedure (Gazzaniga & Heatherton, 2006).

Although benzodiazepines tend to be highly effective in reducing anxiety with few side-effects in the short term, there are potential negative consequences associated with their long-term use as they can reduce alertness, abilities dependent on alertness (e.g. concentration, reaction time) and can be addictive. Benzodiazepines can also lower inhibitions and make some people more impulsive and likely to take risks, particularly if these medications are mixed with alcohol or other drugs. The medications can be used safely with little risk, even over long periods of time, but some people become dependent on their use.

Importantly, benzodiazepines treat the symptoms and not the cause of anxiety. Once medication is stopped, symptoms may return if the underlying cause of the anxiety — the specific phobia — has not been addressed. In addition, use of a benzodiazepine alone may alleviate symptoms but does not actually teach any non-drug dependent coping skills for dealing with anxiety, so they are not widely supported as a long-term solution for a specific phobia (Beyond Blue, 2022a).

Breathing retraining

People experiencing a phobic reaction can over-breathe as respiration rate normally increases in the presence of a perceived threat. They may breathe faster and deeper than necessary (*hyperventilation*) or get into a pattern of uncontrolled rapid and shallow breathing (*tachypnea*). A significant problem is that an abnormal breathing pattern can become habitual and actually increase fear or anxiety. Research has found that many people with specific phobias develop abnormal breathing patterns (Reavley et al., 2013).

Over-breathing is excessive breathing. A consequence of excessive breathing is that we take in more air than the body actually needs. This can upset the balance of oxygen and carbon dioxide, resulting in a low level of carbon dioxide in the blood. Too little carbon dioxide can cause reactions such as dizziness, light-headedness, blurred vision and pins and needles, all of which are associated with a panic attack and can heighten feelings of fear and anxiety. Over-breathing may also cause breathlessness — a sensation of shortness of breath or difficulty breathing. This is a common reaction but it can be both distressing and frightening.

An overall effect of over-breathing is that a counterproductive cycle may be created as a person can become more fearful or anxious because they feel breathless, which leads to more difficulty breathing and other fear, anxiety or panic symptoms. Sometimes, their abnormal breathing pattern may be

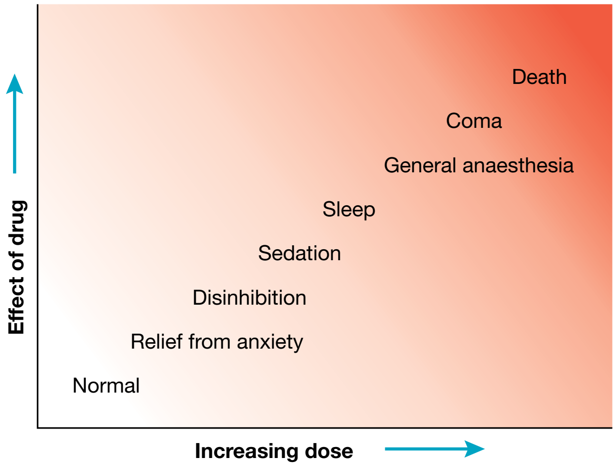

Figure 9.11 A behavioural continuum of sedation. Note the relationship between dosage and behavioural effects. A low dose of a sedative or anti-anxiety drug reduces anxiety, but very high doses are dangerous and can result in death.

Figure 9.12 Fear or anxiety can cause excessive breathing (e.g. hyperventilation) and make the person feel short of breath. This abnormal breathing pattern may increase anxiety and can become habitual.

a tipping point or actually trigger the onset of a panic attack — an extreme anxiety response to a phobic stimulus.

Breathing retraining, also called *breathing training*, is an anxiety management technique that involves teaching correct breathing habits to people with a specific phobia. Breathing retraining helps people to maintain correct breathing or correct abnormal breathing patterns when anticipating or exposed to a phobic stimulus, so it may also help to reduce anxiety or alleviate some of its symptoms. Breathing retraining can give people control over their breathing and may therefore also help them feel as if they have more control of their fear or anxiety (Reavley et al., 2013).

An appropriate breathing pattern generally involves slow, regular breaths in through the nose and out the mouth at a controlled rate as opposed to fast and/or irregular, shallow 'chest breathing' or the rapid, deep breathing of hyperventilation. The goal is to slow the respiration rate, promote a 'normal', regular breathing pattern, prevent over-breathing and maintain the correct balance of oxygen and carbon dioxide in the blood.

Our respiration rate also has an impact on our heart rate, blood pressure and other bodily functions. Slow, regular breathing promotes relaxation. It slows bodily processes, lowers arousal, and in turn can reduce anxiety and stress. Slowing the respiration rate is also an effective method of inhibiting a fight–flight–freeze reaction and returning to a normal state after it has been activated. Generally, a slow respiration rate and fight–flight–freeze are mutually exclusive, which means they can't occur at the same time.

Breathing retraining may also involve teaching the individual how to quickly restore the level of carbon dioxide in their blood if they start over-breathing. This will essentially involve learning a technique that increases carbon dioxide by taking in less oxygen. For example, this can be accomplished by breathing through pursed lips (as if blowing out a candle), or by covering the mouth and one nostril, and breathing through the other nostril.

Breathing retraining can be used by itself or in combination with other treatments. Some studies have found that it can reduce the risk of over-breathing, increase the threshold ('tipping point') for the onset of a panic attack and generally promote relaxation. It may also help individuals manage the physiological arousal and tension they experience when exposed to a phobic stimulus and to correct breathing habits that make their symptoms worse. An advantage is that a person can use their correct breathing technique in public situations without drawing much attention.

However, breathing retraining also needs to be practiced, especially when not particularly anxious, in order to make it habitual. This will make it more likely that an individual will be able to implement the technique even when highly anxious and perhaps not thinking clearly. Generally, breathing retraining is potentially beneficial, but other interventions have been found to be more effective (e.g. CBT) and there is no evidence indicating that it 'cures' specific phobias (Leahy et al., 2012; Reavley et al., 2013).

9.5 LEARNING ACTIVITY 1

Review

1. a. Explain the meaning of 'evidence-based intervention'.
   b. Give two reasons to explain why an 'evidence-based intervention' is the preferred choice for treating specific phobia.
2. a. What are benzodiazepines?
   b. Why are they classified as agonists rather than antagonists?
   c. Explain how benzodiazepines work in alleviating anxiety.
   d. Explain the meaning of short-acting and long-acting in relation to benzodiazepines.
   e. Give two advantages and two limitations of using benzodiazepines to treat phobic anxiety.
3. a. What is breathing retraining?
   b. What does it aim to achieve?
   c. Give an example of an abnormal breathing pattern that may be developed by people with specific phobias and explain why this pattern needs retraining input.
   d. Give an example of a breathing pattern that may inhibit or alleviate fear or anxiety symptoms.

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9.5 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.42; ©VCAA

Which of the following accurately categorises both a contributing factor in the development of a specific phobia and an evidence-based intervention used to treat a specific phobia?

	Contributing factor	Evidence-based intervention
A.	the stress response (biological)	exercise (social)
B.	classical conditioning (biological)	challenging unrealistic thoughts (psychological)
C.	catastrophic thinking (psychological)	psychoeducation (social)
D.	stigma around seeking treatment (psychological)	breathing retraining (biological)

Question 2 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.8; ©VCAA

In terms of assessing and managing the mental health of an individual, the biopsychosocial model considers

A. biological factors more important than psychological and social factors.
B. psychological factors more important than biological and social factors.
C. biological, psychological and social factors equally as important, and interacting to influence mental health.
D. biological, psychological and social factors equally as important, but not interacting to influence mental health.

Question 3 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.34 (adapted); ©VCAA

Mary was prescribed medication to treat her specific phobia. Mary took the medication as prescribed, but still had symptoms of her phobia. Mary's psychiatrist used breathing retraining and benzodiazepines to manage Mary's condition.

Breathing retraining and benzodiazepines are examples of

A. social approaches because they involve human interaction.
B. biological approaches because they reduce physiological arousal.
C. psychological approaches because they reduce physiological arousal.
D. psychological approaches because they reduce psychological arousal.

Question 4 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.45; ©VCAA

A benzodiazepine can be used to treat a specific phobia because it

A. increases the efficiency of the inhibiting action of GABA.
B. decreases the efficiency of the inhibiting action of GABA.
C. increases the efficiency of the inhibiting action of glutamate.
D. decreases the efficiency of the inhibiting action of glutamate.

Question 5 (3 marks)

Source: VCAA 2020 Psychology, Section B, Q.6b; ©VCAA

When she turned four, Maxine received a medium-sized red box out of which popped a clown figure making a loud noise. When the box opened, Maxine ran away from it, towards her parents, screaming in fear. Her parents comforted her by playing with her. As a teenager, Maxine still runs away whenever she sees a similar box and her parents continue to comfort her. Maxine's parents have decided to consult a psychologist with Maxine to try to manage her phobia.

The psychologist discussed with Maxine and her parents the option of using a benzodiazepine agent to manage Maxine's phobia. How could a benzodiazepine agent help manage Maxine's phobia?

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

9.5.2 Psychological interventions

For some people, a specific phobia can cause major disruption to their everyday lives because they have to go to great lengths to avoid the object or situation that triggers their fear or anxiety. For example, a tradesperson may avoid taking jobs in high places due to their fear of heights, an executive may have to turn down a promotion involving overseas travel because of their fear of flying, and someone who works on the 30th floor of a city office building may have to walk up and down the stairs each day due to an intense fear of being exposed to someone else's germs in the confined space of an elevator.

Similarly, people whose phobias are focused on everyday objects, activities or situations will regularly encounter them, so phobic anxiety and avoidance may become central to their lives. However, if the phobic stimulus is rarely encountered, it will not continually interfere with the person's functioning or cause distress, so in these instances, the person is not likely to seek professional help. For example, a person might have a fear of being buried alive (taphephobia), but this situation is very unlikely to be encountered and is therefore not likely to cause significant disruption to a person's life.

People typically seek treatment from a professional only if a phobic stimulus is frequently encountered and is therefore constantly intruding on everyday life. Two of the most commonly used psychological interventions are the 'talking therapy' called cognitive behavioural therapy and a therapy such as systematic desensitisation which involves gradual exposure to phobic stimuli.

Cognitive behavioural therapy (CBT)

As the name suggests, **cognitive behavioural therapy**, commonly referred to as CBT, is a type of psychotherapy that combines cognitive and behavioural therapies to treat phobias and other mental health problems and disorders.

A core assumption of CBT is that the way people feel and behave is largely a product of the way they think, and that subsequent behaviours and emotions can influence cognitions. The mental health professional works with individuals to identify unhelpful thoughts, emotions and behaviours.

The *cognitive therapy* part of CBT is based on the theory that distressing emotions and maladaptive behaviours are the result of faulty patterns of thinking. Therefore, an intervention such as *cognitive restructuring* is a technique that may be used to help the individual identify their cognitive biases and other distorted ways of thinking, refute them, and then modify them so that they are adaptive and reasonable.

The *behaviour therapy* part is based on the theory that behaviour is learned and therefore can be changed. Examples of behavioural techniques include exposure therapy (such as systematic desensitisation), relaxation, mindfulness meditation, activity scheduling and behaviour modification (APS, 2018; APA, 2022).

Unlike other types of 'talking' therapies, CBT does not involve talking freely about whatever comes to mind or dwelling on events in a person's past to gain an insight into their psychological state. It is not a 'lie on the couch' type of therapy.

CBT provides a structured program that tends to be relatively short-term and focused on the 'here and now' — how a person's current thoughts, feelings and behaviours are presently affecting them. Although CBT recognises that events in a person's past have shaped the way they currently think and behave, this is not the focus. CBT aims to find solutions on how to change a person's current

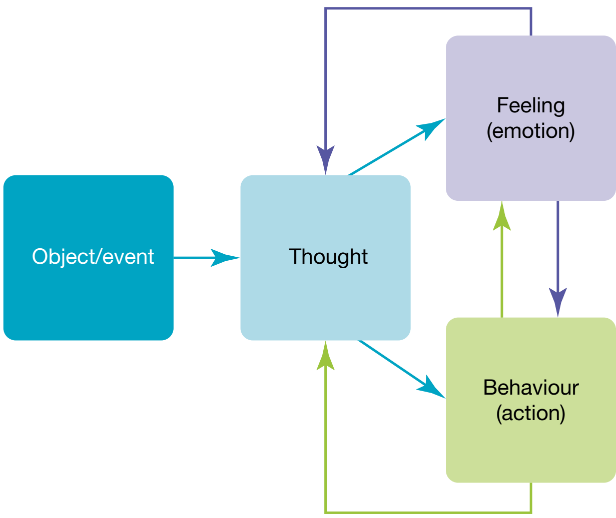

Figure 9.13 A key assumption of CBT is that any object or event we encounter is initially cognitively appraised or interpreted, which leads us to feel and behave in ways that reflect our thoughts. Our behaviour may also influence our feelings, and our feelings may also influence our behaviour.

thoughts and behaviours so that they can function better now and in the future.

Most people with a specific phobia have cognitive biases and excessive behavioural reactions to fear- or anxiety-producing stimuli. Therefore, CBT aims to change thoughts and behaviours that perpetuate the phobia and to improve coping skills. It has been found to be effective in both the short term (immediately after treatment) and the long term (many years after treatment) (APS, 2018).

In addressing the thought patterns underlying a specific phobia, CBT aims to assist the individual to develop a new understanding that their feared stimuli are not (or are unlikely to be) dangerous, so their avoidance and safety behaviours are unnecessary and unhelpful in the long term.

Avoidance and safety behaviours are used by people with phobias to help minimise or control their fear or anxiety. *Avoidance behaviour* involves actions that help avert any contact, exposure or engagement with a feared object, activity or situation. Simply staying away from a phobic stimulus is an example of avoidance behaviour.

Alternatively, an individual may engage in *safety behaviour* whereby they may not directly avoid a phobic stimulus but are willing to have contact with it if certain precautions are in place. For example, someone who is fearful of insects may wear a hat, heavy gloves, long trousers and boots when gardening and someone who is fearful of exposure to germs may visit a friend who has a non-infectious disease only if they are taking a preventative course of antibiotics and can minimise touching objects within their friend's house (Anderson et al., 2011).

Avoiding objects, activities and situations, or using safety behaviours to cope with them, may prevent a feared outcome and reduce anxiety, but the individual tends to become reliant on them and they perpetuate the phobia. Consequently, they are considered maladaptive and are targeted for treatment.

During CBT, the individual will be encouraged to identify their fear- and anxiety-related thoughts as these are likely to reflect cognitive biases that strongly affect whether they experience fear or anxiety and how they behave when exposed to a phobic stimulus. For example, if a person truly believes that all birds might attack them, it should not be surprising that they will be frightened and anxious around birds. However, once the individual can recognise unhelpful ways of thinking that are contributing to their fear and anxiety, they will be better able to make changes to replace these with new ways of thinking that reduce fear and anxiety.

Professionals may use a range of techniques in CBT to help someone identify their cognitive distortions and other unhelpful thinking patterns. For example, some may guide the individual to self-discovery of flawed thoughts underlying their maladaptive feelings and behaviour. Others, in contrast, may take a more direct and blunt approach and explain to the individual why their thinking is flawed.

The individual is then encouraged to look for evidence that supports their fear cognitions and evidence that does not support them. One way of helping a person achieve this is to encourage them to think about their thoughts as hypotheses (rather than facts) that must be subjected to testing and objective evaluation. The assumption is that once these thoughts are recognised as hypotheses and not facts, they are open to questioning and challenging.

Sometimes, a person's cognitive biases result from a lack of information or from inaccurate information. One way of changing such thinking is to encourage the individual to gather accurate information about their phobic stimulus; for example, from experts, books or other reliable sources.

Information may also be provided to the individual. For example, a person who has panic attacks and believes their symptoms are signs of an impending heart attack may be informed about the physiology of anxiety and fear and how the symptoms relate to cardiac functioning.

A person may also be advised to take a course that has an 'education component' and provides accurate information about relevant phobic stimuli. For example, fear of flying is often related to misperceptions about the vibrations, movements and sounds heard during the flight. Most of these stimuli reflect the normal operation of a flying plane and aspects of flight that do not actually indicate an impending crash. Several airlines, including Qantas, offer courses for people who are afraid of flying that provide extensive information about various aspects of aeroplanes and flight to promote realistic thinking with the goal of alleviating fear or anxiety through education.

Figure 9.14 CBT for aerophobia will target thoughts and behaviours that perpetuate the fear of flying.

learnON

learnMORE | Fearless Flyers program for aerophobia

Access learnON for a description of a course to help people overcome their fear of flying.

Once the individual has identified their cognitive biases and evaluated the 'evidence', they are better able to counter them with alternative, more objective and useful thoughts. This can help them face their fears and approach fearful situations more rationally. For example, if a person thinks that birds are likely to fly away as they approach them (instead of thinking that they are likely to attack them), they are less likely to be afraid or feel compelled to avoid them. Engaging in more balanced and objective thinking about a phobic stimulus will then lead to changes in feelings and behaviour, particularly a reduction in fear, anxiety and avoidance.

Behaviour therapy is also a major component of CBT. This could include teaching a relaxation technique, breathing retraining, promoting exercise and/or encouraging activities that are rewarding, pleasant or give a sense of satisfaction. All of these can help distract from or reduce fear and anxiety. The individual is also likely to be taught a technique to help them actually cope with fearful situations. This can be achieved through a behaviour therapy called systematic desensitisation.

Systematic desensitisation

Behaviour therapy for specific phobias relies mainly on treatment involving gradual and repeated exposure to phobic stimuli. There are a number of different approaches to this type of therapy, but they all typically involve exposing the individual to the specific objects or situations that make them fearful and anxious in a safe and controlled way. The goal is to help the individual cope with fearful objects or situations rather than avoid or escape them.

Systematic desensitisation is a commonly used and effective 'graduated exposure' technique that has helped people manage their fear of dogs, spiders, snakes, heights, dentists, mice, balloons, feathers, violins, tunnels, needles or eating in public, sometimes in a single session. It was first developed in the 1950s by South African psychiatrist Joseph Wolpe (1958) to successfully treat an adult female client with agoraphobia (fear being in open or unfamiliar places), but the technique has since been modified.

Systematic desensitisation is a kind of behaviour therapy that aims to replace an anxiety response with a relaxation response when an individual with a specific phobia anticipates or encounters a fear stimulus. The technique applies classical conditioning principles in a process that involves *unlearning* the connection between anxiety and a specific object or situation and *reassociating* feelings of relaxation (and safety) with that particular object or situation.

Generally, the three-step process requires the individual to learn to relax while gradually facing increasingly anxiety-producing phobic stimuli. Over time, the individual associates being relaxed with their phobic stimuli instead of anxiety. Because it is physiologically impossible to be anxious and relaxed at the same time, the individual gradually, or 'systematically', becomes 'desensitised' to anxiety caused by the phobic stimulus (Antony & Swinson, 2000).

The first step in systematic desensitisation involves teaching the individual a relaxation technique that they can use to decrease the physiological symptoms of anxiety when confronted by a phobic stimulus. This may include breathing retraining to learn a slow breathing technique, progressive muscle relaxation and/or visual imagery. As its name suggests, a slow breathing technique involves learning to slow down the respiration rate, either when over-breathing (e.g.

hyperventilating) or, preferably, before its onset. An example of the technique is summarised below.

- Hold your breath for six seconds.
- Breathe in and out on a 6-second cycle, saying the word 'relax' as you breathe out.
- After 1 minute, hold your breath again, then continue to breathe on a 6-second cycle.
- Repeat the sequence until anxiety has diminished.

The second step in systematic desensitisation involves breaking down the anxiety-arousing object or situation into a sequence arranged from least to most anxiety-producing. This is called a fear hierarchy. A **fear hierarchy**, also called an *anxiety hierarchy*, is a list of feared objects or situations, ranked from least to most anxiety-producing. Working with the therapist, the individual identifies different phobic stimuli and constructs a 'step ladder' of anxiety-producing objects and/or situations, with the steps gradually increasing in difficulty.

Ideally, fear hierarchies should consist of 10 to 15 specific situations, each of which is rated and then ranked ('ordered'), often on a 100-point scale. For example, the least anxiety-producing situation may be rated at 30 on a 100-point scale and the most anxiety-producing situation may be rated at 100. Each situation should be quite detailed, including relevant variables such as time of day, duration of exposure and presence of other people.

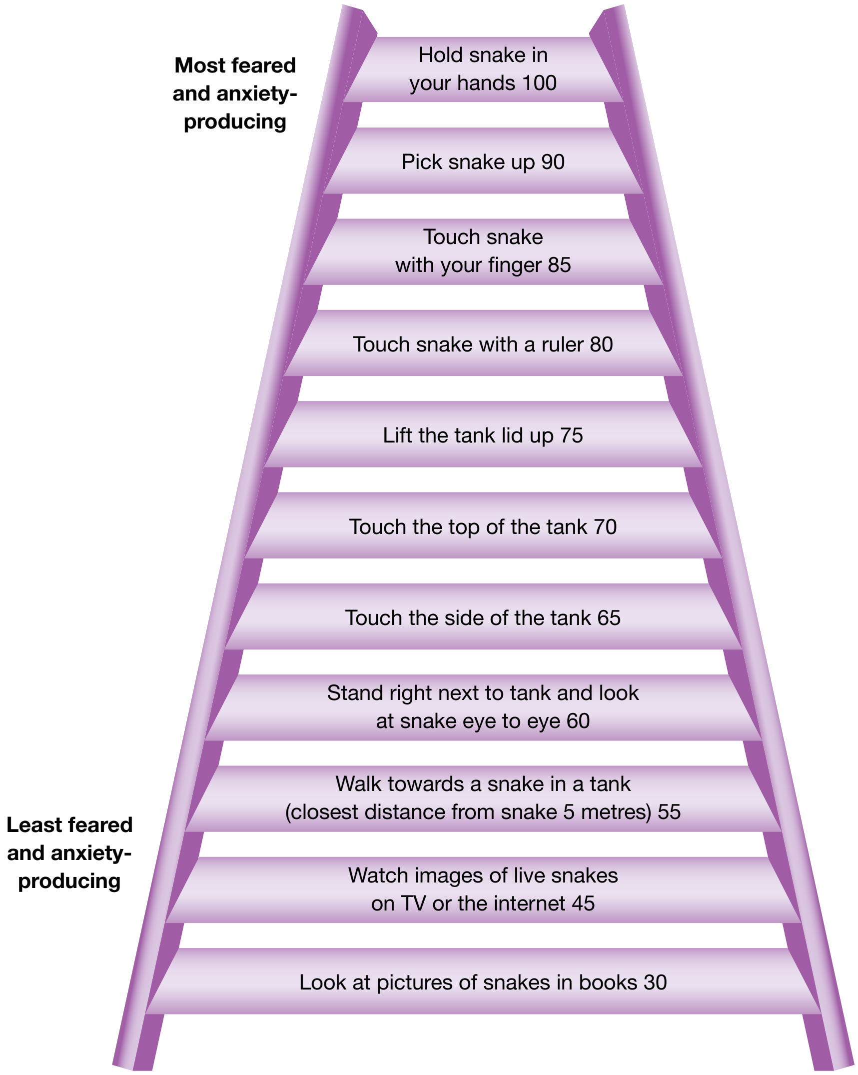

Figure 9.15 An example of a fear hierarchy for a snake phobia (ophidiophobia)

The third step involves the systematic, graduated pairing of items in the hierarchy with relaxation by working upwards through items in the hierarchy, one 'step' at a time. This can be achieved either *in vivo* (in real life) or using *visual imagery* ('imagination') and, more recently, using virtual reality technology during which the individual is exposed to computer-generated scenarios involving the phobic stimulus.

At every step, the individual is encouraged to relax and no advancement is made to the next step until relaxation is achieved. Systematic desensitisation sessions continue until the individual can respond to the most anxiety-producing situation in the fear hierarchy in a relaxed state.

For example, an anxiety-producing situation such as travelling in an elevator could be broken down into a sequence of steps starting with looking at elevators (watching them come and go); standing in a stationary elevator with a support person; standing in a stationary elevator alone; travelling up or down one floor with a support person then gradually extending the number of floors travelled, first with a support person and then alone with the support person waiting outside the elevator; and finally travelling on an elevator alone without a support person nearby. The individual is then asked to visualise the least frightening of the steps while in a relaxed state. If the individual can successfully visualise the fear-producing stimulus and remain relaxed, the next step is tackled.

on Resources

Weblink Fear hierarchy templates

9.5 LEARNING ACTIVITY 3

Review

1. a. What is CBT?
   b. From a CBT perspective, explain why avoidance and safety behaviours are not helpful to a person with a specific phobia.
   c. What are two possible goals of a CBT treatment plan for a specific phobia?
2. a. What is systematic desensitisation?
   b. Explain what a fear hierarchy is and how it is used with reference to treating someone who has a phobia of dogs.
   c. Construct a simple flowchart to summarise the three steps in systematic desensitisation.
   d. In what way does systematic desensitisation apply classical conditioning principles?
   e. Helena has a fear of flying. Together with her therapist, she has constructed a fear hierarchy. Put the steps of her fear hierarchy in the most likely order that she would approach them using systematic desensitisation.
      - The plane doors closing
      - Checking in
      - Boarding the plane
      - The plane taxiing to the runway
      - Thinking about travelling by plane
      - Taking off
      - Arriving at the airport
      - Travelling to the airport in a taxi
      - Being asked to fasten her seatbelt
      - Packing her luggage
      - Booking her plane ticket on the internet
      - Going to the departure lounge
      - Watching the flight attendants demonstrate the safety drill

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9.5 LEARNING ACTIVITY 4

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.49; ©VCAA

Which of the following correctly describes cognitive behaviour therapy and systematic desensitisation?

	Cognitive behaviour therapy	Systematic desensitisation
A.	requires the development of a hierarchy	requires the development of a hierarchy
B.	involves the use of classical conditioning	does not involve the use of classical conditioning
C.	focuses on challenging negative thought patterns	does not focus on challenging negative thought patterns
D.	is not likely to involve breathing retraining	is not likely to involve breathing retraining

Question 2 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.49; ©VCAA

Eleanor's family goes to the beach once a year for their family holiday. One year, Eleanor, five, and her sister Janet, seven, were playing when their father scared the girls by pretending to be a sea monster covered in seaweed. Janet laughed at their dad for being silly but Eleanor got a dreadful fright. Two days later, the girls had an argument and Janet threw seaweed at Eleanor, who covered her face with her hands and became distressed. The following year, Eleanor cried each time the family discussed going back to the beach for a holiday. Her mother was concerned about her behaviour and a consultation with a psychologist revealed that Eleanor had developed a phobia of seaweed.

Which of the following identifies the most appropriate two strategies that Eleanor's family could use to help reduce Eleanor's cognitive biases regarding seaweed?

	Strategy 1	Strategy 2
A.	Teach Eleanor relaxation techniques to use when she feels anxious.	Remind Eleanor of a funny event at the beach.
B.	Encourage Eleanor to think positively.	Discourage Eleanor from avoidance behaviour.
C.	Provide evidence of times Eleanor enjoyed the beach.	Assist Eleanor in replacing negative thoughts with positive thoughts.
D.	Help Eleanor learn about mental illness.	Talk to Eleanor about positive experiences at the beach.

Question 3 (1 mark)

Source: VCAA 2017 Psychology, Q.50 (adapted); ©VCAA

Concerned about her continued reluctance to perform in public, Leanne's friends suggested that she see a psychologist. The psychologist works with Leanne to develop strategies to minimise her reluctance to perform in public. The psychologist first suggests that Leanne perform with her band in front of a close friend, nominated by Leanne, in familiar surroundings. When Leanne is able to do that without feeling anxious, the psychologist suggests that she practise playing with the band in front of a small group of friends in familiar surroundings. The next step involves Leanne performing with the band in front of a small group of friends in unfamiliar surroundings. Eventually, Leanne was able to perform with the band in public.

The treatment used by the psychologist was

A. retraining.
B. cognitive bias.
C. systematic desensitisation.
D. cognitive behavioural therapy (CBT).

Question 4 (1 mark)

Source: VCAA 2012 Psychology 2, Section A, Q.27 (adapted); ©VCAA

A psychologist treated a patient who suffered a phobia of flying. During the therapy the psychologist helped the patient to identify his unhelpful thoughts about flying, and to identify other helpful and more rational thoughts about flying.

The therapy that the psychologist used was

A. cognitive behavioural therapy (CBT).
B. systematic desensitisation.
C. biofeedback.
D. breathing retraining.

Question 5 (10 marks)

Source: VCAA 2021 Psychology, Section B, Q.7; ©VCAA

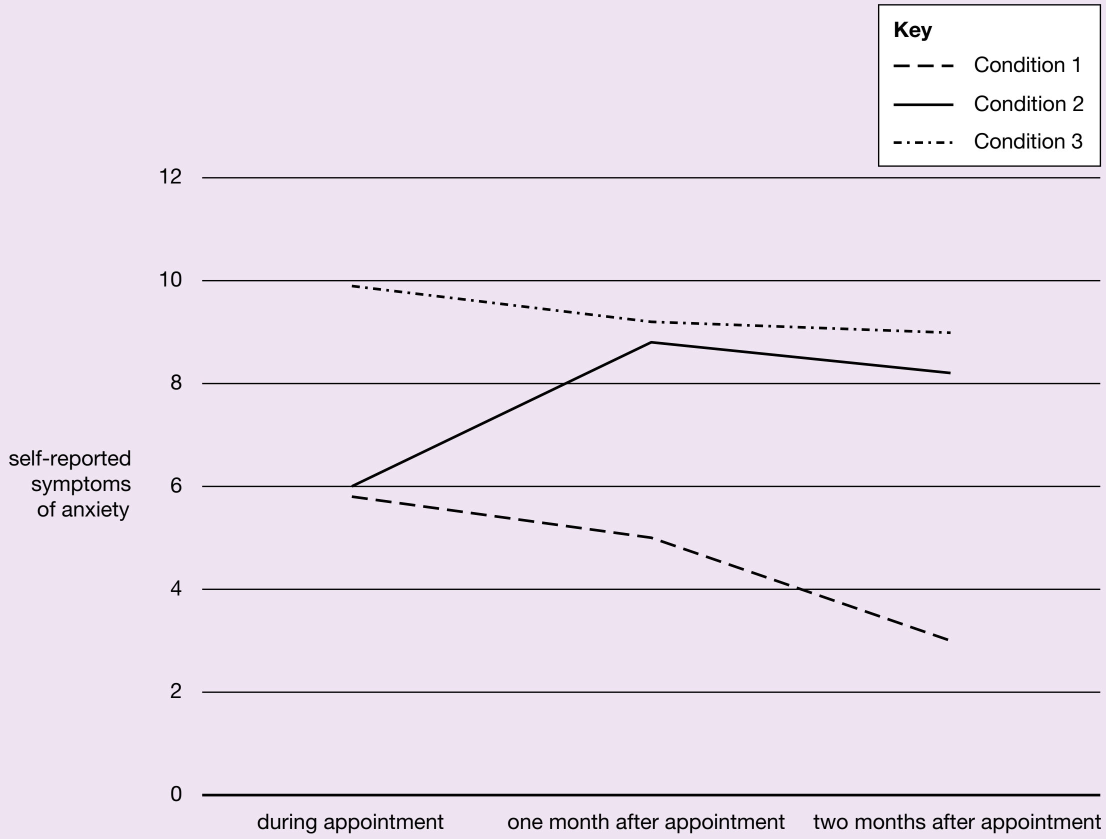
A research study compared the effects of two evidence-based treatment interventions on 87 patients with dental phobias. Participants were randomly allocated, in equal numbers, to one of three treatment conditions:

- Condition 1 – a single session of systematic desensitisation
- Condition 2 – administration of a benzodiazepine agent (taken before a dental appointment)
- Condition 3 – received no treatment for their dental phobia (control group)

In Condition 1 and Condition 2, the participants experienced fewer symptoms of anxiety during dental appointments than the participants in the control group (Condition 3), as measured by a self-report using a Likert scale.

One month after the dental appointment, phobic response returned for the participants in Condition 2 when they subsequently visited the dentist. However, the participants in Condition 1 did not have a return of their phobic response and showed further improvement when they visited the dentist two months later. Of these participants, 21 attended future dental appointments with minimal symptoms of anxiety, compared to only seven participants in Condition 2 and one participant in the control group (Condition 3).

The graph below shows the results of the study.



Analyse the results of the research study. In your response, include a comparison in terms of the similarities and differences in participants' symptoms of anxiety, as well as a discussion of how each condition (Condition 1 and Condition 2) acted to reduce participants' symptoms of anxiety.

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

9.5.3 Social interventions

To complement one or more biological and psychological interventions, treatment for a specific phobia may also involve a social intervention such as psychoeducation for family, friends or others who are close to the person with a specific phobia and therefore part of their social support network.

Psychoeducation for families and supporters

Psychoeducation is not a type of therapy but rather, a form of education. In relation to specific phobia, **psychoeducation** involves the provision and explanation of information to individuals about their phobia to assist their understanding of its characteristics and treatment. In some cases, psychoeducation may be broadened to include family members and others outside the immediate family who can provide social support and be educated about the importance of challenging inappropriate thoughts and not encouraging avoidance behaviours.

Psychoeducation is based on the assumption that increased understanding of symptoms, treatment options, services available and recovery patterns enables individuals to cope more effectively and live more productive and fulfilled lives (APS, 2018).

Psychoeducation can be implemented in a number of different formats and settings, but it rarely involves classroom-type teaching. The format and specific information depends on such factors as the specific phobia, the individual's symptoms, their age, access to social support and other aspects of their circumstances and needs. Psychoeducation programs can be provided in an individual or group format.

In general, a psychoeducation program for a specific phobia is likely to include specific information about the characteristics of the phobia and its causes and consequences. This may include details such as some or all of the following:

- the diagnosis and specific symptoms
- cause(s) and contributory factors to development and perpetuation
- prognosis; e.g. prediction of the future course, with and without treatment
- role of phobic stimuli
- what having a specific phobia is like for the individual, both psychologically and physiologically; e.g. avoidance and safety behaviours, anticipatory anxiety, panic attacks, fight–flight–freeze reactions
- impact on family, friends and others
- types of psychotherapies and treatment interventions that are available, what works, what doesn't and costs
- challenging unrealistic or anxious thoughts

Figure 9.16 Psychoeducation for specific phobia involves the provision of specific information to increase knowledge and understanding of the phobia and its treatment.

- how family, friends and others may support inappropriate thoughts or encourage avoidance behaviours and what they could do instead
- medication; e.g. what it does, how it works, benefits and side effects, potential consequences of misuse or abuse
- role and importance of breathing retraining, exercise, relaxation techniques and a healthy lifestyle in general
- role and importance of support networks
- dealing with stigma surrounding phobias.

There is considerable research evidence showing that the more educated a person is about their phobia and how it affects their own life and the lives of others, the more likely they are to actively monitor and effectively manage their phobia. Participation and self-management are further enhanced if the individual has access to appropriate support from families, friends and others.

In this section we examine psychoeducation for families, friends and other supporters with reference to their challenging unrealistic or anxious thoughts and not encouraging avoidance behaviours.

Challenging unrealistic or anxious thoughts

People with a specific phobia typically have anxious thoughts about their phobic stimulus. For example, a person with a needle phobia may think, ‘If I have a needle, it could hit a bone, lead to an infection and then I might die’, or, ‘I fainted once while getting an injection, so, I’ll never be able to get an injection again without passing out’.

The anxious thoughts that trigger and fuel phobias are usually negative and unrealistic. Often, the individual tends to overestimate how bad it will be if exposed to the object or situation they fear. At the same time, they underestimate their ability to cope. Unrealistic thoughts are unhelpful thoughts. They can trigger anxious thoughts, which are also unhelpful as they also fuel and perpetuate the phobia.

Learning to challenge unhelpful thoughts is an important step in overcoming a phobia, but this can be difficult when anxious or distressed. Families and other supporters can therefore play an important role in helping a person to cope with or overcome a phobia by encouraging them to recognise and challenge unrealistic or anxious thoughts.

Consider, for example, the case of 13-year-old Asha who has a moth phobia. Asha feels very afraid, nauseous and panicky at the sight of any moth, regardless of its size or the situation. She believes that all moths are malicious and that if she encounters a live moth, it will fly directly at her and cause some kind of physical harm. It may even get caught up in her hair or clothing, which could cause her to stop breathing or have a fit.

One day, Asha and her mother are sitting outside and Asha thinks she sees a moth in the distance. She quickly becomes distressed and panicky and says to her mother, ‘There’s a moth over there. It’s going to come and get me. Oh no, my hair is out! The moth is going to get stuck in it.’

During psychoeducation, Asha’s mother learnt that this was an opportunity to help guide Asha towards challenging her unrealistic and anxious thoughts about moth behaviour and the amount of harm a moth can actually cause her. Asha’s mother therefore stayed calm, acknowledged Asha’s worries but then gently challenged her distorted thinking. She reminded her that they are anxiety-influenced thoughts based on wrong assumptions and therefore without any real basis, and not necessarily facts. She encouraged Asha to consider the possibility that all moths would actually want to avoid her, and especially to not get tangled in her hair. Additionally, if by some remote chance a moth bumped into her or became entangled in her hair, clothing or something else, it would be impossible to be physically harmed because of its small size and fragility.

Families and other supporters can also help by encouraging the person with a phobia to test or evaluate their unrealistic or anxious thoughts when not exposed to a phobic stimulus and by supporting them through this process. For example, Asha might be encouraged to write down some of the negative thoughts she has yet to verbalise. After she has identified them in this way, she could be encouraged and assisted to evaluate them, with the goal of learning that they are merely thoughts, shaped by anxiety and fear, without any real basis, and that they should be questioned as they are often based on wrong assumptions.

American psychologist Melinda Smith and her colleagues (2021) have described an example of how a negative unrealistic or anxious thought can be challenged by someone with a phobia. The individual involved has a specific phobia of enclosed places and confinement (claustrophobia).

Negative thought: 'The elevator will break down and I'll get trapped and suffocate.'

Ask yourself the following four questions:

1. Is there any evidence that contradicts my negative thought?

Yes, for example:

'People are currently using the elevator and it hasn't broken down.'

- 'Even if it did break down, I've never heard of anyone dying from suffocation in an elevator. There are air vents which would stop the air from running out.'
- 'I've never been in an elevator that has broken down.'

2. Could you do anything to resolve this situation if it does occur?

- 'Yes, I could press the alarm or use the telephone to call for assistance.'

3. Are you thinking in an unhelpful way?

- 'I'm fortune telling, as there is no evidence to suggest that the elevator will break down or that I'd suffocate.'

4. What would you say to a friend who has this fear?

- 'I would tell a friend that the chances of the elevator breaking down are very slim, it's not something you hear about happening very often.'

Not encouraging avoidance behaviours

It's only natural to want to avoid objects or situations we fear, especially when they cause anxiety or distress. However, as demonstrated by the effectiveness of a behavioural exposure therapy such as systematic desensitisation, an important requirement for overcoming a phobia is to face what is feared.

While avoidance can make the individual feel better in the short term, it prevents them from learning that their phobia may not be as frightening or overwhelming as they think. They also never get the chance to learn how to cope with their fears and experience control over fearful situations. As a result, the phobia is not only perpetuated, but it can become increasingly fearful and more psychologically overwhelming. In addition, avoidance of certain objects or situations because of a phobia can also interfere with an individual's normal routine, which can make the overall experience of a phobia even more distressing (Smith et al., 2021).

It is therefore important that family members and supporters understand what avoidance behaviour is, the role it plays in perpetuating a phobia and how it can impact on daily functioning.

Often, family and supporters encourage or reinforce avoidance behaviours out of concern for the person and because observing phobic reactions in a loved one can be personally distressing. However, this is counterproductive so it is important for them to recognise that this may actually be contributing to the phobia unintentionally and that they should consequently not be encouraging or reinforcing avoidance behaviours.

This does not mean that family and supporters should deliberately force a person with a phobia to be exposed to or engage with objects, activities or situations that arouse fear or anxiety. This can lead to extreme distress and possibly anger.

Instead, through psychoeducation, family members and supporters may learn about the importance of

Figure 9.17 This person has an excessive, irrational fear of being in open places (agoraphobia). It can be counterproductive for family members and supporters to encourage her avoidance behaviours.

gently and calmly encouraging and supporting the individual to not engage in avoidance behaviour, possibly also challenging the behaviour. They can help the individual to realise that through repeated experiences of facing their fear, they will begin to realise that the worst isn't going to happen, or that they're not going to die or 'lose it' (Smith et al., 2021).

Consider again the example of 13-year-old Asha. When Asha reports seeing the moth, her mother may encourage her to remain sitting outside and not to run inside. Asha's mother could provide comfort and reassurance and say something like, 'It is important for you to face your fears so that you can learn that moths are not going to harm you. Although it can be scary at first, over time you will feel less anxious. You will also start to feel more confident and in control. If we stay outside now, moths will begin to lose their power to make you avoid them.' If Asha manages to stay outside, it would be important to continue to provide comfort, positive reinforcement through praise (e.g. 'great job!') and possibly even provide a reward for 'bravery' (e.g. small inexpensive items, extra TV time, making a favourite dinner).

9.5 LEARNING ACTIVITY 5

Review

1. a. What is psychoeducation for specific phobia?
   b. What is its key assumption?
   c. What topics might be included in a psychoeducation program for
      i. an individual with a phobia?
      ii. family and supporters of someone with a phobia?
2. a. Give two reasons to explain why it is important for families and supporters to not encourage avoidance behaviour.
   b. Give an example of an appropriate and an inappropriate way of discouraging avoidance behaviour.
3. a. Explain why family members and supporters should challenge unrealistic or anxious thoughts.
   b. Give an example of an appropriate and an inappropriate challenge or way of challenging such thoughts.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

9.5 LEARNING ACTIVITY 6

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.42 (adapted); ©VCAA

To help Glen manage his feelings of being overwhelmed by his specific phobia of insects, Glen's psychologist suggested that he use a combined biopsychosocial approach.

Which of the following includes all aspects of the biopsychosocial approach?

A. breathing retraining, CBT and psychoeducation for family
B. reducing stigma, breathing retraining and improving personal relationships
C. CBT and challenging unrealistic thoughts, strategies and advice provided by family
D. breathing retraining and reducing stigma

Question 2 (1 mark)

Source: VCAA 2012 Psychology 2, Section A, Q.27 (adapted); ©VCAA

A psychologist treated a patient who suffered a phobia of flying. During the therapy the psychologist helped the patient to identify his unhelpful thoughts about flying, and to identify other helpful and more rational thoughts about flying.

The therapy that the psychologist used was

A. cognitive behavioural therapy (CBT).
B. systematic desensitisation.
C. behaviour therapy.
D. fearless flights therapy.

Question 3 (1 mark)

Source: VCAA 2012 Psychology 2, Section A, Q.41 (adapted); ©VCAA

Charlie has just started secondary school. In History, he was required to give a talk in front of the class. Charlie was very anxious about speaking in front of the class. He stayed home on the day that he had to give his talk and felt relieved.

The psychologist treated Charlie's fear of public speaking by first getting him to give speeches in front of the mirror at home. When Charlie was comfortable, the psychologist told him to give speeches to his family and then to a group of friends. Finally, when Charlie felt comfortable, the psychologist had him speak at the school assembly.

The treatment used by the psychologist was an example of

A. relaxation therapy.
B. behaviour modification.
C. systematic desensitisation.
D. cognitive behavioural therapy (CBT).

Question 4 (1 mark)

Source: VCAA 2013 Psychology, Section A, Q.22 (adapted); ©VCAA

In an experiment studying the impact of psychoeducation on the management of specific phobia, the control group should

A. not be given any psychoeducation at all.
B. be given exactly the same psychoeducation as the experimental group.
C. be able to choose whether to be given psychoeducation or not.
D. be given a different type of psychoeducation than the experimental group.

Question 5 (3 marks)

Source: VCAA 2018 Psychology, Section B, Q.2d; ©VCAA

As a child, David would become frightened when he saw his mother Tracy scream and run away every time she saw a cockroach. Tracy always appeared relieved when she was no longer near the cockroach. David acquired the same phobia of cockroaches and also screamed and ran away whenever he saw a cockroach.

Explain how one evidence-based social intervention could be used to further assist David in managing his specific phobia of cockroaches.

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

9.6 Review

Topic summary

- **Biological factors**
  - GABA dysfunction
  - Long-term potentiation
- **Psychological factors**
  - Behavioural models
    - Precipitation by classical conditioning
    - Perpetuation by operant conditioning
  - Cognitive biases
    - Memory bias
    - Catastrophic thinking
- **Social factors**
  - Specific environmental triggers
  - Stigma around seeking treatment
- **Evidence-based interventions in the treatment of specific phobia**
  - Biological interventions
    - Use of anti-anxiety benzodiazepine agents
    - Breathing retraining
  - Psychological interventions
    - Cognitive behavioural therapy (CBT)
    - Systematic desensitisation
  - Social interventions
    - Psychoeducation for families and supporters
    - Challenging unrealistic or anxious thoughts
    - Not encouraging avoidance behaviours

Key terms

anti-anxiety benzodiazepine agent p. 523
anticipatory anxiety p. 504
avoidance behaviour p. 529
behavioural model p. 511
benzodiazepine p. 523
biological intervention p. 523
biopsychosocial approach p. 504
breathing retraining p. 525
catastrophic thinking p. 516
classical conditioning p. 511
cognitive behavioural therapy (CBT) p. 528
cognitive bias p. 515
evidence-based intervention p. 522
fear hierarchy p. 531
GABA (gamma-amino butyric acid) p. 507
GABA dysfunction p. 507
GABA agonist p. 523
irrational p. 503
long-term potentiation (LTP) p. 509
memory bias p. 515
operant conditioning p. 511
perpetuation (of a phobia) p. 511
phobic stimulus p. 503
precipitation (of a phobia) p. 511
psychoeducation p. 535
psychological intervention p. 528
psychotherapeutic treatment p. 528
safety behaviour p. 529
self-stigma p. 520
social intervention p. 535
social stigma p. 520
specific environmental trigger p. 519
specific phobia p. 502
stigma p. 520
systematic desensitisation p. 530

Note: The **References** for the entire title can be accessed in learnON and are also available as a downloadable PDF.

on Resources

Digital documents Key terms glossary — Topic 9 (doc-38005)
Topic summary — Topic 9 (doc-38006)
Key diagrams PowerPoint — Topic 9 (doc-38008)

Exam question booklet Exam question booklet — (eqb-0130)

9.6 Topic 9 test

Section A: 20 marks **Section B:** 30 marks **Total:** 50 marks

Access learnON to answer the following test questions online and receive **immediate feedback**.

Section A — Multiple-choice questions

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

When using cognitive behavioural therapy for a specific phobia, the mental health professional will primarily target _____ for treatment.

A. inappropriate thoughts
B. long-term potentiation
C. abnormal breathing patterns
D. medications that alleviate anxiety

The following information relates to questions 2 and 3.

Dr Smith is one of 10 doctors who work at the Bayview Lodge Medical Clinic. He wanted to investigate the effect of a new brand of benzodiazepine on the progression of a specific phobia in patients at the clinic. Fifty of Dr Smith's patients volunteered to take part in the study.

Dr Smith randomly divided the participants into two groups and gave Group A the treatment and Group B the placebo. The participants did not know if they were receiving the treatment or the placebo. The participants completed a self-report phobic anxiety scale both before and after the treatment.

Question 2

Source: VCAA 2017 Psychology, Section A, Q.48; ©VCAA

Results from the study showed that the participants who received the treatment reported a greater reduction in levels of anxiety after six weeks compared to the participants who received the placebo.

Can Dr Smith generalise the results from the study to the population of research interest?

A. Yes, because he ensured that all participants voluntarily participated in the study.
B. No, because he used random allocation to assign participants to each group.
C. No, because the sample may not be representative of the population.
D. Yes, because the sample is representative of the population.

Question 3

Source: VCAA 2017 Psychology, Section A, Q.49; ©VCAA

Some of the patients had a legal guardian.

In order to obtain informed consent from these patients, Dr Smith needed to ensure that

A. only the patient was informed about the nature, purpose and risks of the study.
B. only the guardian was informed about the nature, purpose and risks of the study.
C. the guardian provided consent and the patient understood to the best of their ability the nature, purpose and risks of the study.
D. the patient provided consent and their guardian understood to the best of their ability the nature, purpose and risks of the study.

The following information relates to questions 4 and 5.

Charlie has just started secondary school. In History, he was required to give a talk in front of the class. Charlie was very anxious about speaking in front of the class. He stayed home on the day that he had to give his talk and felt relieved.

Question 4

Source: VCAA 2012 Psychology 2, Section A, Q.39; ©VCAA

The next time that Charlie is required to give a talk in front of the class, it is most likely that he will

A. stay home again, as his behaviour is being punished.
B. attend school, as his behaviour is being positively reinforced.
C. stay home again, as his behaviour is being negatively reinforced.
D. stay home again, as his behaviour is being maintained by classical conditioning.

Question 5

Source: VCAA 2012 Psychology 2, Section A, Q.40 (adapted); ©VCAA

Charlie's teachers were concerned and referred him to the school psychologist for some help. The school psychologist told Charlie that he had developed a phobia of public speaking.

Charlie's phobia of public speaking is best explained by using

A. the cognitive model and CBT.
B. the behavioural model and operant conditioning.
C. GABA and the biological approach.
D. psychoeducation and classical conditioning.

Question 6

Jake has a specific phobia of injections and gets anxious whenever he sees a syringe. He reports a crucial incident as a child when he saw his mother have an injection, then faint. For a while, he thought his mother was dead.

In relation to Jake's phobia, a syringe or injection is best described as

A. safety behaviour.
B. avoidance behaviour.
C. phobic anxiety.
D. a specific environmental trigger.

Question 7

Stigma associated with having a phobia will probably result in an individual with a phobia

A. coping as best they can.
B. avoiding powerful negative emotions.
C. seeking social support.
D. seeking treatment from a professional.

Question 8

The best example of a cognitive bias likely to be associated with specific phobia is

A. hopelessness.
B. lack of social support.
C. more attention to signs of threat.
D. thinking about potential threats without settling on the means of avoidance.

Question 9

Source: VCAA 2008 Psychology 2, Section A, Q.24; ©VCAA

Classical conditioning could easily account for how a young child might learn to

A. walk.
B. feed himself.
C. pick up his toys.
D. fear going to school.

Question 10

The tendency for people with a specific phobia to recall threatening information about a phobic stimulus more than positive information, is called _____ bias.

A. selective
B. memory
C. attentional
D. phobic

Question 11

Long-term potentiation may contribute to the development of a specific phobia by

A. transmitting threat information.
B. initiating the fight-or-flight-or-freeze response.
C. storing threat information in long-term memory.
D. strengthening synapses in neural pathways for relevant fear information.

The following information relates to questions 12 and 13.

When Buzz was young, he learned that lightning is followed by loud and frightening thunder. Now, when there is a flash of lightning, Buzz begins to tremble even before he hears the thunder. Buzz has also learned that when he sees the lightning and he is in the backyard, he should run into the house, where he feels safer.

Question 12

Source: VCAA 2012 Psychology 2, Section A, Q.13 (adapted); ©VCAA

Buzz's response of trembling when there is a flash of lightning and his response of running indoors are, respectively, examples of

A. classical conditioning/operant conditioning.
B. operant conditioning/classical conditioning.
C. operant conditioning/attention in observational learning.
D. reproduction in observational learning/classical conditioning.

Question 13

Source: VCAA 2012 Psychology 2, Section A, Q.14 (adapted); ©VCAA

In this scenario, a distinction can be made between the types of learning because Buzz's trembling at the lightning

A. is a voluntary response, whereas running indoors is a reflexive response.
B. is an involuntary response, whereas running indoors is a voluntary response.
C. indicates an active participant, whereas running indoors indicates a passive participant.
D. reflects the process of attention, whereas running indoors reflects the process of reproduction.

Question 14

Drugs that have the effect of stimulating or promoting the excitatory effects of one or more neurotransmitters are called

A. agents.
B. antagonists.
C. agonists.
D. benzodiazepines.

Question 15

When compared with a long-acting benzodiazepine, a short-acting benzodiazepine will

A. have a shorter effect.
B. clear from the body more quickly.
C. have a faster effect.
D. accumulate in the bloodstream.

Question 16

A potential consequence of hyperventilation in response to a phobic stimulus is that the individual may

A. take in less air than their body actually needs.
B. get into a pattern of uncontrolled rapid and shallow breathing.
C. increase the level of carbon dioxide in the blood.
D. decrease the level of carbon dioxide in the blood.

Question 17

Sharib has a specific phobia of escalators and refuses to use one to travel to the basement of a department store. This overt reaction is an example of

A. avoidance behaviour.
B. memory bias.
C. safety behaviour.
D. catastrophic thinking.

Question 18

The first step in systematic desensitisation as an intervention for a specific phobia is likely to involve

A. teaching a relaxation strategy that can be used to manage fear responses.
B. breaking down the fear-arousing event or situation into a logical sequence of steps and creating a 'stepladder' or fear hierarchy.
C. systematic, graduated pairing of items in a fear hierarchy with relaxation by going up the steps on the ladder, one at a time.
D. identifying cognitive biases or distortions, underlying feelings and/or behaviour associated with the phobic stimulus.

Question 19

The first step in the two-factor learning theory of how phobias may develop or be perpetuated involves _____, and the second step involves _____.

A. a phobic stimulus, avoidance behaviour
B. classical conditioning, operant conditioning
C. a phobic stimulus, the stress response
D. avoidance behaviour, a phobic stimulus

Question 20

Most adults diagnosed with a specific phobia

A. fear that their response to a phobic stimulus may become a specific environmental trigger for children.
B. realise that their fear is grossly in excess of any real danger posed by a phobic stimulus.
C. experience a gradual reduction in anxiety level whenever they contemplate being exposed to a phobic stimulus.
D. require medication to manage their phobic anxiety and function effectively in everyday life.

Section B — Short answer questions

Question 1 (1 mark)

A list of feared objects or situations, ranked from least to most anxiety-producing, is used as part of a treatment intervention for specific phobias that is called a/an _____.

Question 2 (1 mark)

What is a goal of psychoeducation in the treatment of a specific phobia?

Question 3 (3 marks)

Source: VCAA 2019 Psychology, Section B, Q.6c; ©VCAA

A double blind, placebo-controlled study is used to investigate the effects of short-acting, anti-anxiety benzodiazepine agents. Participants are assigned either to the benzodiazepine agent or to the placebo. Before the study begins, participants are fully informed of confidentiality, voluntary participation and withdrawal rights.

Explain why a placebo is needed in this type of study and how the researcher would satisfy ethical considerations resulting from the use of a placebo.

Question 4 (2 marks)

Explain the role of catastrophic thinking in the development and perpetuation of specific phobia.

Question 5 (2 marks)

What are two potential benefits of breathing retraining as an intervention in the treatment of specific phobia?

Question 6 (2 marks)

Give two reasons to explain why evidence-based interventions are preferred in the treatment of a specific phobia.

Question 7 (2 marks)

Explain why families or supporters of people with a specific phobia are advised to not encourage avoidance behaviour.

Question 8 (4 marks)

Explain how classical and operant conditioning may contribute to the development and perpetuation of a specific phobia, with reference to an example demonstrating the influence of each learning process.

Question 9 (7 marks)

a. What is GABA (gamma-amino butyric acid)? 1 mark
b. What is GABA dysfunction? 1 mark
c. Explain how GABA dysfunction may contribute to the development and perpetuation of a specific phobia. 2 marks
d. How do benzodiazepines alleviate fear or anxiety symptoms? 2 marks
e. Why do mental health professionals tend to prefer that benzodiazepines are not used in isolation of psychotherapy? 1 mark

Question 10 (6 marks)

An experiment was conducted at a large university to test the effectiveness of systematic desensitisation for treating specific phobia.

Twenty participants were selected from volunteer psychology students enrolled at the university where the researchers worked. Selection was based on questionnaires and interviews which determined whether they had a snake phobia. Only those assessed to have a severe snake phobia were included.

The participants were randomly allocated to one of two conditions. The experimental group participants received systematic desensitisation during ten 45-minute sessions in which they learned a breathing relaxation technique and gradually worked through their hierarchy of fears. The control group participants did not receive any therapy.

At the end of the program, all participants were assessed one at a time using a Snake Avoidance Test during which observations were made of their behaviour when faced with a live snake, and by getting them to rate their level of fear in the presence of the snake.

The results showed that 9 of the 10 in the experimental group were able to touch or hold the snake, whereas only 1 control group participant was able to do so. Self-ratings of fear by the experimental group were also significantly lower.

a. Identify the experimental research design. 1 mark
b. Identify the independent and dependent variables. 2 marks
c. Write a research hypothesis that would be supported by the results. 1 mark
d. Give two reasons to explain why the results of this experiment do not necessarily mean that systematic desensitisation is in itself an effective treatment of specific phobia. 2 marks

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on Resources

Go to learnON to access answers to the Topic 9 test. A customisable Word version of the test can also be downloaded from the **Digital documents** tab of the Resources panel.

learnMORE | Fearless Flyers program

The odds of being in a plane crash or killed in a plane crash vary according to how and where you take the flight. Generally, the odds of being in a crash that results in at least one fatality are about 1 in 3.4 million and about 1 in 4.7 million for dying in a crash on a major world airline. Although most people with a phobia of flying (aerophobia) would be unaware of these statistics, many would know that there is a very low likelihood of a plane they are travelling in crashing — much lower than being killed in a car crash fatality on the way to the airport. Yet this does not reduce their anxiety about flying. Fearless Flyers is one program helping people overcome aerophobia. Fearless Flyers Incorporated is a not-for-profit organisation that offers paid courses to help people conquer their fear of flying. Qantas, Airservices Australia and the Bureau of Meteorology support the program and provide volunteer aviation professionals (pilots, engineers, cabin services, air traffic controllers and meteorologists).

Course topics covered include:

- understanding the physiology of fear and effective relaxation techniques
- pilots, engineers and cabin crew (their qualifications and training)
- aircraft design, testing and maintenance; what makes a plane fly
- meteorology: turbulence (what causes it and what effect it has on an aircraft) and weather forecasting for aviation
- air traffic control and navigation of commercial aircrafts.

The course may also include one or more tours such as:

- a tour of a jet aircraft on the ground, e.g. participants sit in the cockpit with a pilot, who will explain the basics of the flight deck and aircraft controls; tour around the outside of the aircraft with a maintenance engineer; tour of the aircraft cabin with a senior flight attendant
- a tour of the air traffic control tower to observe air traffic controllers at work and learn about their training
- a tour of the flight simulator training facility and the emergency procedures training facility.

At the end of the course, participants graduate with a flight, usually to a major capital city.

Source: fearless flyers inc. Retrieved from http:// fearlessflyers.com.au/

on Resources

Weblink Fearless Flyers program

10 Maintenance of mental wellbeing

TOPIC CONTENT

10.1 Overview

KEY KNOWLEDGE

- the application of a biopsychosocial approach to maintaining mental wellbeing, with reference to protective factors including adequate nutritional intake and hydration and sleep (biological), cognitive behavioural strategies and mindfulness meditation (psychological) and support from family, friends and community that is authentic and energising (social)
- cultural determinants, including cultural continuity and self-determination, as integral for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples

Source: ©VCAA, *Psychology Study Design: 2023–2027.* p.40.

Many factors contribute to the maintenance of mental wellbeing. As well as being organised as internal and external factors, they are often defined as risk or protective factors.

A **protective factor** is something that enhances and helps to protect mental wellbeing and reduces the likelihood that mental ill-health will occur. These factors strengthen a person's mental wellbeing and work to improve a person's ability to cope with difficult circumstances.

Any personal characteristic, activity, situation or event in everyday life that reduces the likelihood of the occurrence or re-occurrence of mental ill-health may be considered a protective factor. Protective factors may be thought of as assets that help safeguard against the effects of risk factors and minimise their impact. However, this does not mean that one or more protective factors guarantees prevention of the experience of a mental health problem or illness.

Protective factors may be contrasted with risk factors which adversely impact on mental wellbeing. A **risk factor** is something that increases the likelihood of experiencing mental ill-health, or can make existing mental health difficulties more severe or long lasting. Examples of risk factors include genetic predisposition, stressful life events, alcohol and other drug use, discrimination and racial injustice, homelessness and unemployment.

As you are aware, the biopsychosocial approach is a way of explaining how biological, psychological and social factors combine and interact to influence a person's mental wellbeing. From this perspective, protective factors that influence wellbeing are interrelated and interactive. They affect and are affected by each other, with each one exerting more or less influence, depending on the individual, their resilience and what else is happening in their life at that time.

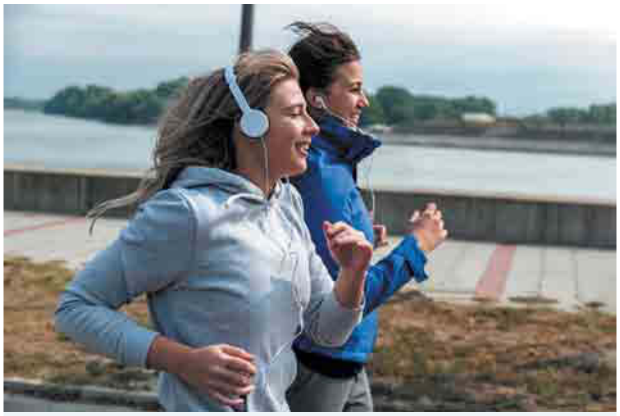

Figure 10.1 Regular exercise is commonly described as a protective factor for maintaining mental wellbeing.

Achieving and maintaining good mental health and wellbeing requires increasing protective factors, minimising risk factors and breaking down barriers to seeking help.

In this topic we examine a range of protective factors using the biopsychosocial approach. These include:

- biological factors involving adequate diet and sleep;
- psychological factors involving cognitive behavioural strategies and mindfulness meditation; and,
- a social factor involving support from family, friends and the community.

We also examine cultural factors that are essential for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples; specifically, cultural continuity and self-determination.

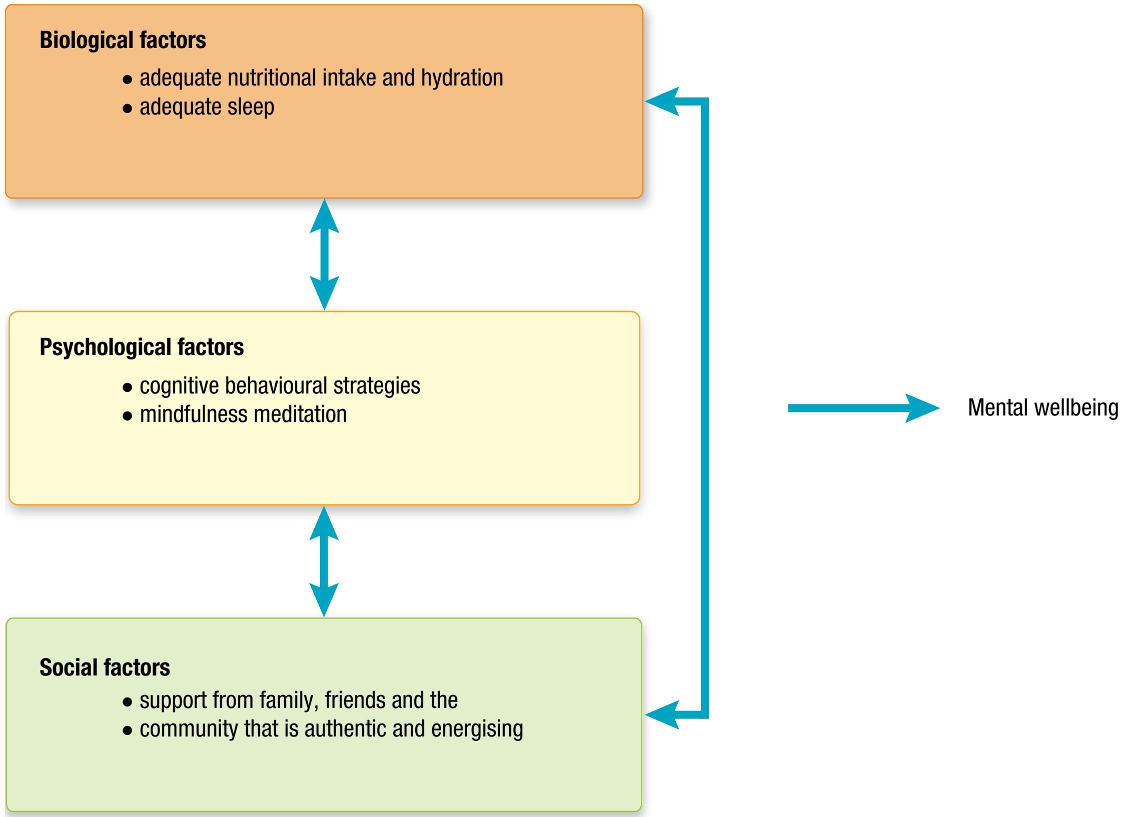

Figure 10.2 Protective factors contributing to the maintenance of wellbeing from a biopsychosocial perspective. Note how contributory factors from each domain affect and are affected by one another. These factors are specified in the Psychology Study Design. Numerous other contributory factors have also been described.

10.1 LEARNING ACTIVITY

Multiple-choice questions

1. A protective factor for mental wellbeing
   - **A.** helps to create mental ill-health.
   - **B.** prevents exposure to a problem that may affect mental wellbeing.
   - **C.** prevents the development of mental health problems and illnesses.
   - **D.** decreases the risk or impact of a problem that may adversely affect mental wellbeing.
2. According to the biopsychosocial approach, which one of the following would be described as a biological contributory factor to maintenance of mental wellbeing?
   - **A.** good quality sleep
   - **B.** mindfulness meditation
   - **C.** support from family and friends
   - **D.** any cognitive behavioural strategy
3. According to the biopsychosocial approach, which one of the following would be described as a psychological contributory factor to maintenance of mental wellbeing?
   - **A.** a nutritionally balanced diet
   - **B.** good quality sleep
   - **C.** mindfulness meditation
   - **D.** support from family and friends

4. A risk factor for mental wellbeing
   A. helps to create mental health problems and illnesses.
   B. prevents exposure to a problem that may affect mental wellbeing.
   C. causes the development of mental health problems and illnesses.
   D. decreases the likelihood of a problem that may adversely affect mental wellbeing.
5. Which one of the following would be the most significant risk factor for the mental wellbeing of Aboriginal and Torres Strait Islander people?
   A. poor diet
   B. poor sleep
   C. cultural continuity
   D. failure to access CBT

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

10.2 Biological protective factors

There are many biological interventions that are protective factors and can be used to help maintain or improve mental wellbeing. These include medications and relaxation techniques such as breathing retraining, exercise, meditation and yoga. What we eat and how well we sleep can also affect our mental wellbeing.

In this section, we examine the potential benefits of having an adequate diet and adequate sleep. Both are achievable without support from a health professional.

10.2.1 Adequate nutritional intake and hydration

Most people know that eating well and drinking lots of water are vital to good physical health and contribute to an overall healthier lifestyle. An adequate diet, including food and water, is important to proper body functioning. It not only reduces the risk of physical health problems such as cardiovascular disease, diabetes and digestive issues, but it can also help with sleep, energy levels, mood and mental health. We tend to generally feel better and have an overall sense of mental wellbeing when we eat well and are adequately hydrated.

Having *adequate nutritional intake and hydration* means eating a good amount of a variety of different foods and ensuring we drink enough water to maintain good physical health and feel mentally well as a result. It is not about the way we look or how much we weigh. Nor is it about counting calories or having tiny portion sizes (ReachOut, 2022b).

There are some relatively simple guidelines for maintaining adequate nutritional intake and hydration. One important guideline is that an adequate diet needs to be 'balanced'. This basically means a diet with minimal amounts of the bad things (e.g. junk food and lots of sugars) and more of the good things (e.g. vegetables, fruit, grains and plenty of water).

Adopting this guideline helps ensure we have enough of all the vitamins and minerals that help our body and brain function well. Generally, no food is off limits — it's just a question of how often we eat certain foods and how much of them we eat. Eating when hungry and stopping when full is also useful. There are, however, some drinks that should be avoided.

According to various mental health service providers such as Beyond Blue, ReachOut and headspace, a number of specific nutritional and hydration strategies can also help maintain mental health. These include:

- *Eat a variety of foods:* Each food contains its own unique vitamins and minerals. Therefore, in order for our body to have a balance of all the nutrients it needs, it's important to eat lots of different foods. The *Australian Guide to Healthy Eating* recognises five main food groups, which are all equally as important when it comes to getting the nutrients we need. As shown in Figure 10.3 on the next page these are (1) vegetables and legumes/beans, (2) fruit, (3) milk, yoghurt and cheese, (4) lean meats (meats without a lot of fat), poultry, fish, eggs, tofu, nuts and seeds, and (5) grain (cereal) foods.
- *Drink lots of water:* The adult human body is up to 60% water, so water is a very important part of an adequate diet. It is recommended that we have around eight glasses of water every day, but the most important thing is to drink as much

Figure 10.3 The five main food groups according to the *Australian Guide to Healthy Eating*. Legumes/beans are included twice because they are a source of protein as well as being vegetables.

Source: National Health and Medical Research Council (2017). *Australian Guide to Healthy Eating*. Retrieved June 5, 2022, from https://www.eatforhealth.gov.au/guidelines/australian-guide-healthy-eating

on Resources

Weblink *Australian Guide to Healthy Eating* as we feel we need. Sometimes we will need more, such as when we exercise.

Soft drinks contain a lot of sugar and few nutrients, as do a lot of the fruit juices. Alcoholic drinks also have very little of nutritional value, so it's best to limit intake. Coffee and energy drinks (which are made with caffeine and loads of sugar) can increase alertness and provide 'pep up', but this tends to pass quickly and can leave us feeling tired or sleepy as the effect wears off.

Figure 10.4 Processed food is any food, including drinks, that has been altered in some way during preparation. Not all processed foods lack nutritional value or are unhealthy, but some may contain high levels of salt, sugar and fat.

- *Don't skip breakfast and try to eat regularly throughout the day*. Breakfast is important in re-fuelling the body with nutrients after sleep and energising the body for daily activities. Eating regularly helps maintain blood sugar and energy levels.
- *Don't rely on vitamin/mineral supplements*. Real foods are the best source of vitamins and minerals, especially fresh or natural foods. While supplements are no substitute for a healthy diet, there may be occasions when they are helpful. For example, if under-eating and/or eating poor quality foods for prolonged periods, a multivitamin/mineral supplement can help meet nutritional needs until able to resume better eating patterns.
- *Avoid heavily processed foods with surplus salt, sugar or fat*. A processed food is any food that has been altered in some way during preparation. Food processing can be as basic as freezing, canning, baking and drying.

  Not all processed foods are unhealthy but some may contain high levels of salt, sugar and fat to make their flavour more appealing, to extend their shelf life, or in some cases to contribute to the food's structure, such as salt in bread or sugar in cakes. Other examples of common processed foods include breakfast cereals, cheese, tinned vegetables, savoury snacks such as crisps, sausage rolls, pies and pasties, meat products such as bacon, sausage, ham and salami, and 'convenience foods' such as microwave meals.

  Eating processed foods can result in eating more than the recommended amounts of sugar, salt and fat as we may not be aware of how much has been added to the food. These foods can also be higher in calories due to the high amounts of added sugar or fat in them.

  Not all processed food is a bad choice. Some foods need processing to make them safe, such as milk, which needs to be pasteurised to remove harmful bacteria. Other foods need processing to make them suitable for use, such as pressing seeds to make oil (NHS Choices, 2020).
- *Don't rely on drugs and alcohol*. Drinking alcohol, smoking cigarettes and taking other drugs for recreational purposes or to cope with a mental health problem or disorder all have nutritional consequences. Regular use of these substances can deplete the body of certain nutrients and disrupt regular eating patterns, worsening mood fluctuations and challenging a person's ability to establish healthy eating habits. Tobacco smoking, for example, can suppress appetite and therefore lead to a person not eating enough. Thiamine and other vitamin deficiencies are common in heavy drinkers and these deficits can cause low mood, irritability and/or aggressive behaviour. Cannabis can stimulate appetite and in some cases lead to over-eating; however, taking amphetamines can lead to going days without eating.

10.2.2 Adequate sleep

Sleep is an essential, naturally occurring, involuntary state, without which we cannot function at our best. We cannot avoid the need for sleep. Eventually our body shuts down and we sleep whether we want to or not. We have all experienced the effects of going without sleep for varying periods of time so we know it is important for our mental wellbeing as well as physical health. It is as vital to our functioning as eating, drinking and breathing.

The way we think, feel and behave while awake depends in part on what happens while we sleep. During sleep, we undergo a number of important maintenance processes that help us to function and be productive during waking time.

According to *restoration and recovery theories* on the purpose of sleep, our body undergoes repair and replenishes resources depleted during the major waking period. Additionally, sleep triggers the release of hormones that affect growth and other functions. Sleep may also give our brain some 'down time' to process information and to form or consolidate new pathways to help us remember what we learnt when awake and ensure the relevant knowledge and skills are available when needed.

We all need to make sure we get the right amount of sleep, and enough good quality sleep, more often than not. There is no set amount of sleep time that is appropriate for everyone. The amount of sleep time people need is a highly individual matter and varies in relation to age, lifestyle, sleep habits and many other factors.

Good quality sleep tends to be the result of spending enough uninterrupted time in both NREM and REM sleep, including enough deep sleep which helps us feel refreshed. It also depends on whether we are sleeping at a time when our body is prepared and ready to sleep.

Generally, an adequate amount of total sleep time is about 10 hours per night for school age children, about 9 hours for teenagers and about 8 hours for adults. Elderly people tend to need less sleep. However, some people in these lifespan stages can cope very well with much less sleep and some need much more every night. In particular, there are some people who are genuine short sleepers (sleep less than 5.5 hours per 24 hour period) or long sleepers (more than 9.5 hours).

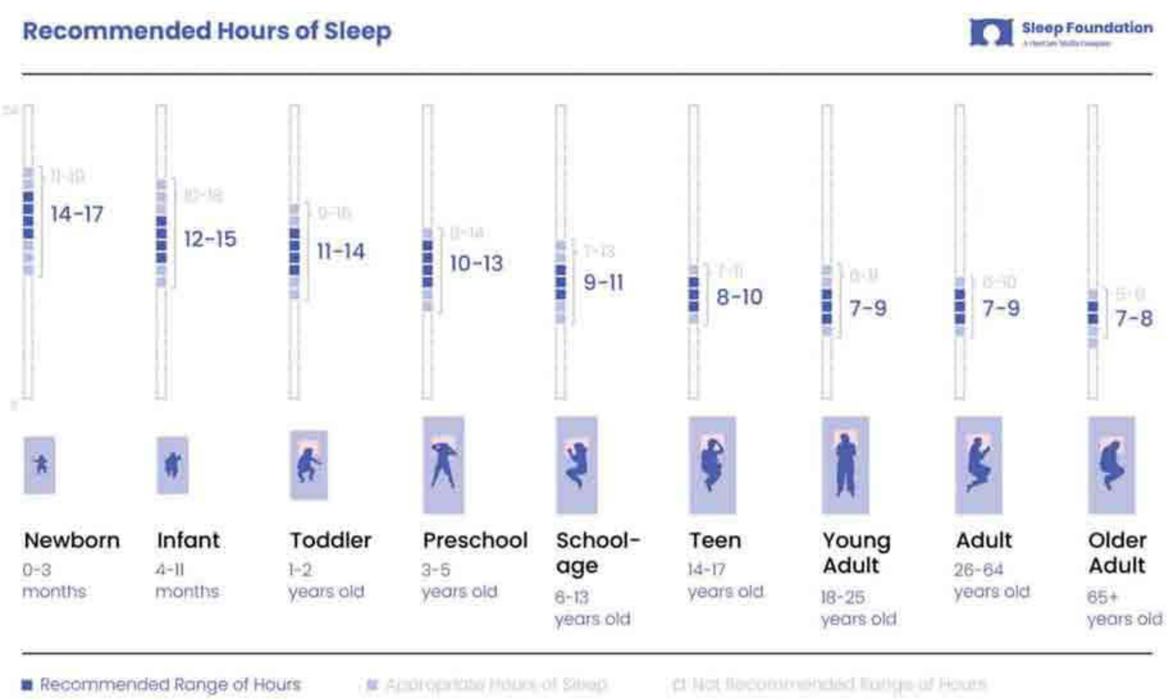

Figure 10.5 Recommended hours of sleep according to age.

Source: Sleep Foundation (2022). *How much sleep do we really need?* Retrieved June 8, 2022, from https://www.sleepfoundation.org/how-sleep-works/how-much-sleep-do-we-really-need

Overall, adequate sleep tends to be more about waking up feeling rested, refreshed and ready for the day and feeling positive about ourselves and our abilities, rather than getting a certain number of hours (Bruck, 2006; SHF, 2022b).

As described in topic 7, inadequate or poor sleep can adversely affect mental wellbeing by impairing affective, behavioural and cognitive functioning. You are familiar with many of these impairments, especially sleepiness and fatigue. For example, a sleepy and fatigued person tends to be irritable, have difficulty controlling their emotions (often resulting in amplified emotional responses), have a lower level of alertness, have difficulty maintaining concentration, be slower to react and make more mistakes. They also tend to have lapses in memory, think less clearly, make poor judgments and be more accident prone when compared with people who are not sleepy and fatigued. These types of side-effects of inadequate sleep can adversely affect our overall sense of wellbeing.

Additionally, when moody or over-reacting emotionally, we can have problems getting along with others and may not be particularly pleasant company. Sometimes we can even have problems simply making conversation. Consequently, inadequate sleep can also affect our relationships with others and thereby further compromise our mental health.

There is considerable research evidence that indicates a strong link between sleep and mental health and wellbeing. In particular, many people who experience mental health problems also experience sleep problems. Poor sleep quantity or quality over a sustained period is considered a risk factor for the development or perpetuation of a range of mental health disorders, including mood, anxiety, addictive, personality and psychotic disorders.

In the same way that a healthy diet can help improve our mental health and wellbeing, so can sleep. There is no doubt that adequate sleep can help us think, feel and do better as well as enhance our enjoyment of life in general. This may require some time and effort, but it's worth it. For many people, it may simply be a case of making small attitude or lifestyle adjustments (i.e. improving sleep hygiene). For those with insomnia or another sleep disorder it may be necessary to seek professional support.

There is no universal answer to the question of what constitutes 'adequate sleep'. What is important is that people should find out how much good quality sleep they need and develop good sleep hygiene to ensure that they achieve this on a regular basis (MHF, 2011; Suni, 2022e).

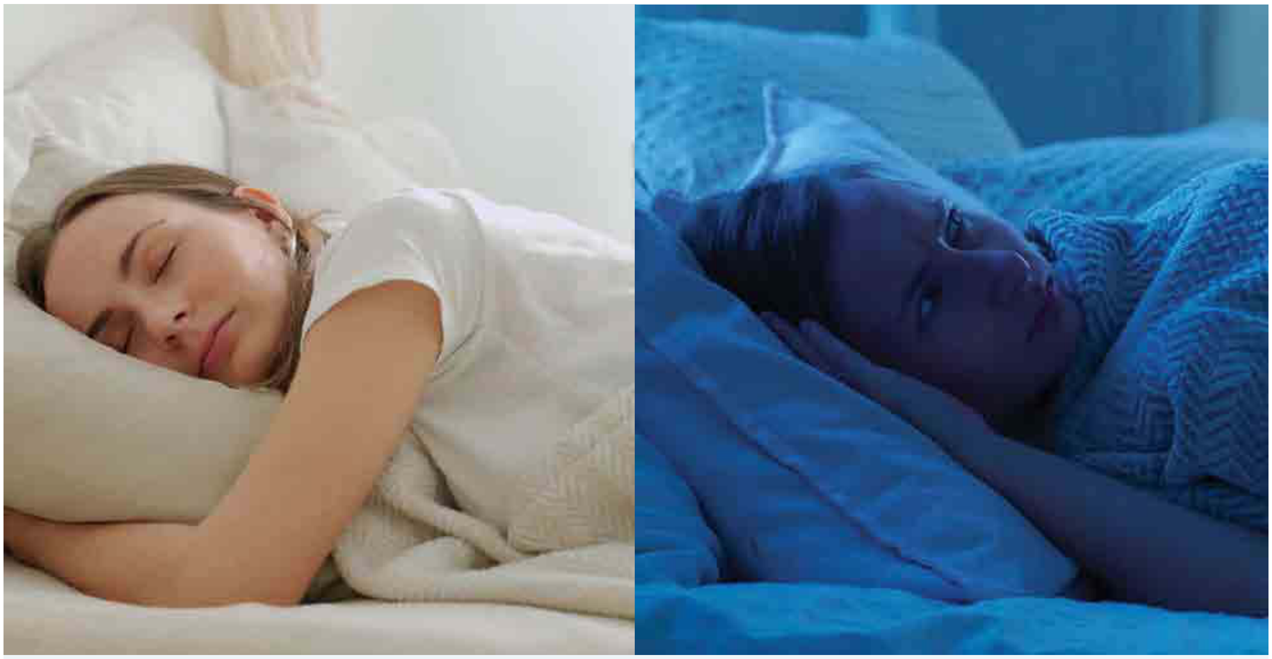

Figure 10.6 Adequate sleep — the right amount of sleep, and enough good quality sleep — is vital for mental wellbeing.

10.2 LEARNING ACTIVITY

Multiple-choice questions

1. All biological protective factors may also be described as _____ factors.
   A. genetic
   B. internal
   C. external
   D. biopsychosocial
2. Having adequate nutritional intake basically means
   A. eating processed foods.
   B. calorie counting and having tiny portion sizes.
   C. avoiding all junk foods at all times.
   D. eating a variety of different foods to maintain good physical health.
3. Having adequate hydration basically means
   A. minimal amounts of sugar drinks.
   B. drinking a good amount of a variety of drinks.
   C. drinking as much water as possible.
   D. drinking enough water to maintain good physical health.
4. Which one of the following is a nutritional or hydration strategy that is most likely to also help maintain mental wellbeing?
   A. drink lots of water
   B. avoid too many foods that are unusual or different
   C. eat plenty of processed foods that contain nutrients
   D. ensure vitamin supplements are a regular part of a nutritional diet
5. Adequate sleep basically means
   A. an average of 8 hours sleep per day for all people of all ages.
   B. getting a certain number of hours of sleep each night.
   C. regularly getting the right amount of sleep, and enough good quality sleep.
   D. having the set amount of sleep time that is appropriate for everyone.

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10.3 Psychological protective factors

People who are mentally healthy and report a good level of mental wellbeing usually think logically and clearly and tend to have a positive view of themselves and life in general. Their generally positive attitude helps them be productive, realise their abilities, cope effectively with the challenges and stressors of everyday life, and to fully enjoy and appreciate other people, day-to-day life and their environment in general.

Establishing positive thinking patterns (rather than negative) and having the ability to identify and challenge maladaptive, erroneous or unrealistic thoughts and expectations is an important means of protecting and maintaining mental health and wellbeing. It is also desirable to spend more time doing those activities that are enjoyable and promote positive (rather than negative) feelings. These types of adjustments to thinking and behaving can be achieved through cognitive behavioural strategies.

10.3.1 Cognitive behavioural strategies

Cognitive behavioural strategies are techniques drawn from cognitive behavioural therapy (CBT) to identify, assess and correct faulty patterns of thinking and problem behaviours that may be threatening or adversely affecting mental wellbeing. As you would expect, cognitive strategies target thinking and behavioural strategies target behaviour, but they may overlap.

Cognitive strategies

One of the most effective cognitive strategies for changing negative thoughts and thinking styles or patterns is called cognitive restructuring.

Cognitive restructuring, or *cognitive reframing* as it is also called, is the process of learning to identify, challenge, and modify or replace negative, irrational thoughts (or *cognitive distortions*) with more reasonable and helpful ways of thinking. In turn, this can help reduce maladaptive ways of feeling and/or behaving that are influenced by such thinking.

Negative, irrational thinking, especially when automatic or habitual, can not only adversely impact on mental wellbeing, but also achievement. For example, if you get an assignment back that contains a number of criticisms and is accompanied by a low mark despite your having made a big effort, you may think, 'I am so dumb, I am hopeless. I will never be able to do well in this subject'. This, in turn, may lead to a maladaptive feeling of helplessness or worthlessness in that subject and may result in you not trying to do well in the future.

Cognitive restructuring is a core component of CBT. The process involves various techniques such as 'self-monitoring', 'Socratic questioning' and doing a 'cost-benefit analysis' to weigh up the pros and cons of a cognitive distortion.

While best achieved with the support of a CBT specialist, you can use some of its techniques yourself to reframe less serious, day-to-day negative thoughts. For example, you can use cognitive restructuring to mentally prepare yourself for events that may trigger negative thoughts, stress or anxiety, such as making an oral presentation in class or going to a party where you won't know many other people.

An initial step in the cognitive restructuring process is to identify negative thoughts and the situations with which they are associated. This can be achieved using a journal or diary with 'daily thought records' for self-monitoring.

A typical thought record would include notes such as the situation where the negative thought occurred, details of the negative thinking, and emotions and behaviours that may have occurred with the thoughts. These records can then be analysed to determine if certain patterns exist. For example, Beyond Blue (2016a) has described the following five strategies that can be used to identify and challenge negative, irrational and unhelpful thoughts.

Strategy 1: Consider the evidence
If you find yourself thinking negatively about an event or situation, ask yourself, 'What evidence do I have that this is actually true or going to happen?' Chances are, you probably don't have any evidence and you're worrying without good reason.

Strategy 2: Is there an alternative explanation?
If you have it in your head that an event happened because of something you did or didn't do, ask yourself: is there an alternative to that explanation?

Strategy 3: What would you say to a friend who is thinking like that?
It is the easiest thing in the world to call yourself unpleasant names when you make a mistake. But, as you will appreciate, unhelpful and negative self-talk can be very harmful and discouraging. So, if you find yourself in a situation where you are tempted to call yourself dumb, stupid, an idiot or refer to yourself in some other unpleasant way, act like your own best friend, and say something helpful like, 'Chill out. It was a mistake, you didn't do it on purpose.'

Strategy 4: What is the likelihood?
Again, it is easy to imagine the worst when something important to you happens or remains unresolved. In these situations where your imagination is tempted to run wild with negative possibilities, ask yourself, 'What is the likelihood?' When you think rationally and objectively, you can reduce your stress and help yourself feel a bit better.

Strategy 5: Is there a more helpful way to think about this?
This is about looking at an event (even one with a less than ideal outcome) and working out if there is a way to think about it that isn't just going to make you feel miserable. For example, suppose you discover that you have no money left in your bank account and became really stressed because you thought you had enough to do something special with a friend. Will that make the money problem disappear? No.

Mistakes and disappointments arising from mistakes are inevitable in life — they are a part of how we learn. And a big part of learning is looking at everything that happens, good and bad, in helpful ways. If you think in a more constructive or helpful way in this situation, then you might realise the need to create and stick to a budget in the future. This helps ensure that you don't make the same mistake again. Knowing this can actually make you feel a lot better (Beyond Blue, 2016b).

Table 10.1 Some common cognitive distortions

Thinking error	Description
All-or-nothing	When you see everything as black or white, with no in between. If something isn't 100% perfect, then it's a total failure.
Over-generalisation	When you see one event that didn't turn out so well as part of a never-ending pattern of failure or disappointment.
Mind-reading	When you decide in your mind what other people must be thinking, without checking the facts, and then you act on that (probably incorrect) assumption.
Fortune-telling	When you predict that things will turn out badly, even if you have absolutely no proof that this will be the case.
Magnification	When you make one little mistake and it becomes so huge in your mind that it spoils everything else in your day.
Minimisation	When you downplay anything good that might have happened to you because you are too focused on any aspect of the event that went wrong.
Catastrophising	When you make extreme judgments and imagine the very worst outcomes will occur, even if there isn't a scrap of evidence they will.

Based on Beyond Blue (2016). *Common thinking errors*. Retrieved February 6, 2016, from https://www.beyondblue.org.au/docs/default-source/senseability/common-thinking-errors.pdf?sfvrsn=2

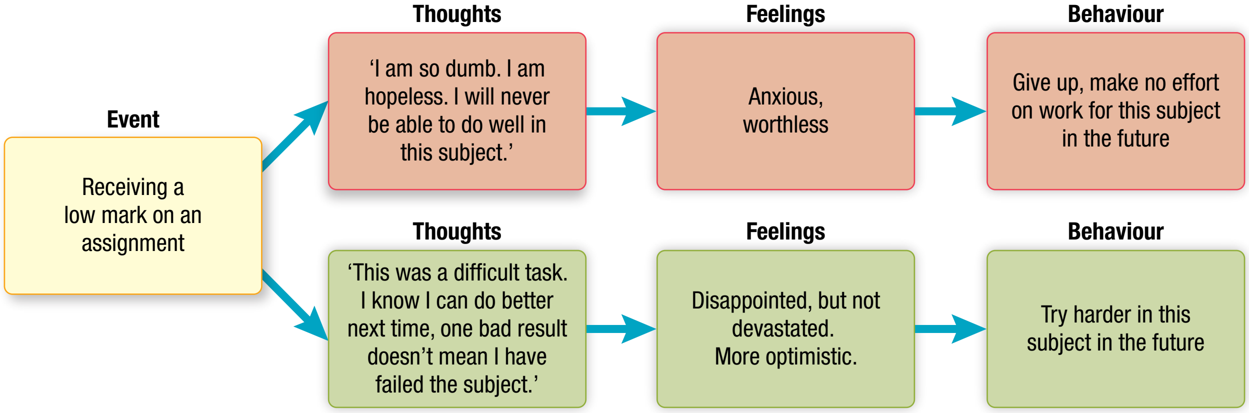

Figure 10.7 Using cognitive behavioural strategies, negative thoughts that underlie maladaptive feelings and behaviour can be changed.

Behavioural strategies

Behavioural strategies may be used to protect, maintain or improve mental wellbeing through behaviour change. Strategies will vary according to the individual's needs and could involve skills training that targets a specific area of functioning, such as breathing or relaxation training to help with stress management, learning anger management skills to help control emotional reactivity, social skills training to improve ways of interacting with others or training that focuses on improving parenting skills.

A commonly used strategy is called behaviour activation. It was initially developed as a treatment intervention for people with depression but has since been used more widely.

Behaviour activation, or *activity scheduling* as it is also called, involves identifying and scheduling activities that promote enjoyment or reduce stress. The focus is on helping people develop specific goals and achievable plans that encourage them to regularly engage in mood elevating, positively reinforcing activities that enhance mental wellbeing. These can be as simple as going for a walk or calling a friend (Gros et al., 2012; Carey, 2019).

Steps involved in behaviour activation typically include the following.

1. *Monitor current activities*: Write down all the activities you do over the course of a week or two by recording in an activity schedule such as one shown in Figure 10.8. Rate each activity on level of enjoyment experienced using a 10-point scale, with 0 equivalent to 'no enjoyment' and 10 equivalent to 'maximum enjoyment'. Criteria may vary for different individuals; for example, activities may be rated for 'level of pleasure', 'level of achievement', 'sense of closeness to others' or a number of these.

   When baseline data of current activities and their ratings have been collected, you move onto step 2.

2. *List activities associated with enjoyment*: Look back over your activities and ratings and note what activities were associated with more and less enjoyment. Make a list of these activities under two headings — 'Most enjoyable activities' and 'Least enjoyable activities'. You might also make a list of activities you have thought about trying but never have.

   Note also that some activities might not be pleasurable, but they nonetheless give you a sense of achievement (such as writing up a SAC or going to your casual job).

Example 1

Time	Friday	Saturday	Sunday
9–10 am	school 6	play tennis 9	go for 45 min jog 9
10–11	school 6	play tennis 9	clean up room and do washing 2 social media 7
11–12	school 6	catch up and lunch with friends 9	homework 4
12–1 pm	lunch with friends 8	lunch with friends 9	lunch with mum 7
1–2	school 6	casual job 7	friend called around 9
2–3	school 6	casual job 7	friend called around 9
3–4	school 6	casual job 7	homework 4
4–5	read school novel 6	casual job 7	take dog for a 40 min walk 7
5–6	read school novel 6	do chores at home 4 social media 8	help brother make dinner 7
6–7	eat with family 7 clean up 5	eat dinner at friend's house 8	catch up with cousins 9
7–8	Netflix 7 social media 8	go to movie 10	catch up with cousins 9
8–10	Netflix 7 social media 8	go to movie 10 social media 9	organise the week 7 read school novel 4 social media 8

Example 2

Day	Morning	Afternoon	Evening
Friday	• wake by 7 AM • eat a full breakfast • bus to school	• walk dog for 30 mins	• social media • read school novel
Saturday			
Sunday			

Figure 10.8 Extracts from two different types of activity schedules. Note example 1 requires hourly entries.

3. *Plan to do enjoyable activities*: Schedule some activities from the 'most enjoyable' list over the coming week so that you can do them. Steer clear of the 'least enjoyable' activities. You might also schedule one or more activities you have thought about trying but never have.

   Take account of the days and times you are most likely to complete each activity, log them in your diary, and problem-solve any obstacles that might get in the way. Consider planning an activity with family or friends for some additional support and encouragement.

   It is important to maintain a healthy balance of both pleasurable and achievement-based activities. Too many pleasurable activities can be unhelpful if it means we neglect our responsibilities, which then pile up and become overwhelming. On the other hand, too many achievement-based activities can feel like all work and no play. Of course, some activities give us a sense of both pleasure and achievement (McEvoy, 2016).
4. *Complete planned activities*: Do the planned activities according to the schedule. If an activity is scheduled in the diary, then it should get done, regardless of how you are feeling. Each activity might once again get rated for enjoyment in the schedule.
5. *Evaluate the schedule*: After engaging in enjoyable activities for a week or so, look over the schedule and activity ratings to find out whether it is having its intended mood elevating effect and enhancing mental wellbeing. If the schedule is not having any impact, it is possible that you may have chosen activities that are too hard, require too much planning or don't really enjoy as much as previously thought.

10.3.2 Mindfulness meditation

Meditation refers to the practice of sitting for a period of time in quiet stillness, your attention turned inward and focused on something specific. That something depends on the type of meditation you're engaged in.

Meditation is also a technique used to achieve an altered state of consciousness characterised by focused attention and heightened awareness. It has been practiced in cultures throughout the world for thousands of years. While traditionally used for religious and spiritual purposes, meditation is now also used for its physical and mental health benefits.

Mindfulness is awareness of one's internal states and surroundings without judgment. It involves paying full attention and being present in whatever you're doing, moment to moment. When you are being actively mindful, you are fully aware of your thoughts, feelings, behaviours, movements and affects you have on others around you. You are also fully aware of where you are and what you're doing.

Mindfulness allows you to experience yourself, others, and situations at face value without judgment, rather than getting caught up in negative thoughts and worrying about how things should be or what might or might not happen. It is a state conducive to good mental wellbeing that can be achieved anytime, anywhere, and with anyone, by being fully engaged in the here and now.

Mindfulness and meditation are quite similar, but they aren't identical. Both are calming and focus the mind but in subtly different ways. In addition, mindfulness can be practiced both informally (at any time or place) and formally (during seated meditation). Meditation, however, is usually practiced for a specific amount of time, whereas mindfulness can be applied to any situation for any period of time throughout the day. Meditation is also a way of practising mindfulness.

Mindfulness meditation is a type of meditation in which a person focuses attention on their breathing, whilst thoughts, feelings, and sensations are experienced freely as they arise. It involves paying attention, noticing, experiencing, doing, and being, right here, right now.

Mindfulness meditation is intended to enable individuals to become highly attentive to sensory information and to focus on each moment as it occurs. The formal meditation time is devoted to concentrating on the present moment, what you are experiencing during the meditation, and to achieve the state of mind associated with mindfulness.

Mindfulness meditation is used to teach people how to slow down their racing thoughts, let go of negativity, and calm both their mind and body. It helps people avoid being distracted by negative or automatic unhelpful thinking and responses by learning to observe their thoughts, emotions, and other present-moment experiences without judging or reacting to them.

It promotes mental wellbeing to some extent and may also be used to as a therapeutic intervention to provide relaxation and relief from stress or anxiety, for hypertension, chronic pain, insomnia and various other conditions. There is ample research evidence that supports the use of mindfulness meditation for better mental health and wellbeing (Eisler, 2019; Cam et al, 2021; APA, 2022; Peterson, 2022).

While there may be some benefit to mindfulness meditation, it cannot treat mental ill-health on its own, and should not be relied upon to do so. For example, research evidence shows that mindfulness meditation does not outperform CBT or other talk-based therapies. The evidence for mobile phone interventions and apps is less positive, especially when compared with treatments that have a strong evidence base (Van Dam, 2022).

Figure 10.9 Mindfulness meditation may be used formally or informally. If you want to practice it, a good starting point is to find a YouTube video or free smartphone app that provides instructions for beginners. Beyond Blue and headspace recommend checking out the Smiling Mind app as a possible starter.

on Resources

Weblink Smiling Mind website — information about mindfulness and the app

10.3 LEARNING ACTIVITY

Multiple-choice questions

1. All psychological protective factors may also be described as _____ factors.
   - A. internal
   - B. external
   - C. behavioural
   - D. biopsychosocial
2. The main purpose of using cognitive behavioural strategies is to help change
   - A. diet and hydration intake.
   - B. participation in enjoyable activities.
   - C. the balance of cognitions and behaviours.
   - D. negative thoughts that underlie maladaptive feelings and behaviour.

3. Cognitive restructuring is likely to focus on changing
   A. activity scheduling.
   B. nutritional intake and hydration.
   C. negative, irrational thoughts.
   D. use of mindfulness meditation.
4. Which one of the following is best described as a behavioural strategy?
   A. CBT
   B. relaxation training
   C. cognitive training
   D. cognitive reframing
5. Which one of the following is an essential feature of mindfulness meditation?
   A. heightened spiritual or religious awareness
   B. attainment of any altered state of consciousness as long as it is fundamentally different from ordinary waking consciousness
   C. focusing on what is being immediately experienced without distraction from negative thoughts while in relaxed state
   D. focusing on anything and everything that reaches the senses or comes to mind at any time or in any place

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10.4 Social protective factors

The growing prominence of the biopsychosocial approach has placed increased emphasis on the importance of social factors that can affect our mental wellbeing, particularly support from family, friends and community that is authentic and energising.

10.4.1 Support from family, friends and community

Being connected with other people and the community in general is an important part of protecting and maintaining mental wellbeing. As well as the social needs that are fulfilled through authentic interactions with others, connectedness helps ensure access to social support.

Social support generally refers to the assistance, care or comfort provided by people to each other, typically to help them cope with a stressor or mental health issue. The people who provide social support can vary and include anyone with whom we may have a relatively stable or ongoing relationship, although this does not necessarily mean a close interpersonal relationship or an intimate relationship. However, social support is more likely to be beneficial when it is authentic and energising or uplifting.

People who may provide social support can include family members, friends and people in the local and wider community, such as neighbours, peers at school, teachers we trust, work colleagues, members of a church or self-help group to which we may belong, professionals (e.g. family doctor, a counsellor or psychologist) and even people with whom we may connect in the 'virtual community' through telephone help lines or online support groups and chat rooms.

Support may take the form of practical help (e.g. doing chores, offering advice), tangible support that involves giving money or other direct material assistance, and emotional support that allows the individual to feel valued, accepted and understood (APA, 2022).

When experiencing an issue affecting mental health and wellbeing, people often don't feel like mixing with others. There is a tendency to avoid seeing friends and family. Some people may even avoid going to school or their workplace and skip other commitments within their community such as their casual job or sports training. Interacting with others can just seem too overwhelming and difficult. It can often be more comfortable and feel easier to be alone.

Research findings indicate that isolating oneself from others instead of seeking some form of social support is not usually helpful. For example, it can make the person feel worse and delay access to some kind of intervention that can be helpful.

Figure 10.10 Support from others is considered a vital protective factor for maintaining mental wellbeing.

Connecting with other people can often be the best medicine. Making the effort to see or stay in touch with other people is likely to result in feeling better, and, in some cases, can be a critical, even a life-saving means of support. This includes efforts that may involve contacting or seeing others only for short periods or in ways in which the individual feels comfortable; for example, catching up on the phone, posting a comment on Facebook or going to a movie with a friend or family member. Similarly, it can make a difference to go out into the community where it may be possible to have a chat with someone at the local shopping strip or mall. People seem to be inherently predisposed to be social, and really do feel better and more connected after even a brief encounter (SANE, 2020; Beyond Blue, 2022b).

According to Melbourne University psychologists Elise Kalokerinos, Katie Greenaway and Anh Tran (2020), 'social support is key to a happy and healthy life — people who have and seek support from others tend to be more mentally and physically healthy. Supportive interactions also strengthen our relationships, meaning we can use support to shore up our social connections for when we need help down the track.' However, despite being so important, and although well-intentioned, they have found that the support we provide to others is often ineffective.

Kalokerinos and her colleagues have provided the following evidence-based tips for how to provide more effective social support to someone with a problem adversely affecting their mental wellbeing.

1. **Validate first, reframe second**
   It is important to *validate* the other person's feelings, including by being empathic, by listening and by expressing understanding. It is also beneficial to help the person *reframe* or change any negative thinking about their issue.

   Both types of support are desirable; starting with validation, saying something like 'I understand why you feel this way, it must be hard' and then reframe the situation, saying something like 'This challenge might eventually be an opportunity'.
2. **Avoid downward spirals**
   Sometimes when we talk to others about their problems, we can get caught up in their emotional reaction and spiral down together as we vent back and forth, focusing on problems we may share and negative emotions. This can result in a negative outcome for both people in the interaction.

   If you find yourself in this kind of interaction, you can interrupt these downward spirals by changing the topic of conversation, or by pursuing a shared distracting activity. You can return to the discussion when you feel ready to try working towards a more constructive solution.

3. **Be authentic and energising**
   Social support is most helpful when it is authentic and provides truth by helping the other person to understand the situation more fully. It is also most helpful when it offers them control, and energises the other person by helping them feel as if they're capable of managing the situation.

   To help effectively, avoid telling the person what to do. It is often not helpful to try to solve a problem for them or suggest that they look at things differently when they are upset. Instead, try to help the person make their own choices. For example, try asking them to talk through what they could do to improve their situation with you, rather than telling them straight out what you think is the best course of action.
4. **Listen well**
   A good listener is attentive, which can be demonstrated with eye contact and by providing non-verbal signals and brief phrases like 'mm-hmm'. These unobtrusive responses reassure the person that you're both listening to and understanding them.

   Rather than making assumptions about the situation, ask the person a few questions about what is happening and how they are feeling. Let them do most of the talking.

   A good listener also provides scaffolding to help the other person explain what's wrong. They do this by asking questions, including 'What happened next?', and by helping to elaborate on ideas; for example, asking 'Do you think they did that because they were worried?'
5. **Be responsive, not dismissive**
   Being responsive to the person means trying to understand them, valuing their opinions and abilities, and making them feel cared for. It is not only crucial for a good relationship, but researchers have found that social support is only helpful when it includes responsiveness.

   It is also important to not ignore or invalidate the other person's feelings, or to be dismissive of how they feel. Instead, acknowledging their feelings, providing comfort, showing compassion and non-judgmentally accepting others' feelings helps them feel seen and supported.

Figure 10.11 The type of social support that is available may vary within and between cultures and locations. Individuals will also have preferences but it is most helpful when it is authentic and provides truth, and also energises the other person by helping them feel as if they're capable of managing the situation.

10.4 LEARNING ACTIVITY 1

Review

Complete the following table to summarise the influence of biopsychosocial protective factors for mental wellbeing.

Protective factor	What is it?	How it may influence mental wellbeing	Example
a. Biological • adequate nutritional intake and hydration • adequate sleep			
b. Psychological • cognitive behavioural strategies – cognitive strategy – behavioural strategy • mindfulness meditation			
c. Social • support from family, friends and community that is authentic and energising			

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10.4 LEARNING ACTIVITY 2

VCAA exam questions

Question 1 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.43 (adapted); ©VCAA

Adequate sleep may help maintain mental wellbeing because it is a

A. biological risk factor.
B. psychological protective factor.
C. biological protective factor.
D. social protective factor.

Question 2 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.47 (adapted); ©VCAA

Which of the following identifies biological protective factors and psychological protective factors that could contribute to protection against development of a mental disorder?

	Biological protective factors	Psychological protective factors
A.	adequate nutritional intake, hydration and sleep	stress and mindfulness meditation
B.	good diet, adequate hydration and sleep	cognitive behavioural strategies and mindfulness
C.	resilience and social support	mindfulness meditation and cognitive behavioural strategies
D.	adequate nutritional intake, hydration and sleep	cognitive distortions and activity scheduling

Question 3 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.44; ©VCAA

Which one of the following is a difference between risk factors and protective factors in the progression of mental disorders?

A. A catastrophic event can be a risk factor but is not likely to be a protective factor.
B. Coping abilities and strategies can be risk factors but are not likely to be protective factors.
C. Biological factors, such as genetics, can present as risk factors but are not likely to be protective factors.
D. Risk factors reduce the occurrence of a mental disorder, whereas protective factors increase susceptibility to a mental disorder.

Question 4 (1 mark)

Source: VCAA 2019 Psychology, Section A, Q.42; ©VCAA

Over a few months, Marguerite experienced significant issues with her boss at work. Marguerite is usually very optimistic and positive but her problems with her boss were making her very unhappy. She could not think of any solution. Marguerite discussed the situation with her partner, who had noticed a significant change in her attitude. Her partner suggested that she join him at the gym to help manage her stress.

Marguerite's current attitude would be considered a psychological risk factor because

A. it is influenced by her workplace.
B. it is based on her belief about the outcome.
C. she is expressing her concerns to her partner.
D. her emotions about the situation are caused by neurohormones.

Question 5 (1 mark)

Source: VCAA 2017 Psychology, Section A, Q.42 (adapted); ©VCAA

To help Glen manage his feelings of being overwhelmed by fatherhood, Glen's doctor suggested that he use a combined biopsychosocial approach.

Which of the following includes all aspects of the biopsychosocial approach?

A. mindfulness meditation, adequate sleep and accessing social support
B. adequate sleep, activity scheduling and behaviour activation
C. adequate nutritional intake and hydration, adequate sleep and support from family, friends and community that is authentic and energising
D. adequate nutritional intake and hydration, cognitive behavioural strategies and mindfulness meditation

To answer these and additional questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

10.5 Cultural determinants for wellbeing of Aboriginal and Torres Strait Islander peoples

There is no single Aboriginal and Torres Strait Islander culture or group, but numerous groupings, languages and kinship affiliations, as well as ways of living. Aboriginal and Torres Strait Islander cultures exist and thrive in a wide range of communities throughout Australia.

Aboriginal and Torres Strait Islander people may currently live in urban, rural or remote settings, in urbanised, traditional or other lifestyles, and move frequently between these ways of living, but there is a shared cultural heritage and strong connection to culture.

While diversity exists across and within Aboriginal communities, some cultural characteristics are part of all Aboriginal and Torres Strait Islander cultures and unite the people through shared history and shared experiences (DHHS, 2017; DOH, 2021).

Culture generally refers to the way of life of a particular group, society or community that sets it apart from other groups, communities and societies. Culture includes such things as the language, knowledge systems, customs, beliefs, values, attitudes, norms about what is right and wrong, food, art, dance and music, as well as any other features which distinguish it from other groups, societies or communities. These are passed on from generation to generation, and are the basis for everyday understandings, practices and behaviours.

Figure 10.12 Aboriginal and Torres Strait Islander peoples share a strong connection to culture.

10.5.1 Cultural determinants

Cultural determinants of mental wellbeing are protective factors that help maintain strong connections to culture, strengthen cultural identity, enhance resilience and contribute to the maintenance of good mental wellbeing. These include, but are not limited to, cultural continuity; self-determination; connection to Country; language; family, kinship and community; cultural expression; and cultural beliefs and knowledge.

Cultural determinants also contribute to improved outcomes across the social, political and historical determinants of mental wellbeing shown in Figure 8.4 in Topic 8. Gains in these determinants, in turn, reinforce cultural connectedness, maintenance and pride in cultural identity.

Celebrating and connecting to culture, community and Country builds self-esteem, resilience and creates a buffer against risks factors that can adversely affect mental wellbeing. Intergenerational effects of colonisation and laws and policies such as child removal, loss of language and racial discrimination that have disconnected Aboriginal and Torres Strait Islander people from culture, have been found to lead to and perpetuate poor mental wellbeing outcomes (DOH, 2021; Dudgeon et al., 2022).

Cultural continuity and self-determination are two of the cultural determinants that are integral for the maintenance of mental wellbeing in Aboriginal and Torres Strait Islander peoples.

10.5.2 Cultural continuity

Maintaining connection to culture, Country and community wherever one lives is essential to achieving better mental wellbeing outcomes and is vital in passing on important cultural knowledge to younger generations (DOH, 2021).

Cultural continuity involves the preservation of all things to do with Aboriginal and Torres Strait Islander peoples' culture over time, and the sense of history, identity and belonging this provides.

It involves intergenerational maintenance and transmission of cultural knowledge and practices, including language, self-determination, and connections to Country, family and kinships, community, spirit, spirituality and ancestors.

Cultural continuity ensures maintenance of cultural connection, which is integral to Aboriginal and Torres Strait Islander peoples' social and emotional wellbeing (SEWB). It has been described as 'being who we are' and as 'Indigenous peoples' sense of history, identity and relationships through cultural practices'.

The importance of cultural continuity for mental wellbeing is also evident in Indigenous communities in Canada and America, where strong cultural practices supporting cultural continuity have been shown to protect against serious mental health issues. For example, researchers have found a negative correlation between cultural continuity (as measured by cultural knowledge) and self-harm rates among Canadian indigenous adolescents. Furthermore, promoting cultural values and restoring a sense of cultural continuity have been found to promote resilience and healing of past traumas (Chandler & Lalonde, 1998; Oster, 2014; Auger, 2016; Dudgeon et al., 2014; 2022).

Figure 10.13 Cultural continuity involves the preservation of all things to do with Aboriginal and Torres Strait Islander peoples' culture over time, and the sense of history, identity and belonging this provides.

10.5.3 Self-determination

Self-determination is another protective factor for the mental wellbeing of Aboriginal and Torres Strait Islander people.

At an individual level, self-determination refers to the state of being free to control one's own life. When applied to Aboriginal and Torres Strait Islander communities, **self-determination** refers to the right to freely determine or control their political status and freely pursue their cultural, social and economic development. This basic human right is crucial to overcoming disadvantage in all these areas and ensuring their future generations survive and thrive.

Self-determination does *not* mean that Aboriginal and Torres Strait Islander people or communities are separate or detached in some way from the wider Australian community.

Aboriginal and Torres Strait Islander people have always known what is best for themselves and their own communities. However, they have not always been involved in the laws and policy decisions that affect their own health and wellbeing. Their communities have long struggled for the right to self-determine their lives.

Governments now recognise that mental health outcomes for Aboriginal and Torres Strait Islander people are best when Aboriginal and Torres Strait Islander people are empowered to lead the development, delivery and evaluation of the policies that affect them and the services that they use. Aboriginal community control ensures that mental health services are tailored to each community's particular priorities and goals, and deliver culturally appropriate solutions driven by the local community.

According to the Victorian Government's *Aboriginal health, wellbeing and safety strategic plan 2017–2027*, self-determination must be central to the provision of Aboriginal and Torres Strait Islander health services, including SEWB.

Furthermore, in relation to mental wellbeing, self-determination specifically means that rather than Aboriginal and Torres Strait Islander people merely being 'engaged' or 'consulted' as 'advisors' or 'co-designers' of mental health services and policies, they are authorised and empowered to take ownership and responsibility for designing, delivering and evaluating policy and services on their own terms.

It is recognised that self-determination is more than consultation. Consultation alone does not present any decision-making authority or control over outcomes. Self-determination also requires more than participation in service delivery. When the participation model has been used, Aboriginal and Torres Strait Islander people have not determined the

Figure 10.14 Self-determination is a nationally and internationally recognised basic human right. It is integral to the maintenance of Aboriginal and Torres Strait Islander peoples' mental wellbeing.

nature of the services that are best for them or how these are provided (Dudgeon et al., 2014; DHHS, 2017; DOH, 2021).

It is also recognised that all decisions about mental health and wellbeing are best made based on Aboriginal and Torres Strait Islander values and traditions, as defined by them, in a particular location or geographic area.

The strategic plan also states three reasons why self-determination is necessary.

1. *Self-determination works* Research evidence demonstrates that self-determination produces effective and sustainable outcomes for Indigenous peoples around the world when the users of the policies and services participate in their design, delivery and evaluation.
2. *Aboriginal and Torres Strait Islander people have a right to self-determination* Self-determination is necessary because Australia is signatory to a number of international law and human rights frameworks which specifically state and affirm Indigenous peoples' rights to self-determination.
3. *Aboriginal and Torres Strait Islander people have requested self-determination* Self-determination is necessary because Aboriginal and Torres Strait Islander people have long called for it (DHHS, 2017).

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learnMORE | Joe Williams — The Enemy Within

Access learnON to read about how First Nations educator Joe Williams promotes mental wellbeing with a focus on connection and belonging.

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Teacher weblink Aboriginal health, wellbeing and safety strategic plan 2017–2027

10.5 LEARNING ACTIVITY

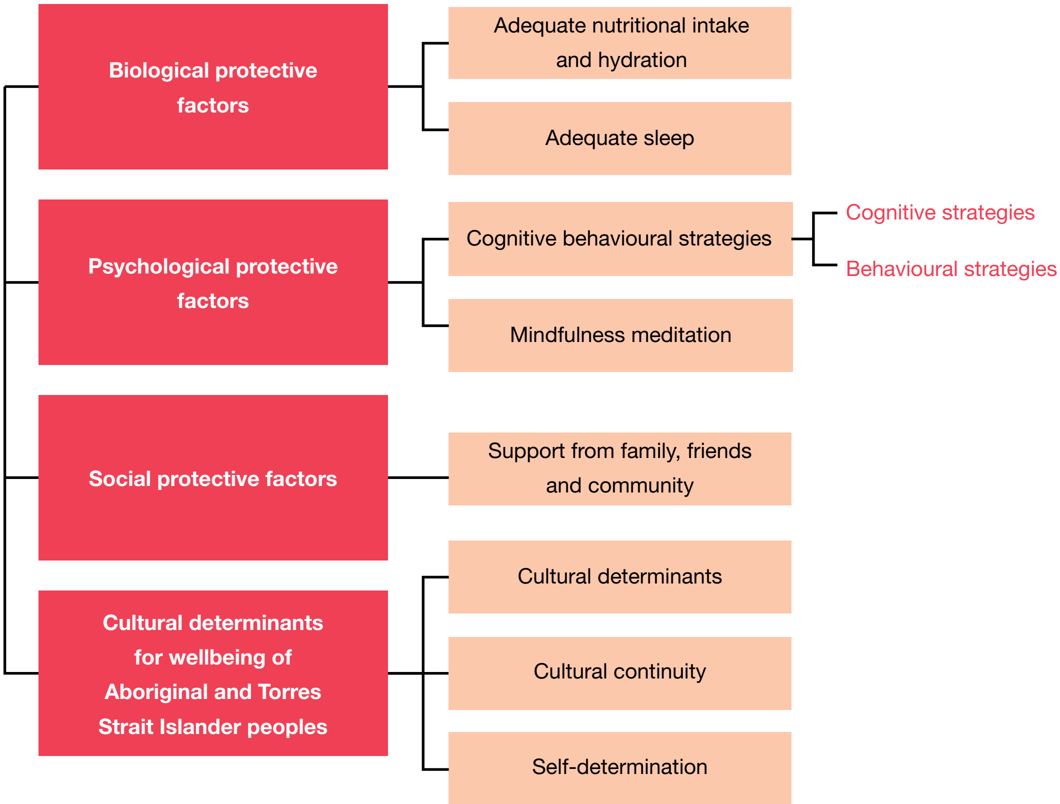
Multiple-choice questions

1. Aboriginal and Torres Strait Islander peoples' culture
   - A. changes with time.
   - B. is diverse.
   - C. is a psychological risk factor.
   - D. is a biological protective factor.
2. Aboriginal and Torres Strait Islander peoples' culture is best described as
   - A. a way of life.
   - B. a way of knowing.
   - C. a type of songline.
   - D. intergenerational knowledge.
3. Which of the following is a cultural determinant for Aboriginal and Torres Strait Islander peoples' mental wellbeing?
   - A. colonisation
   - B. type of housing
   - C. self-determination
   - D. child removal from families
4. Cultural continuity is
   - A. cultural preservation across time.
   - B. unique to Aboriginal and Torres Strait Islander peoples.
   - C. a state of being free to control one's own life.
   - D. a risk factor for Aboriginal and Torres Strait Islander peoples' mental wellbeing.
5. Which practice best reflects self-determination?
   - A. regulation of choices
   - B. shared ownership of choices
   - C. authentic consultation about possible choices
   - D. allowing freedom to make own choices

To answer questions online and receive **immediate feedback**, access learnON at www.jacplus.com.au.

10.6 Review

Topic summary



Key terms

activity scheduling p. 557
adequate hydration p. 550
adequate nutritional intake p. 550
adequate sleep p. 553
behaviour activation p. 557
biological protective factor p. 550
biopsychosocial approach p. 548
cognitive behavioural strategy p. 555
cognitive restructuring p. 556
cultural continuity p. 567
cultural determinant (of mental wellbeing) p. 566
culture p. 566
mindfulness meditation p. 559
protective factor p. 548
psychological protective factor p. 555
risk factor p. 548
self-determination p. 568
social protective factor p. 561
social support p. 561

Note: The **References** for the entire title can be accessed in learnON and are also available as a downloadable PDF.

on Resources

Digital documents Key terms glossary — Topic 10 (doc-38028)
Topic summary — Topic 10 (doc-38029)
Key diagrams PowerPoint — Topic 10 (doc-38031)

Exam question booklet Exam question booklet — (eqb-0132)

10.6 Topic 10 test

Section A: 10 marks **Section B:** 40 marks **Total:** 50 marks

Access learnON to answer the following test questions online and receive **immediate feedback**.

Section A — Multiple-choice questions

Choose the response that is **correct** or **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1 (1 mark)

Mental wellbeing is best described as

A. the absence of mental illness.
B. a lack mental health issues.
C. a lack of difficulties in everyday life.
D. a state of mental health.

Question 2 (1 mark)

Source: VCAA 2016 Psychology, Section A, Q.20 (adapted); ©VCAA

Abraham and Ben are actors who have played many roles on television over the last two years. Three months ago, Abraham obtained a new role in a television series that guaranteed him work for the next two years. Ben, however, has been out of work for the last three months. During this time, Ben auditioned for 15 roles in different shows, but has yet to secure any work.

Ben decided to ask Abraham to help him practise his lines for an upcoming audition.

Being able to practise his lines with Abraham is an example of

A. a social factor that will help to protect Ben's mental wellbeing.
B. a biological factor that will help to protect Ben's mental wellbeing.
C. social support that will decrease Ben's ability to cope with his situation.
D. a psychological factor that will decrease Ben's ability to cope with his situation.

Question 3 (1 mark)

Source: VCAA 2021 Psychology, Section A, Q.41 (adapted); ©VCAA

Which of the following describes the strength of representing mental health on a continuum and using a biopsychosocial model of mental health?

A. presents a hierarchy of biological, psychological and social factors in mental health
B. represents mental health as a range between being mentally healthy and having a mental disorder
C. illustrates the biological, psychological and social components as having an equal risk of predisposing an individual to having a mental disorder
D. emphasises mental health as a combination of biological, psychological and social factors interacting together

Question 4 (1 mark)

The negative correlation between cultural continuity and self-harm rates observed in Indigenous communities means that

A. there is an inverse relationship between cultural continuity and self-harm.
B. there is a negligible relationship between cultural continuity and self-harm.
C. the incidence of self-harm is dependent on cultural continuity.
D. cultural continuity contributes to the causation of self-harm.

Question 5 (1 mark)

Social support is more likely to contribute to mental wellbeing when the person

A. has lots of friends.
B. has both family and friends.
C. accesses social support available within their local community.
D. accesses social support that is authentic and energising.

Question 6 (1 mark)

Which of the following is most likely to be a protective factor for mental wellbeing?

A. poor coping skills
B. poor sleep
C. loss of a significant relationship
D. close friendships

Question 7 (1 mark)

Social contributory factors to mental wellbeing are generally considered to be sourced in an individual's

A. internal environment.
B. external environment.
C. interpersonal perceptions.
D. cognitive behavioural strategies.

Question 8 (1 mark)

Which of the following is a psychological protective factor for mental wellbeing?

A. challenging self-critical thoughts
B. community engagement
C. accessing an online forum to share a problem
D. participation in a self-help group to solve a problem

Question 9 (1 mark)

Which one of the following dietary guidelines is the most likely to contribute to mental wellbeing?

A. take care with portion size in each meal
B. maintain a rough idea of the calorie count for each meal
C. eat a good amount of a variety of different foods
D. eat as much as you want of whatever you want as often as you want as long as the food is not unhealthy

Question 10 (1 mark)

Source: VCAA 2020 Psychology, Section A, Q.44; ©VCAA

Theodore lost his job two years before he intended to retire and it had a negative impact on his mood and ability to cope. He did not pay two electricity bills despite having sufficient funds. He became withdrawn while at his golf club and soon stopped playing. When he also started complaining of sleeping problems, his daughter encouraged him to see his family doctor with her.

To try to improve Theodore's resilience, the doctor decided to focus on biological, psychological and social factors. Which of the following is a combination of the most likely strategies the doctor would initially encourage or use?

	Biological	Psychological	Social
A.	prescribing medication	challenging Theodore`s negative thought patterns	reminding Theodore about his supportive family
B.	getting Theodore`s friends to bring him meals	getting Theodore to join the seniors' club	getting Theodore to start an exercise program
C.	organising genetic testing	getting Theodore to make lists of the things he needs to do	taking Theodore to a nutritionist
D.	organising nutritious meals	challenging Theodore's negative thinking about the future	getting Theodore's friends to visit him regularly

Section B — Short answer questions

Question 1 (1 mark)

Behavioural activation is also called _____.

Question 2 (3 marks)

a. Explain the meaning of biopsychosocial approach to mental wellbeing. 1 mark

b. Explain how the biopsychosocial approach influences the way mental health professionals consider a person's mental health and wellbeing. 2 marks

Question 3 (4 marks)

Source: VCAA 2014 Psychology, Section B, Q.11 (adapted); ©VCAA

George experienced an episode of mental illness and was admitted to a psychiatric ward for two months. After he recovered and left the hospital, George was informed that he had lost his job. George sold his car to get some money, but that meant he was unable to get to his counselling sessions as he had no transport. Then, he ran out of money and was evicted from his home. Without a permanent address, George did not receive his concession card and could not afford to buy his medication. After six weeks, George experienced another episode of mental illness.

a. Suggest a biological factor, a psychological factor and a social factor that may have resulted in a more positive outcome for George than the one he experienced. 3 marks

b. The three factors that may have resulted in a more positive outcome for George's mental health are called _____ factors. 1 mark

Question 4 (3 marks)

a. Explain the meaning of adequate sleep. 1 mark

b. Describe two benefits of adequate sleep to mental wellbeing. 2 marks

Question 5 (3 marks)

a. What is mindfulness meditation? 1 mark

b. Explain how it may contribute to mental wellbeing with reference to an example. 2 marks

Question 6 (3 marks)

Jimmy has an extremely stressful job as prison guard at a maximum security prison that adversely affects his mental wellbeing. He is constantly hypervigilant, always concerned that he may be attacked by a prisoner anywhere, anytime. He thinks this way even when having his lunch break in the administrative area which is far away from the prisoner areas and non-accessible by prisoners.

Describe one biological, one psychological and one social strategy Jimmy could use to reduce his stress levels and safeguard his mental wellbeing.

Question 7 (4 marks)

Explain the meaning of each of the following concepts and how they may influence the mental wellbeing of Aboriginal and Torres Strait Islander peoples.

a. cultural continuity 2 marks

b. self-determination 2 marks

Question 8 (9 marks)

A researcher conducted an experiment to test whether a diet with an adequate amount of omega-3 fatty acid will prevent the development of anxiety disorders.

The experiment involved a randomised, double-blind placebo trial with 81 participants aged 13 to 25 years of age who were experiencing various anxiety symptoms, but did not have a diagnosable anxiety disorder.

Participants were randomly allocated to either the experimental group or control group for a period of 12 weeks. Participants in the experimental group took capsules containing 1.2 g of omega-3, whereas participants in the control group took a placebo.

At the end of the 12-week period, participants in the experimental group were found to have a significantly reduced number of anxiety symptoms compared with participants in the control (placebo) group.

The researcher concluded that omega-3 dietary intake may offer a safe and effective prevention strategy in young people who are at a high risk of developing an anxiety disorder.

a. The experiment is described as being a 'randomised, double-blind, placebo trial'. Explain what this means with reference to each term. 3 marks

b. Write a research hypothesis that would be supported by the results obtained. 2 marks

c. Identify the independent and dependent variables. 2 marks

d. Describe a potential extraneous or confounding variable that may be relevant to this particular experiment. 1 mark

e. Explain an ethical issue of relevance to the use of a placebo treatment in this particular experiment. 1 mark

Question 9 (10 marks)

Source: VCAA 2020 Psychology, Section B, Q.7; ©VCAA

Researchers at a university are planning to examine the impact of protective factors designed to increase resilience.

A sample of 100 participants will be randomly selected from people who respond to an advertisement placed in national newspapers and on social media. All participants will complete a self-report resilience scale three times: at the beginning of the study, immediately after the experimental conditions end, and six months later.

Participants will be randomly allocated to one of three conditions for six months:

- a condition in which participants will receive fortnightly coaching about diet and sleep behaviours
- a condition in which participants will be counselled fortnightly in the use of cognitive behavioural strategies
- a 'no treatment' condition

Using appropriate psychological terminology, evaluate the proposed design for this study. Your evaluation should consider the method and procedures of the investigation, and at least one effect of these on the analysis and/or interpretation of results and possible conclusions that may be drawn.

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Go to learnON to access answers to the Topic 10 test. A customisable Word version of the test can also be downloaded from the **Digital documents** tab of the Resources panel.

learnMORE | Joe Williams — The Enemy Within

I am a proud Wiradjuri/Wolgalu, First Nations Aboriginal man born in Cowra, raised in Wagga NSW, Australia. Despite a successful professional sporting career, I have battled with suicidal ideation and Bipolar Disorder the majority of my life. After a suicide attempt in 2012, I felt my purpose was to help people who struggle with mental illness through my *The Enemy Within* workshops.

The work that I have been delivering across the country and around the world essentially is about connecting people. Connection is a key contributing factor to individual and collective wellness because, since the evolution of humankind, we as a people have come from a species that relies on communal connections and interaction with each other.

The First Nation people of the land now called Australia, documented as the longest continuation of humankind, lived together in groups.

The one thing that kept us connected as a people across a continent that spanned over 500 separate and individual nations, with over 2500 different dialects of language, was the many common values that closely linked us to one and other and connected us to Country: Mother Earth.

As first people, the story of everything in our existence has importance. We believe that everything has a story of origin; the story of how it came to be — the creation story.

When learning about the creation, the stories of how things came to be, I believe people miss out on the most important lessons in the story: the values.

The many values that are so cleverly placed and embedded within the stories are the values that impacted our behaviours over many thousands of years.

It is these values within the stories, that helped us to be on a path of positive wellbeing. These stories, in essence, are about helping each other.

Stories, rules and laws about how we are to behave in community, our responsibilities and obligations.

Indigenous peoples across the globe lived as a collectivist society; looking out for each other, looking after one another, putting others before our own individual needs. It is in living like this, did the original people live, love, and thrive in their surroundings.

The old saying, ‘It takes a village to raise a child,’ is often overlooked with a lack of importance, when it is in fact, the very key to people living holistically well, now, today as a people.

The challenge we all find with a modern society is, we don’t have a village anymore; we live separated, segregated and of non-belief in the old ways.

The old ways were about connectedness, a place of nurture and belonging.

What is the first thing we do as people when we aren’t mentally or emotionally well?

We isolate…

When people aren’t well, often it is with a deep yearning or want to be and feel connected.

We search for connectedness and belonging, but we search for it in isolation, in substance, and a false identity of who we are.

As a people, so many of us are lost; wandering aimlessly through a world where they don’t quite fit. Craving to connect to something, anything, because we are so disconnected from ourselves.

When we talk of connecting to culture; behaviours repeated over time is what formulates a culture.

The behaviours of the old ways were drenched in the importance of values, and it is these values that underpin our behaviours and what kept us strong.

It kept us strong socially, emotionally and kept our wellbeing intact for many thousands of years.

Whilst the above refers to the values in how we view things, it is in the physical activity and practice which is aligned to our behaviours; is what helps to feel better mentally and emotionally. In doing things for others, it provides us a gateway to values of compassion and empathy, that allows us as individuals to connect to gratitude and be thankful for the things we have in our lives.

For many, many years, I have struggled with my own personal challenges mentally and emotionally. It is through the practice of doing things for others which allows me to connect to the values. Doing things for charity, those in need, those in a less fortunate and more challenging situation than me, helps me to connect to the things that are important in my life; connection, community and identity.

As a collectivist people, we have always done things for others; and the more we as individuals do things for others, the more we receive from others.

GLOSSARY

accuracy how close a measure relates to the 'true' value of the quantity being measured

acronym a pronounceable word formed from the first letters of a group of words

acrostic in relation to a *mnemonic*, making verbal associations for items to be remembered by constructing a sentence, phrase or other composition using the first letters of the information to be remembered

activity scheduling see *behaviour activation*

acute stress stress that lasts for a relatively short time

adaptive behaviour any behaviour that enables the individual to adjust to the environment appropriately and effectively; compare with *maladaptive behaviour*

adrenaline a hormone secreted during stress; also called *epinephrine*

Advanced Sleep Phase Disorder a circadian rhythm sleep disorder characterised by a shift of the major sleep episode to an earlier time compared to desired or conventional sleep times, resulting in sleep onset and awakening much earlier than desired and excessive sleepiness; see also *circadian rhythm sleep disorder*; compare with *Delayed Sleep Phase Syndrome*

afferent pathway a neural pathway that carries information towards the brain or spinal cord (e.g. sensory information); compare with *efferent pathway*

agonist a chemical agent (e.g. drug) that stimulates neurotransmitter activity; compare with *antagonist*

aim a statement outlining the purpose of the investigation

alarm reaction the first stage of the General Adaptation Syndrome in which the body goes into a temporary state of shock, then rebounds (counter shock), following initial awareness of a stressor

alpha brain wave pattern associated with a relaxed, calm, internally focussed wakeful state of consciousness, especially if eyes are closed

altered state of consciousness any state of consciousness that is distinctly different from normal waking consciousness or any waking state in terms of level of awareness and experience; compare with *normal waking consciousness*

Alzheimer's disease a neurodegenerative disorder characterised by gradual widespread degeneration of brain neurons, progressively causing memory decline, deterioration of cognitive and social skills, and personality changes

amygdala a small structure in the medial temporal lobe, deep within the brain and part of the limbic system; involved in emotional reactions (particularly fear and anger) and formation of a wide variety of emotional memories

anecdote an informal verbal report of an event that has been casually observed

antagonist a chemical agent (e.g. drug) that inhibits neurotransmitter activity; compare with *agonist*

antecedent stimulus an object or event that precedes a specific behaviour and signals the probable consequence for the behaviour and therefore influences the occurrence of the behaviour

anticipatory anxiety in relation to *specific phobia*, worry or apprehension about the possibility of being exposed to a phobic stimulus in the future

anxiety a state of arousal involving unpleasant feelings of apprehension or uneasiness that something is wrong or something unpleasant is about to happen

aphantasia absence of visual imagery

appraisal in relation to the *Lazarus and Folkman model*, the cognitive evaluation of the nature and significance of a stressor; see *primary appraisal* and *secondary appraisal*

approach coping strategy an effort to cope with stress by confronting the stressor and dealing directly with it and its effects; compare with *avoidance coping strategy*

Atkinson–Shiffrin multi-store model a representation and explanation of memory as consisting of three separate stores called sensory memory, short-term memory and long-term memory, differing in function, capacity and duration

attention the process of focusing on specific stimuli or aspects of the sensory environment whilst ignoring and therefore excluding others; in *observational learning*, the first step in the process which involves watching a model's behaviour and its consequences

autobiographical memory a person's memory for episodes or experiences that occurred in their own life; compare with *episodic memory*

autonomic nervous system a subdivision of the peripheral nervous system that connects the central nervous system to the body's internal organs and glands, providing feedback to the brain about their activities

avoidance behaviour in relation to *specific phobia*, actions that help avert any contact, exposure or engagement with a phobic stimulus

avoidance coping strategy an effort to cope with stress by evading the stressor and dealing indirectly with it and its effects; compare with *approach coping strategy*

basal ganglia a group of structures (neuron cell bodies called nuclei) deep within the brain, involved in the generation of voluntary movements and long-term implicit memories involving motor skills

behaviour any action made by a living person (or animal) that can be observed or measured

behaviour activation a CBT technique to help an individual identify and schedule activities that promote enjoyment or reduce stress; also called *activity scheduling*

behaviourist approach to learning emphasises the study of observable behaviour alone to understand and explain learning, without regard to underlying mental processes; see *classical conditioning* and *operant conditioning*

beneficence in relation to research ethics, the commitment to maximising benefits and minimising the risks and harms involved in taking a particular position or course of action

benzodiazepines a group of drugs that work on the central nervous system, acting selectively on GABA receptors in the brain to increase GABA's inhibitory effects and make postsynaptic neurons resistant to excitation; commonly called sedatives or mild tranquilisers

beta brain wave pattern associated with alertness and intensive mental activity during normal waking consciousness; also present during REM sleep dreams

between groups see *between subjects*

between subjects an experimental design in which each participant is assigned to only one group or condition and provides only one score for data analysis; also called *independent groups* and *between groups*

biased sample a research sample that does not adequately represent the key characteristics of its population

biological clock innate timing that regulates one or more biological rhythms; see also suprachiasmatic nucleus

biological factor in the biopsychosocial model, a physiologically based or determined influence, often not under our control, such as the genes we inherit

biological rhythm a naturally occurring cycle of physiological, psychological or behavioural changes; see *circadian rhythm* and *ultradian rhythm*

biopsychosocial approach a way of describing and explaining how biological, psychological and social factors combine and interact to influence an individual's behaviour and mental processes, including mental wellbeing; sometimes called the *biopsychosocial model* or *theory*

blood alcohol concentration (BAC) a measure of alcohol in the body expressed as grams of alcohol/100 mL of blood

breathing retraining in relation to specific phobia, an anxiety management technique that involves teaching correct breathing habits; also called breathing training

bright light therapy a technique for treating circadian rhythm sleep disorders that uses timed exposure of the eyes to light with the aim of shifting an individual's sleep-wake cycle to a desired, more appropriate or conventional schedule

carryover effect an order effect in an experiment that arises from experiencing a task and thereby affects current performance

case study an intensive, in-depth investigation of some behaviour, event or problem of interest in a single individual, group, organisation or situation

catastrophic thinking cognitive bias which involves overestimating, exaggerating or magnifying an event, activity or situation and predicting the worst possible outcome

central nervous system the brain and spinal cord

cerebellum structure at the base of the brain with multiple roles, including coordination of fine muscle movements, regulation of posture and balance, and various perceptual and cognitive processes; in relation to memory, involved in formation of long-term motor skill memories and stores implicit memories of simple conditioned reflexes

chronic stress stress that continues for a prolonged period of time

circadian rhythm a biological rhythm involving physiological, psychological or behavioural changes that occur as part of a cycle with a duration of about 24 hours; compare with *ultradian rhythm*

circadian rhythm sleep disorder a sleep disorder involving sleep disturbance that is primarily due to a mismatch between an individual's sleep–wake pattern and the pattern that is desired or required

classical conditioning a three-phase learning process (before conditioning, during conditioning and after conditioning) that results in the involuntary association between a neutral stimulus and unconditioned stimulus to produce a conditioned response; see also *three-phase model of classical conditioning*

classically conditioned memory implicit memory of a conditioned response to a conditioned stimulus acquired through classical conditioning, e.g. simple conditioned reflex responses

cognitive behavioural strategy in relation to psychotherapy, a CBT technique used to identify, assess and correct faulty patterns of thinking or problem behaviours that may be adversely affecting mental health and wellbeing

cognitive behavioural therapy (CBT) a type of psychotherapy based on the assumption that the way people feel and behave is largely a product of the way they think; aims to identify, assess and correct faulty patterns of thinking that may be affecting mental health and wellbeing

cognitive bias a mistaken way of thinking that leads to systematic errors of judgment and faulty decision-making

cognitive model emphasises the role of mental processes in describing and explaining behaviour

cognitive restructuring a CBT technique that may be used to help the individual identify their cognitive biases and other distorted ways of thinking, refute them, and then modify them so that they are adaptive and reasonable

conclusion in relation to research, a decision about what the results obtained from a research study mean

conditioned response in classical conditioning, the learned or acquired response to the conditioned stimulus

conditioned stimulus in classical conditioning, the stimulus that is initially neutral and does not normally produce the unconditioned response but eventually becomes associated with the unconditioned stimulus and elicits a conditioned response

conditioning a learning process through which stimuli and responses become associated with one another

confidentiality ethical guideline for research involving the privacy, protection and security of a participant's personal information, including results

confounding variable a variable other than the independent variable that has affected the results (the dependent variable) and whose effect(s) cannot be separated from that of the independent variable, thereby providing an alternative explanation(s) for the results; compare with *extraneous variable*

conscious response a reaction to a sensory stimulus that involves awareness; usually voluntary, goal-directed and with some degree of control over it; compare with *unconscious response*

consciousness a state of awareness with variations in level and associated with distinguishable psychological and physiological characteristics

consciousness awareness of something either internal or external to oneself, including objects and events in the external world, and of our sensations, mental experiences and own existence at any given moment

consequence in operant conditioning, the environmental event that occurs immediately after the relevant behaviour and has an effect on the occurrence of the behaviour

consolidation the neurobiological process of making a newly formed memory stable and enduring following a learning experience

context the setting, situation or environment in which an event occurs

context-specific effectiveness in relation to coping, when there is a match or 'good fit' between the coping strategy that is used and the stressful situation

continuum a spectrum or scale with distinct extremes or opposites on which something (including personal characteristics) can be shown to be varying in level or degree

continuum of awareness in relation to consciousness, a spectrum or scale with total awareness and complete lack of awareness at the two extremities, and other states of awareness (or consciousness) in between

control condition in an experiment, the standard against which the experimental condition can be compared; involves the control group who are not exposed to the independent variable

control group the group in an experiment not exposed to the independent variable

controlled experiment an experimental investigation of the relationship between an independent variable and a dependent variable, whilst controlling all other variables

controlled variable a variable that is considered to have an effect on the dependent variable so it is held constant to remove its potential effect

convenience sampling selecting participants who are readily or most easily available

coping in relation to stress management, attempting to manage the demands of a stressor in some effective way

coping flexibility the ability to effectively modify or adjust one's coping strategies according to the demands of different stressors

coping strategy a specific method used to manage or reduce the stress produced by a stressor; see also *approach coping strategy* and *avoidance coping strategy*

correlation the degree of a relationship between two variables

correlation coefficient a statistic used to describe the relationship between two variables

correlational study a research method used to investigate the relationship between variables without any control over the setting in which the relationship occurs or any manipulation by the researcher

cortisol a hormone secreted from the adrenal glands in response to a stressor

counter shock in the General Adaptation Syndrome, rebound from the temporary state of shock during the initial alarm reaction stage

counterbalancing systematically changing the order of treatments or tasks for participants in a 'balanced' way to 'counter' the unwanted effects on performance of any one order

cultural continuity the preservation of all things to do with culture over time, and the sense of history, identity and belonging this provides

culture the way of life of a particular community or group that sets it apart from other communities and groups

data information collected through research; see also *primary data*, *secondary data*, *quantitative data* and *qualitative data*

debriefing ethical guideline requiring that at the end of the experiment, the participant leaves understanding the experimental aim, results and conclusions including wellbeing checks where appropriate

deception (in research) when a researcher deliberately conceals the true purpose of the experiment from participants by misleading or misinforming them

Delayed Sleep Phase Syndrome a condition in which the major sleep episode is delayed in relation to the desired sleep time or what is considered a conventional time; see also *circadian rhythm sleep disorder*

delta brain wave pattern associated with deep, dreamless sleep or unconsciousness

demand characteristic a cue in an experiment that may influence or bias a participant's response, thereby distorting the results

dependent variable the variable the researcher measures, after selecting the independent variable that is assumed to have an effect on the independent variable

dopamine a neurotransmitter or neuromodulator with multiple functions depending on where it acts; functions include roles in coordinating movement, learning and behaviours that are rewarding

double blind a procedure in which both the participants and the experimenter(s) interacting with them are unaware of the conditions to which the participants have been allocated; compare with *single blind*

echoic memory auditory sensory memory for incoming auditory information that stores sounds in their original sensory form for about 3 or 4 seconds

efferent pathway a neural pathway that carries information away from the brain or spinal cord (e.g. motor information); compare with *afferent pathway*

elaborative rehearsal the process of linking new information in a meaningful way with information already stored in memory or with other information to aid its storage and future retrieval from long-term memory; compare with *maintenance rehearsal*

electroencephalography a method of studying brain wave patterns by recording the electrical activity of the brain

electromyography a method of studying the electrical activity of muscles during sleep

electro-oculargraphy a method of measuring eye movements or eye positions during sleep

empirical evidence data collected through systematic observations and/or carefully controlled experiments

encoding in relation to memory, conversion of information into a usable form so that it can be neurologically represented and stored in memory

endogenous originating within an organism; compare with *exogenous*

enteric nervous system a sub-division of the autonomic nervous system embedded within the walls of the gastrointestinal (digestive) tract and dedicated to its functioning

enterotype describes the unique combination of gut microbiota each individual possesses

entrainment process of adjusting or resetting a biological rhythm to align with external cues or an environmental cycle

episodic memory the long-term explicit memory of personally experienced events associated with a particular time and place; compare with *autobiographical memory* and *semantic memory*

ethics in relation to research, standards that guide researchers to identify good, desirable or acceptable behaviour

evidence-based intervention a treatment that has been found to be effective on the basis of scientific evidence

excitatory effect when a neurotransmitter stimulates or activates a postsynaptic neuron to perform its functions; compare with inhibitory effect

exhaustion stage the third stage of the General Adaptation Syndrome when the body can no longer sustain resistance

exogenous originating outside an organism; compare with *endogenous*

experiment a research method to test whether a variable(s) influences or causes a change in another variable(s), usually under controlled conditions; typically involves the manipulation of an independent variable, the measurement of a dependent variable, and exposure of various participants to one or more of the conditions being studied

experimental condition the condition in an experiment in which participants are exposed to the independent variable; involves the experimental group; sometimes used to mean any or all groups or conditions in an experiment, including the control group (or conditions)

experimental group the group in an experiment exposed to the independent variable

experimenter bias see *experimenter effect*

experimenter effect any influence on the results produced by the person carrying out the research; also called *experimenter bias*

explicit memory long-term memory that can be consciously retrieved and stated ('memory with awareness'); see also *episodic memory* and *semantic memory*; compare with *implicit memory*

external factor an influence on behaviour or mental processes that originates outside a person

external stressor a stressor which originates outside the individual from situations and events in the environment

external validity the extent to which the results obtained for a study can be applied beyond the sample that generated them, specifically to individuals in a different setting and over time; compare with *internal validity*

extraneous variable any variable other than the independent variable that can cause a change in the dependent variable and therefore affect the validity of the results in an unwanted way; compare with *confounding variable*

fear hierarchy a list of feared objects or situations, ranked from least to most anxiety-producing

field experiment a psychological experiment that is conducted outside the laboratory in a 'real-world' setting

fight-or-flight-or-freeze response an involuntary, bodily response to a sudden and immediate threat (or stressor) in readiness for fight (confront), flight (escape) or freeze (be silent and unseen)

fixed alternative question see *fixed-response question*

fixed-choice question see *fixed-response question*

fixed-response question a question that presents a number of fixed alternative answers from which participants are required to choose; also called *fixed alternative question* or *fixed-choice question*

focus group in psychological research, a small set of people who share characteristics and are selected to discuss a topic of which they have personal experience

free-response question a question which allows participants to answer entirely as they want to; also called *open ended question*

functioning generally refers to how well an individual independently performs or operates in their environment

GABA (gamma-amino butyric acid) the primary inhibitory neurotransmitter in the central nervous system, making postsynaptic neurons less likely to fire

GABA (gamma-amino butyric acid) dysfunction failure to produce, release or receive the correct amount of GABA needed to regulate neurotransmission in the brain; see *GABA*

General Adaptation Syndrome a three-stage physiological response to stress involving alarm reaction (shock/countershock), resistance and exhaustion

generalisation in research, a decision about how widely the findings of an investigation can be applied, particularly to other members of the population from which the sample was drawn

glutamate the main excitatory neurotransmitter in the CNS, thereby enhancing information transmission by making postsynaptic neurons more likely to fire

gut–brain axis a bidirectional, multi-faceted communication link between the central and enteric nervous systems

gut microbiota the microorganisms (e.g. bacteria, viruses and fungi) present in each individual's digestive tract ('gut')

habituation the process of growing accustomed to a stimulus and decreasing responsiveness to it; also called *habituation learning*

hippocampus a structure in the medial temporal lobe, deep within the brain and part of the limbic system; crucial role in the formation, encoding and consolidation of new long-term explicit memories and their transfer to the cortex for storage

hypnogram a sleep graph typically showing sleep types and stages in relation to time

iconic memory visual sensory memory for incoming visual information that stores visual images in their original sensory form for about a third of a second

implicit memory long-term memory that does not require conscious or intentional retrieval ('memory without awareness'); see also *procedural memory* and *classically conditioned memory*; compare with *explicit memory*

independent groups see *between subjects*

independent variable variable that is manipulated (controlled, selected or changed) in order to test its effects on the dependent variable

informed consent ethical guideline requiring that participants understand the nature and purpose of the experiment, including potential risks, before agreeing to participate

inhibitory effect when a neurotransmitter blocks or prevents a postsynaptic neuron from firing and therefore performing its functions; compare with *excitatory effect*

integrity in relation to research ethics, the commitment to searching for knowledge and understanding, the honest reporting of all sources of information and results, whether favourable or unfavourable, in ways that permit scrutiny and contribute to public knowledge and understanding

internal factor an influence on behaviour or mental processes that originates inside or within a person

internal stressor a stressor that originates within the individual

internal validity the extent to which an investigation actually investigated what it set out to investigate and/or claims to have investigated; compare with *external validity*

interview asking questions to obtain self-report data

justice in relation to research ethics, moral obligation to ensure that there is fair consideration of competing claims; that there is no unfair burden on a particular group from an action; and that there is fair distribution and access to the benefits of an action

laboratory experiment a psychological experiment that is conducted within a laboratory setting

learning a relatively permanent change in behaviour due to experience

long-term depression the long-lasting decrease in the strength of synaptic connections and transmission and neuronal response; compare with *long-term potentiation*

long-term memory a memory store that holds a potentially unlimited amount of information for a very long time, possibly permanently; see also explicit memory and implicit memory

long-term potentiation the long-lasting enhancement of synaptic transmission due to repeated strong stimulation; compare with *long-term depression*

maintenance rehearsal repetition of information over and over again so that it can be kept in short-term memory; compare with *elaborative rehearsal*

maladaptive behaviour any behaviour that interferes with a person's ability to successfully adjust to the environment and fulfil their typical roles in society; compare with adaptive behaviour

mean the arithmetical average of all the individual scores (or values) in a set of scores

measure of central tendency a score that indicates the central or average value of a set of scores; see also *mean*, *median*, *mode*

measure of variability a statistic that indicates how widely scores (or values) are distributed or scattered around the central point

median the middle score (or mid-point) of a set of scores (or values)

melatonin a hormone secreted by the pineal gland in relation to the amount of light that is detected; influences alertness and drowsiness and timing of the sleep–wake cycle; a higher melatonin level is associated with greater drowsiness and vice versa

memory processing, storage and retrieval of information acquired through learning; often described as neurological representation of learning; also see *Atkinson–Shiffrin multi-store model of memory*

memory bias a type of cognitive bias involving distorting influences of present knowledge, beliefs and feelings on the recollection of previous experiences; see *cognitive bias*

mental process generally refers to a person's thoughts, feelings and other mental activities that cannot be directly observed; compare with *behaviour*

mental wellbeing an individual's state of mind, enjoyment of life, and ability to cope with the normal stresses of everyday life and develop to their potential

method of loci a mnemonic device for which the items to be remembered are converted into mental images and associated with specific locations; also called *memory palace* or *mind palace*

microbiome the population of microbiota in a defined environment

microsleep a very short period (e.g. a few seconds) of involuntary sleep

mindfulness meditation a type of meditation in which a person focuses attention on their breathing, whilst thoughts, feelings, and sensations are experienced freely as they arise; involves paying attention, noticing, experiencing, doing and being, right here, right now

mixed design an experimental design that combines the features of the within subject and between subjects designs

mnemonic any technique used to assist memory; see *acronym, acrostic, method of loci, songlines*

mode the most frequently occurring score (or value) in a set of scores

model a body of interrelated concepts ('ideas') that attempt to explain interrelated observations and make predictions about future events; also called theory; in *observational learning* who or what is being observed.

motivation processes within an organism which activate behaviour that is directed towards achieving a particular goal

naturalistic observation when the researcher views and records behaviour of interest in the natural, 'real life' environment where it would ordinarily occur

negative correlation when two variables change in opposite directions — as one variable increases, the other variable tends to decrease (and vice versa)

negative punishment the removal or loss of a desirable stimulus thereby weakening or decreasing the likelihood of a response recurring again; compare with *positive punishment*

negative reinforcement the removal of an unpleasant or aversive stimulus, thereby strengthening or making a desired response more likely to reoccur; compare with *positive reinforcement*

negative reinforcer any unpleasant or aversive stimulus that, when removed or avoided, strengthens or increases the frequency or likelihood of a desired response; compare with *positive reinforcer*

neocortex the largest and most recently evolved part of the brain's cerebral cortex

neural pathway a route based on interconnected neurons that form a communication network within the brain and between the brain and other parts of the nervous system and body

neural synapse the site where communication typically occurs between adjacent neurons; also called *neural junction* or *synapse*

neuromodulator a neurotransmitter that can influence the effects of other neurotransmitters; also called *modulator neurotransmitter*

neurological disorder any disease or disorder of any part of the nervous system

neuroplasticity the ability of the brain and other parts of the nervous system to change in response to experience

neurotransmitter a chemical substance produced by a neuron that carries a message to other neurons or cells in muscles, glands or other tissue; compare with *neuromodulator*

neutral stimulus in classical conditioning, any object or event that does not normally produce a predictable response; becomes a conditioned stimulus through repeated association with the unconditioned stimulus

non-maleficence in relation to research ethics, avoiding the causations of harm

non-participant observation when the researcher tries to conceal their presence so that their observations are made in entirely inconspicuous manner

normal waking consciousness state of consciousness associated with being awake and aware of objects and events in the external world, and of one's sensations, mental experiences and own existence; compare with *altered state of consciousness*

NREM sleep non-rapid eye movement sleep with three stages involving increasingly deeper sleep; compare with *REM sleep*

objective data information that is observable, measurable, verifiable and free from the personal bias of the researcher; compare with *subjective data*

observational learning acquisition of information, skills or behaviour through watching the performance of others, either directly or indirectly; involves a sequence of processes called attention, retention, reproduction, motivation and reinforcement; also called *modelling*

observational study collection of data by carefully watching and recording behaviour as it occurs without any intervention or manipulation of the behaviour being observed

open ended question see *free-response question*

operant any response (or set of responses) that acts on the environment to produce some kind of consequence

operant conditioning a learning process whereby the consequences of a behaviour (e.g reward or punishment) determine the likelihood that it will be performed again in the future; see also *three-phase model of operant conditioning*

operationalise define how variables will be manipulated as measured in a research investigation

opinion a point of view that is not necessarily based on verifiable evidence and can be disputed

order effect when performance on the dependent variable is influenced by the specific order in which an experimental task is presented rather than the independent variable

outlier an extreme measurement, one that significantly differs from all others in a data set

panic attack a period of sudden onset of intense fear or terror, often associated with impending doom and bodily symptoms

parasympathetic nervous system a sub-division of the autonomic nervous system that calms or restores the body to its normal state of functioning after the need for sympathetic nervous system activation has passed; compare with *sympathetic nervous system*

participant variable a personal characteristic of a research participant that could influence their responses

peripheral nervous system (PNS) entire network of nerves located outside the central nervous system; carries information to and from the central nervous system (via its somatic and autonomic sub-divisions)

personal error a fault or mistake by the researcher; also called *human error*

phobia a persistent and irrational fear of a particular object, activity or situation, which is consequently either strenuously avoided or endured with marked distress

placebo a fake treatment that is like the independent variable treatment but which is actually neutral or has no known effect

placebo effect when there is a change in a participant's behaviour due to their belief that they are receiving some kind of experimental treatment and they respond in accordance with that belief, rather than to the effect of the independent variable

population in relation to research, the entire group of research interest from which a sample is drawn

positive correlation when two variables change in the same direction

positive punishment presentation of an unpleasant stimulus that weakens a response or decreases the likelihood of the response occurring again; compare with *negative punishment*

positive reinforcement presentation of a positive reinforcer following a desired response; compare with *negative reinforcement*

positive reinforcer a stimulus that strengthens or increases the frequency or likelihood of a desired response; compare with *negative reinforcer*

precision how closely a set of measurement values agree with each other

primary appraisal in the Transactional Model of Stress and Coping, an individual's evaluation of the significance of a potential stressor and whether anything is at stake in the encounter, resulting in a decision that it is either irrelevant, benign–positive or stressful; compare with *secondary appraisal*

primary data information collected directly by the researcher (or through others) for their own purpose; compare with *secondary data*

procedural memory the long-term implicit memory of skills that have been learned previously

protective factor something that enhances and helps to protect mental wellbeing and reduces the likelihood that mental ill-health will occur; compare with *risk factor*

pruning the elimination of weak, ineffective or unused synapses (and therefore connections to other neurons); also called *synaptic pruning*

psychoeducation the provision and explanation of information to individuals about a mental health disorder to assist their understanding of its characteristics and treatment

psychological construct a concept, description or explanatory model that describes specific psychological activity or a pattern of associated activities or processes

psychological factor in the biopsychosocial model, an internal, mental process and influence such as the effects of our prior experiences, memories and ways of thinking

punishment delivery of an unpleasant consequence following a response, or the removal of a pleasant consequence following a response, in order to weaken a response or decrease the likelihood of it occurring again; see also *positive punishment* and *negative punishment*

qualitative data non-numerical information involving the 'qualities' or characteristics of a participant's experience of what is being studied

quantitative data numerical information on the 'quantity' or amount of what is being studied

questionnaire data collection tool with a written set of questions or other prompts designed to collect self-report data

random allocation procedure used to place participants in experimental and control groups (or conditions) so that they are as likely to be in one group as the other; ensures uniform distribution of participant characteristics; also called *random assignment*

random error an error due to some chance factor or chance variation in a measurement

random sample a sample that has been selected using a random sampling technique

random sampling sample selection technique that ensures every member of the population of research interest has a genuinely equal chance of being selected to be part of the sample; helps achieve a representative sample

rating scale data collection tool with fixed-response questions or statements for which participants rank each item by selecting from a number of choices

reflex an unconscious, automatic, involuntary reaction to a stimulus that occurs in the same way each time

reinforcement when a stimulus strengthens or increases the frequency or likelihood of a response that it follows; may also refer to the process of administering the stimulus (i.e. reinforcer); see also *positive reinforcement* and *negative reinforcement*

reinforcer any stimulus that strengthens or increases the frequency or likelihood of a response that it follows; see also *positive reinforcer* and *negative reinforcer*

reliability the extent to which a measure produces results that are consistent, dependable and stable

REM sleep rapid eye movement sleep

repeatability the degree to which a specific research investigation obtains similar results when it is conducted again under the same conditions on all occasions

repeated measures see *within subjects*

representative sample a sample that closely resembles the population from which it is drawn in key characteristics

reproducibility how close the results are to each other when an investigation is replicated under changed conditions

rerouting when new connections are made between neurons to create alternate neural pathways

research hypothesis a testable prediction of the relationship between two or more variables

research method a particular way of conducting a research study or investigation to collect accurate and reliable data on a question or problem of interest

resilience the ability to successfully cope with and manage change, uncertainty and adversity, and to 'bounce back' and restore positive functioning

resistance stage the second stage of the General Adaptation Syndrome, when the body's resistance to the particular stressor rises above normal

respect in relation to research ethics, consideration of, and due regard to, the extent to which living things have an intrinsic value and/or instrumental value

response a reaction by an organism to a stimulus

retrieval in relation to memory, recovery of stored information and bringing it into conscious awareness for use

risk factor in relation to mental health, something that increases the likelihood of experiencing mental ill-health, or can make existing mental health difficulties more severe or long-lasting; compare with *protective factor*

sample the subset or part of the population that is selected for a research investigation

sampling process of selecting participants from a population of research interest; see also *random sampling, stratified sampling* and *convenience sampling*

secondary appraisal in the Transactional Model of Stress and Coping, an individual's evaluation of their ability to control or overcome a stressful situation; compare with *primary appraisal*

secondary data information that was not collected directly by the current researcher but was collected at an earlier time by someone else; compare with *primary data*

self-determination the human right to freely determine or control one's political status and freely pursue one's cultural, social and economic development

self-report a participant's responses to questions presented by the researcher

self-stigma when an individual accepts the negative views and reactions of others, internalises them, and applies them to themself; see also *social stigma*

semantic memory long-term explicit memory of facts and knowledge about the world; compare with *episodic memory*

sensory memory the entry point of memory where new incoming sensory information is stored in its original, raw state for a very brief time; see also *echoic memory* and *iconic memory*

serotonin a neurotransmitter or neuromodulator with multiple functions depending on where it acts; functions include emotional processing, mood, and sleep onset

shift work disorder a circadian rhythm sleep disorder due to work shifts being regularly scheduled during the usual sleep period; work shifts overlap with all or part of the sleep period, requiring adjustment of sleep and wake times to the work times; see also *circadian rhythm sleep disorder*

shock in the General Adaptation Syndrome, the temporary state immediately following exposure to a stressor during the initial alarm reaction stage

short-term memory a memory system with limited storage capacity in which information is stored for a relatively short time, unless renewed in some way; also maintains information in conscious awareness and functions as 'working memory'

simulation study reproducing situations of research interest in a realistic way to investigate the behaviour and/or mental processes of individuals in that environment

single blind a procedure in which participants are unaware of ('blind' to) the experimental condition they are in

situational variable an external factor associated with the experimental setting that may influence participant responses and therefore the results

sleep a regularly occurring altered state of consciousness that typically occurs naturally and is primarily characterised by partial or total suspension of conscious awareness

sleep debt the accumulated amount of sleep loss due to insufficient sleep

sleep deprivation inadequate quantity or quality of sleep

sleep diary a self-report record of an individual's sleep and waking time activities

sleep disorder any sleep disturbance that is persistent and regularly disrupts sleep, causing distress or impairment in important areas of everyday life during normal waking hours

sleep disturbance any sleep-related problem that disrupts an individual's normal sleep–wake cycle

sleep hygiene practices that tend to improve and maintain good sleep and full daytime alertness

sleep inertia a temporary period of reduced alertness and performance impairment that occurs immediately after awakening, especially after a poor night's sleep and if abruptly awakened

sleep latency the length of time it takes to transition from being awake to being asleep

sleep onset the transition period from being awake to being asleep

social-cognitive approach to learning emphasises the role of cognitive processes such as attention, memory and motivation in learning, in addition to environmental stimuli such as conditioning, reinforcement and punishment; see also *observational learning*

social and emotional wellbeing (SEWB) in relation to Aboriginal and Torres Strait Islander peoples, a holistic, multi-dimension framework that describes and explains physical, social, emotional, spiritual and cultural wellbeing

social factor in the biopsychosocial model, an influence from the external social environment in which we interact with others, such as the range and quality of our interpersonal relationships with family, and our cultural background

social learning the process of learning by observing the social interactions and behaviours of others

social stigma the negative attitudes and beliefs held in the wider community that lead people to fear, exclude, avoid or unfairly discriminate against people with a disorder

social support the assistance, care or empathy provided by people to each other

somatic nervous system a sub-division of the peripheral nervous system that carries sensory information to the central nervous system and motor information from it

songline a navigational route comprising a sequence of locations used by Aboriginal and Torres Strait Islander peoples which may also serve as mnemonic; also called *dreaming track*

specific phobia an anxiety disorder characterised by marked and persistent fear about a specific object, activity or situation, typically avoided or endured with marked anxiety or distress

spinal cord a long, thin bundle of nerve tissue connecting the brain and rest of the body via the peripheral nervous system; initiates simple reflex responses independently of the brain; see also *spinal reflex*

spinal reflex an unconscious, involuntary response to certain stimuli, initiated within the spinal cord and controlled solely by neural circuits; also called *reflex arc*

sprouting the creation of new extensions on a neuron to allow it to make new connections with other neurons

standard deviation statistic that summarises how far scores within a set of scores spread out, or deviate, from the mean for those scores

state of consciousness a state of awareness with variations in level and associated with distinguishable psychological and physiological characteristics

stigma a sign of social disapproval, often involving shame or disgrace; see also *self-stigma* and *social stigma*

stimulus any object or event that elicits (produces) a response from an organism

storage in relation to memory, retention of encoded information over time

storage capacity in relation to memory, the amount of information that can be retained at any given moment

storage duration in relation to memory, the length of time that information can be retained

stratified sampling a sampling technique involving sampling from different subgroups in the same proportions as they occur in the population of interest

stress a psychobiological response produced by internal or external stressors; see also *acute stress* and *chronic stress*

stressor a stimulus that produces stress

subjective data information that is based on personal opinion, interpretation, point of view or judgment; compare with *objective data*

suprachiasmatic nucleus (SCN) an area of the brain's hypothalamus that regulates the timing and activity of the sleep–wake cycle (and other biological rhythms); see also *biological clock*

sympathetic nervous system a subdivision of the autonomic nervous system; activates internal muscles, organs and glands to prepare for vigorous activity or to deal with a stressor, fear stimulus, threat or emergency; compare with *parasympathetic nervous system*

synaptic gap the tiny space between the axon terminal of a presynaptic neuron and the dendrite of a postsynaptic neuron; also called *synaptic cleft*

synaptic plasticity the ability of a synapse to change in response to experience

synapse the site where adjacent neurons communicate by transmitting neural signals to one another

synaptic pruning see *pruning*

systematic desensitisation a behaviour therapy for treatment of specific phobia that aims to replace an anxiety response with relaxation when an individual encounters a fear-inducing, phobic stimulus

systematic error a measurement error produced by some factor that consistently favours one condition rather than another

theory a body of interrelated concepts ('ideas') that attempt to explain interrelated observations and make predictions about future events; also called *model*

theta brain wave pattern associated with drowsiness, falling asleep and creative activities

three-phase model of classical conditioning explains classical conditioning with reference to processes occurring before, during and after conditioning; see *classical conditioning*

three-phase model of operant conditioning explains operant conditioning as occurring in a specific sequence: (1) presence of an antecedent stimulus that occurs before the behaviour; (2) the behaviour that occurs due to the antecedent and (3) the consequence to the behaviour; see *operant conditioning*

Transactional Model of Stress and Coping proposes that stress involves an encounter between an individual and their environment, and that a stress response depends upon both an individual's appraisal of the stressor and their ability to cope with it

triple blind procedure a procedure in which the participants, experimenters, and research assistants only doing data analysis are all unaware of the particular experimental conditions

ultradian rhythm a biological rhythm involving physiological, psychological or behavioural changes that occur as part of a cycle shorter than 24 hours; compare with *circadian rhythm*

uncertainty when something (e.g. a particular outcome) is not accurately or precisely known

unconditioned response in classical conditioning, an involuntary response that occurs when the unconditioned stimulus is presented

unconditioned stimulus in classical conditioning, any stimulus that consistently produces a particular naturally occurring, involuntary response (i.e. an unconditioned response)

unconscious response a reaction to a sensory stimulus that does not involve awareness; involuntary, unintentional, automatic and we cannot ordinarily control its occurrence; compare with *conscious response*

validity the extent to which a measure accurately measures what it is supposed to be measuring; see also *internal validity* and *external validity*

variability the degree to which measures or values differ from one another

variable something in which individuals, animals or objects differ among themselves, can change in amount or kind, and is measurable

vicarious conditioning in observational learning, when an individual observes a model displaying behaviour that is either reinforced or punished and later behaves in the same way, in a modified way, or refrains from doing so as a result of the observation

voluntary participation ethical guideline requiring that no coercion or pressure is put on the participant to partake in an experiment, and they freely choose to be involved

withdrawal right ethical guideline requiring a participant being able to discontinue their involvement in an experiment at any time during or after the conclusion of an experiment

within-groups see *within subjects*

within subjects an experimental design in which each participant is in both the experimental and control groups or all the treatment conditions (if there is no control group); also called *repeated measures*

zeitgeber an environmental time cue

zero correlation no relationship between two variables

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