Human–Computer Interaction Series

Phil Turner

A Psychology of User Experience

Involvement, Affect and Aesthetics

Second Edition

Springer

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Chapter 1
The Everyday Use of Digital Technology

1.1 Introduction

For most people, the words "*digital technology*" means only one thing, their mobile phone (cell phone or smartphone) of which there are estimated to be 7 billion and 15 billion respectively according to the *statista* website (2023). This works out to be about three each. Really.

These powerful computer-based devices are used to access information, goods, and services by way of apps which, remarkably, we are able to use without training or dedicated instruction. Furthermore, most people have reported that their phone is their most precious possession and that nearly 30% of younger users who will, in less than 24 months, buy a newer model.

We use our phones to access the Web and various forms of social media (e.g., Facebook, WhatsApp, Facebook Messenger, and Instagram). But this becomes all the more complex when it is revealed that approximately 50% of us will use our phones to invite and conduct social interaction while the other 50% (or so) will use them to avoid other people. To understand what is going on, we can no longer appeal to the narrowly cognitive accounts prevalent in HCI for the last 50 years as they simply do not reflect these monumental changes in society and the rapid definition and redefinition of our technological culture.

Our routine use of personal, mobile technology is a consequence of our familiarity with it. If this sounds a little circular (or self-referential), then all the more re-assuring. We have learned to use this technology vicariously (from the many forms of the media), and by imitating others starting in the school playgrounds and sitting next to us at work. We describe this everyday use of digital products as *coping*.

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1.2 Varieties of Coping

To cope, at first sight, seems an innocuous choice of terms as that is more usually associated with dealing with emotional situations or trauma or the robes of the clergy. However, to cope (at heart) is quite fierce, as it is not just about getting by or to "muddle through" but dealing with a situation effectively. Etymologically to cope means to vie with, to match, and is from the Middle English *to strike, to encounter* (Skeat 1879).

The philosopher Hubert Dreyfus was the first to articulate an account of practical coping which he defines as the "*mostly smooth and unobtrusive responsiveness to circumstances that enable human beings to get around in the world*". Dreyfus proposes practical coping as an alternative to classical accounts of cognition which involve the application of "rules" to an internal representation (such as a mental model) as a means to create plans which are duly executed. Coping is the practical, *skilful,* and representation-free dealing with the world and, of course, technology. Rouse, commenting on Dreyfus' contribution to phenomenology, argues that his greatest contribution has been the "*phenomenological articulation of embodied, practical coping*" (Rouse 2000, p. 7). Given the absence of an internal representation and "rules" for its manipulation, practical coping cannot be made fully explicit—just as with any form of tacit knowledge (Polyani 1983) or "situated action" (Suchman 1987). Practical coping is a description of the everyday and of the mundane; for example, eating, sitting working at a desk, sitting killing time at a desk, and playing a sport. Tool use is a key feature of this practical coping. So, for example, in writing this book, I am sitting at a table, typing on my iMac, drinking a mug of coffee (without spilling it on the keyboard), fixing my typos and occasional mis-keying (skilful, but not error-free) as I go along and thinking of the next sentence—in short, I am displaying practical coping. While Dreyfus' practical coping is a product of his work with Heidegger's corpus, there are alternate accounts.

Valera's *immediate coping* which is yet another form of non-representational cognition based on skilled behaviour. In some aspects, it seems like a continuation of Piaget's work on genetic epistemology ("the origin of knowledge"). Indeed Varela (1999) begins his *Ethical Know-How* by citing Piaget's (1997) *The Moral Judgement of the Child* he writes that his interest was in moral judgement and not moral behaviour. Piaget arguing that "*pure reason is the arbiter both of theoretical reflection and daily practice*". Thus, to understand judgment and behaviour one must understand the underlying cognitive processes ("pure reason").

In the context of understanding how children make moral judgements, Piaget focused on the underlying cognitive process while Valera was highly critical of this reason-first approach arguing that we should begin with understanding the skilled behaviour itself and not the inferred context-free judgments which drive it.

1.2.1 Everyday Coping

While Dreyfus and Valera have offered two related but discrete accounts of coping neither author references digital technology specifically. However, this account of *everyday coping* hopes to address this lacuna. Immediately, we encounter a problem. As, by definition, coping is smooth, unobtrusive, and immediate; that is, it just works—its very smoothness presents singular problems in studying it. User experience is a result of using digital technology: good, bad, indifferent, pleasurable, repeated, direct, indirect, vicarious; important, or trivial, or just a matter of killing time (as this is a potentially long list, so I won't go on) no matter what, UX depends on some form of technology use (but this also includes "hands-off"). And as we have said, for most people, their cell phone or smartphone is the key digital product which they use to access the Web and social media platforms. In addition to this, everyone simply picks up (that is, learns vicariously) how to use their phone. We learn by imitating others courtesy of our mirror neurons (if they prove to exist) and very many of us do so from a very early age. Cell phones are not, of course, limited to adults, as children are exposed to them from an early age, for example, most British children own a cell phone (and "could not live without them"). And this familiarity with digital products began early. Evidence of this can be found in the sales brochures of toy manufacturers: BRIO, for example, sell "*my first mobile phone*" (a toy) which is said to be suitable for children aged 10 months and over (note that this reads *10 months* not *10 years*) and this age is more or less at the threshold of a child's first spoken word. So, some children may be proud phone owners (real or make-believe) before they can hold a conversation. Suggesting that children have acquired and are able to animate ("run") mental models of their phones seems improbable. Better to treat it as evidence of skilled behaviour. Figure 1.1 shows a child skilfully coping with their phone.

Digital technology has become everyday because of its routine, habitual indispensable, and occasionally compulsive use. This is unsurprising as Agre observed that "*everyday life is almost wholly routine …*" which he defines as, "*a frequently repeated pattern of interaction between an agent and its familiar environment*" (1997, p. 107). The familiar environment is, of course, accessing the Web by way of an application-enabled smartphone.

Applications having effectively transformed our smartphones into surrogates for a wide range of tickets (bus, cinema, train, etc.), a payment system (acting in lieu of a credit card), and a mobile games console, a messaging system, a health monitor, a lifeline home and for some, our confidante. And most recently a number of powerful and easy-to-use artificial intelligence chatbots have appeared (e.g., Open AI's ChatGPT4, Google Bard, and Baidu's Ernie).

For digital technology to be quite literally available everywhere then its use must be *intuitive*.

We are familiar with digital technology because we see it everyway—about town, on TV, in the movies, advertised in magazines, and this prolonged exposure engenders *familiarity*. And Raskin, the designer behind the Macintosh wrote that a user interface

Fig. 1.1 A child using a phone. Photo by Anna from Pixabay

is intuitive in as it much as it resembles (or is identical) to something the user already knows. He continues, "In short, *intuitive* in this context is an almost exact synonym of *familiar*". Later, and at greater length, he continued, "*one of the most laudatory terms used to describe an interface is to say that it is* "**intuitive**". *When examined closely, this concept turns out to vanish like a pea in a shell game and be replaced with the more ordinary but more accurate term* **familiar**" (Raskin 2000). Similarly, Kara et al. (1997) have also posed the question "Are what we call "intuitive" user interfaces really just familiar user interfaces?" There numerous design guidelines which echo this directing the HCI specialist to make use of the familiar and to date this has been achieved by way of the widespread use of metaphor, the most familiar of which is the so-called desktop metaphor (except that it is not a metaphor, more properly it is the desktop simile and has become unfamiliar with the passing of time).

1.3 A "Disorder" of HCI

HCI is not a single academic discipline as it has, over the years, drawn upon (but failed to harmonise) computer science, cognitive and social psychology, sociology and a dozen or more other contributions from the social sciences and the Humanities, and this is to say nothing of the contribution from commercial interests such as Apple, Google, Microsoft, and Facebook (now Meta) and government labs such as DARPA.

This has left HCI a rich, complex, and fertile mess of ideas but without any discernible order or coherence.

We have identified a number of themes from the last 50 or more years which seem particularly relevant to the current discussion of the use of digital products and UX. This is not intended to be complete but illustrative. These are:

- **familiarity**: this is not a matter of memory but the readiness to deal with (cope) with technology. Think skilled behaviour rather than mental model.
- **affordance**: the means by which we directly perceive what something might be used for with conscious thought or reflection.
- **automaticity**: this is automatic processing is this when people think unconsciously, unintentionally, involuntarily, and effortlessly. This all sounds familiar except that Moors and de Houwer (2006) write that, "there is no consensus about what automaticity means" (ibid, p. 297).
- **flow** as described by Csikszentmihalyi (1996, 1997 and many more) is being completely involved in an activity for its own sake. Every action, movement, and thought follows inevitably from the previous one, like playing jazz. Time flies, the ego disappears. Your whole being is involved, and you are using your skills in balance with the demands of the task.
- **mirror neurons**, which were first identified by neuroscientist Giacomo Rizzolatti and his colleagues at the University of Parma (Rizzolatti et al. 1996). They recognised that these that the neurons could help explain how and why we "read" other people's minds and feel empathy for them. If watching an action and performing that action can activate the same parts of the brain in monkeys—down to a single neuron—then it makes sense that watching an action and performing an action could also elicit the same feelings in people.

1.4 How We Experience the Digital World

Figure 1.2 is a "repertory grid" of an undergraduate's digital world. The image has been created with software using the interview data from an undergraduate student. The individual involved was subject to a structured interview which sought to identify the digital(ish) objects of his world which he described as comprising a cell phone, a camera, a games console, and the other things which he thought were relevant to this investigation such as books and clothing. These are identified by an "X" in the image below. Then we asked him about how he thought and felt about these objects with regard to a series of dimensions such as "exciting" to "unremarkable" and "permanent" or "ephemeral". These dimensions had been identified from earlier interviews with groups of undergraduates. The software then plotted between the objects and the "constructs" by which they differed to give and overall impression of the "landscape" of the individual's digital world.

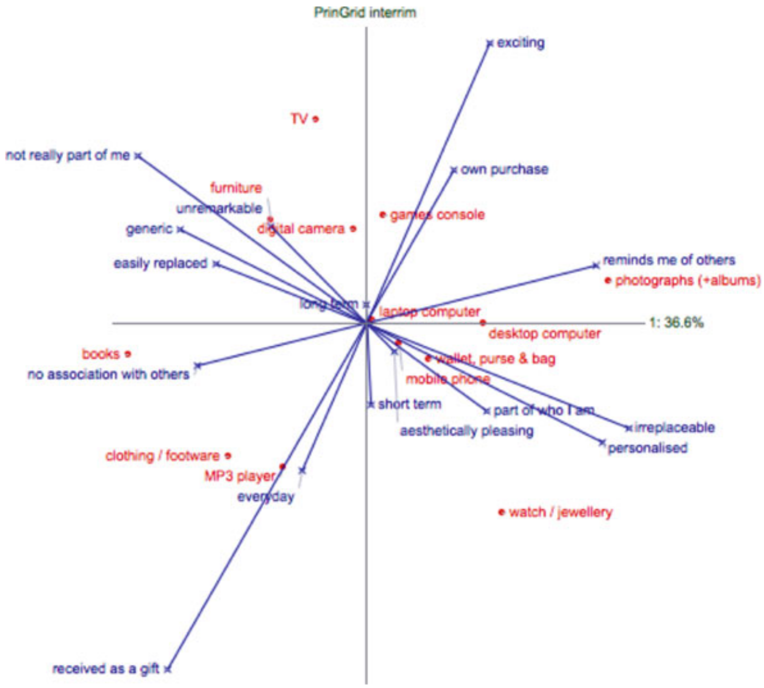

Fig. 1.2 A rep grid of a student's digital world

1.4.1 Our Technological Horizon Defines Our "Generation"

However, there is something of a downside to our familiarity with technology and it is that it tends to create a "**horizon**". A technological horizon is our baseline familiarity with technology or a social practice or institution. It refers to how far (metaphorically) we can see. So, for example, shopping has traditionally involved going to a store, selecting goods, paying for them (with money), and then returning home with them. This practice is one which many of us in the West grew up with and one which we see as natural, authentic, and familiar. This everyday practice established—in part—our technological horizon for shopping. This self-same generation may or may not have embraced Internet shopping which offers greater convenience, cheaper goods, and wider choice but also requires us to change our everyday practices to accommodate them. Shopping at a dotcom is quite a different experience to visiting a city-centre store yet it is one which the current generation may establish as their default or technological horizon. Technological horizons are in action every time someone utters something like, "in my day …" or when which reflects an individual's familiarity with how things were.

The use of repertory grids allowed us to build up a series of pictures of how people see their digital world. What has emerged is that our relationship with technology is one of *involvement*. We are involved with it because it is everywhere and we loved or hated it and we cannot live without it. It is a fact of our everyday life and "user experience" is the result of being involved with it. We care about its appearance, and how it makes us feel (and look). So, our definition of UX is based on our practical, everyday involvement with it rather than as a result of say, factor analysis. Further, UX cannot be confined to individual digital products such as phones or tablets because we are surrounded with a network of them enfolding and involving us with digital technologies of all kinds.

Our user experience is the result of using digital products. This is not limited to the fun or pleasure or engagement that we may have with them. Instead, we try to make sense of digital products, consciously and unconsciously, by appreciating their appearance, how we feel about it and how it makes us feel, how we make it our own, and the many other things which we discuss in this book. What brings together these very different experiences are that they all contribute to making sense of technology.

User experience arises both from our direct use of digital products, from its anticipated or imagined use, and from vicarious use (e.g., by watching other people use their technology). These experiences are also coloured by our own internal dispositions (which are many and varied) and by the circumstances of the use of the product itself (e.g., at work, with others, against the clock, for fun, and so on). Add to this, definitions of UX often appear as a list of plausible attributes littered with a surprising number of "for examples" and "so-on's". This makes UX an open-ended concept and with each new attribute the definition grows, and correspondingly when last year's tired old ideas gutter and fade it shrinks again.

Blackler and her colleagues have reported a series of studies of "technology familiarity" which they found to be good predictors of subsequent performance with new but similar or related technology. They found that people with good "*technology familiarity*" began to use the new technology more quickly and used more of its features than those with poorer technology familiarity (Blackler et al. 2003a, b, 2010). These observations have been echoed by Dixon and O'Reilly (2002) who have also argued that people almost never learn completely new procedures as they simply adapt their behaviour from prior knowledge. Blackler and Hurtienne (2007) have noted that the, "*use of products involves utilising knowledge gained through other experience(s). Therefore, products that people use intuitively are those with features they have encountered before*".

So, we can understand **familiarity** as the readiness to cope with the world, and this readiness can be demonstrated, not by having complex, abstract cognitive structures in our heads but demonstrating "know-how" and acting appropriately.

Familiarity has a central role in everyday life. Forty years ago, Bewley et al. (1983), writing of the four design goals which were adopted in the design of the Xerox Star's user interface, noted that the first of these was, "*There should be an explicit user's model of the system, and it should be familiar (drawing on objects and activities the user already works with) and consistent*". User model, familiarity and consistency. Similarly, Raskin (1994) discussing the rise of intuitive user interfaces concluded that by intuitive we really meant familiar. We daily demonstrate our familiarity by coping with situations, tools, and objects by our understanding of the referential whole—or world.

1.5 The World According to Heidegger

A world, according to Heidegger, has three key characteristics:

1. A world comprises the totality of interrelated pieces of equipment. Each piece of equipment being used for a specific task—hammers are for driving nails into wood (it is not meaningful to consider a hammer without reference to other equipment, for example, nails); a word processor is used to compose text.
2. The second "component" of a world is the set of *purposes* to which these tasks are put. Of course, while we cannot meaningfully separate out purposes from tasks in these worlds, we can recognise that the word processor is used to write an academic paper for the *purpose* of publication and dissemination. Similarly, nails are driven into wood to provide illustrations for philosophical discourse.
3. Finally, in performing these tasks we acquire or assume an *identity* (or identities) as carpenters, academics, and so forth. Thus, by *worlds* we mean *cultural worlds*. In using these concepts and viewpoints, we are moving away from thinking in terms of *what* are the nature of things (and ourselves) to *how* we manage and cope with things.

This contradicts the view which assumes that we have to synthesise a "manifold" of things, perspectives, and sense data. Instead, Heidegger argues that we simply perceive the room's Gestalt and in doing so we are able to deal with its contents through our familiarity with other rooms.

In his *The Basic Problems of Phenomenology*, he calls it the "*sight of practical circumspection […], our practical everyday orientation*" (163). Assuming that we are enculturated into the world of modern computing, when we enter our places of work we see desks, chairs, computers, network points, and so forth. We do not perceive a jumble of surfaces, wires, and inexplicable beige boxes (unless we have just been burgled). We demonstrate our familiarity by coping with situations, tools, and objects.

1.6 A Thousand Useful Acts

From quite a different perspective, the American pragmatic philosopher John Dewey has observed that much of our everyday behaviour does not require conscious thought. One hundred years later this remains true of our most popular pre-occupation. As Dewey himself put it, (1922, p. 178) habits do not require conscious thought, writing, "*we walk and read aloud, we get off and on street cars, we dress and undress, and do a thousand useful acts without thinking of them*". Among some of the thousand useful acts (without thinking of them) are tweeting, checking an alert. Faced with a smartphone, all of us can use it (without specifically learning how to do so). This is because we are familiar with their operation and design. If we a new application for our phones we quickly learn how to use it. It becomes automatic in operation. Again, we do not need an instruction manual or a formal training as we rely on the affordances offered by the app's user interface. In getting this far, we have only used our Type I cognition. Although not everyone agrees, our (cognition) operates in two modes, namely Types I and II thinking otherwise called *automatic* or *controlled* thinking. *Kahneman's Thinking Fast, Think Slow* (2011) offers a very readable introduction to the subject. Type I thinking is basic and rudimentary (many of the higher animals can manage this too). Examples of Type I include simple arithmetic (e.g., $2 + 2 =$). This operates *like* perception, as it is quick and more or less automatic. If the application requires greater care in its use, we can simply switch to Type II thinking which can handle complex and demanding (tasks). We need this for understanding quantum physics or discussing Martin Heidegger's philosophy as both require considered-thought, attention, and memory.

Not all psychologists think there are two separate mechanisms: some believe there is only one while others have argued for third algorithmic form. What is important is that it feels like there are two systems.

Controlled and automatic thinking share some of the characteristics of Types I and II thinking but are often more associated with skilled performance. So, a skilled driver of a motor car displays automatic responses in navigating their way through a busy city while a novice is much more controlled.

This is still a pretty good definition, even after 130 years. More modern (though still fairly traditional) definitions of attention still tend towards the "*the mental process of focusing on something*" variety. Attention is generally (though not universally) regarded to be a cognitive process that enables one to select tasks or information that will be actively or thought about (e.g., Posner 1982; Driver 2001). Here the keywords are "information" and "processed" for these definitions are very much a product of treating cognition as *human information processing*. Attention is also usually recognised to have a limited capacity (e.g., Chun 2011) which might be allocated or divided between (among) competing demands of which Kahneman's capacity allocation model of attention is a good example (Kahneman 1973).

Attention seems to lend itself to be regarded in terms of managing information in the more general sense, for example, Gazzaley and Rosen's *The Distracted Mind* (2016) seeks to bring together attention, working memory, and goal management as the background against which to understand how digital technology distracts us.

Another term which has a certain recent currency is that of our "attention span". The attention span refers to the number of objects which can be simultaneously perceived or (perhaps) held in memory. We see it in action in "Kim's game" (Kipling 1901) and in the kinds of memory exercises said to be enjoyed by boy and girl scouts. And, there is some evidence that our attention spans (collectively) seem to be dropping. Lorenz-Spreen et al. (2019) have noted that the "*trajectories of how cultural items receive collective attention*" is showing an increasing gradient. In plainer English, we are producing and consuming content more quickly. These cultural items which include news reports, tweets, updates from social media friends, and the like which are posted or "pushed at us" are being consumed more rapidly due to *social acceleration* (Rosa 2013). Lorenz-Spreen et al. (2019) found that in 2013, Twitter hashtags stayed in the Top 50 for an average of 17.5 h; by 2016 this had decreased to 11.9 h, which is taken to be evidence of contracting attention spans in our digital society.

Digital technology is often described as being "always on" and offering "anywhere–anytime access", and there is also evidence beginning to appear of people who describe themselves in similar terms (Pew Research 2018). If this is so, the use of technology must necessarily interrupt and fragment what is left of their non-digital lives (assuming that there is anything left). Unsurprisingly, this fragmentation of attention has been seen to reduce work performance (Leroy 2009), increase task error rates (Bailey and Konstan 2006), and induce stress (Mark et al. 2008). Given the number of applications (and associated hardware) we use, Mehrotra et al. (2015) have estimated that a typical phone user receives up to 100 notifications every day.

1.7 Affordance

Gibson (1977) introduced the idea of affordance to HCI to describe the range of possible actions between the environment and an actor. He defined them as:

> The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, the noun affordance is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment.

He revised this initial definition of an affordance in his seminal 1979, *The Ecological Approach to Visual Perception* when he wrote "*An elongated object, especially, if weighted at one end and graspable at the other, affords hitting or hammering (e.g., a shillelagh). A graspable object with a rigid sharp edge affords cutting and scraping (e.g., a knife)*".

And again, then again in 1986, he wrote, an "affordance" denotes the *relationship* between the organism and its environment thus "*the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill*" (Gibson 1986, p. 127).

Figures 1.3, 1.4, 1.5 and 1.6 illustrate affordances. Figure 1.3 is the image of a stick. If we pick up a stick with the intent to use it for self-defence or to strike someone, we do so on the basis of the affordances it offers. Is it robust enough? Is it long enough? Is it not too heavy? Will the dog let me have it? We do this very quickly and usually without pausing for reflection. We perceive or ("pickup") the affordances without a thought.

In the kitchen, we select a knife suitable for cutting what we are working with. A short knife for peeling vegetables; more substantial knives for heavier tasks.

Figure 1.4 is an image of a robust knife.

We never seemed to learn how to drink water. It was just there, and it seemed obvious. Water affords drinking particularly on a hot day. Figure 1.5 illustrates the affordances of a glass of cool, clean water.

Fig. 1.3 "A stick to beat you with". Image by Jamie Street from Unsplash

Fig. 1.4 "A knife affords cutting". Image by Nick from Pixabay

Sometime during the nineteenth century, the post-box was invented in England. These boxes afforded the posting of letters affixed with the appropriate value of postage stamps. Quite how this was managed remains a little mysterious but who are we to argue with Gibson? Figure 1.6 illustrates an English post-box. Later in Gibson's research, as we have noted, he began to include examples of "cultural affordance" like

Fig. 1.5 "Water invites drinking". Photo by Nicolas Ruiz from Unsplash

Fig. 1.6 "Post box". Photo by Krisztina Papp from Unsplash

a post-box which affords posting letters. The English variety provides the angled slots for letters (like most others) but is identified by its red colour (which varies between nations) and the ER (Elizabeth Regina) or older VR (Empress Victoria) or GR (for King George VI) the eagerly awaited CR (King Charles III) indicating the name of the current monarch. See also Turner (2005) for a detailed discussion of cultural affordances.

The use of smartphones from the perspective of affordance, would have us exploiting the shape and feel of the phone (this might be limited to affords throwing at or being used as a sporting puck (I'm thinking ice hockey). But the making use of the phone's affordances as offered by the size, behaviour, and properties of the keyboard and screen (size, resolution, and so forth) to compose then we would be limited to send, receiving, and reading text or make a call or checking your social media account or the local sports results. It is almost certain that we do some extent, but this does not seem like a complete account of use.

It is argued, when the affordances of an artefact are perceptible, they offer a direct link between perception and action. A measure of support for this comes from positron emission tomography (PET) which has shown that those parts of the brain responsible for motor representation are activated in response to the perception of the affordances of objects. Grèzes and Decety (2002, p. 212) concluding that "*perception of objects automatically affords actions that can be made towards them*".

An affordance is not cognitive and is more properly described as belonging to an "ecological" perspective, and by this we mean the web of relationships between people and things (including technology) and the environment. So, a knife is meaningful to me because I can use it to cut things, but the exact same artefact is of no use to a goldfish. Shepard (1984, p. 418) makes the much the same point with respect to a wool slipper which "*may primarily afford warmth of foot for a person, gum stimulation for a teething puppy, and nourishment for a larval moth*".

To appreciate how different this is from mainstream cognitive accounts, we need to place it in the context of Gibson's earlier work. His work during WW2 on the "controlled flight into ground" (sic) by pilots inspired him to argue that perception is direct (and is not mediated by internal representations), and that the environment (pertinent to that an organism) affords the actions available to the organism. Thus, an appropriate analysis of the environment is crucial for an explanation of perceptually guided behaviour (such as flying an aircraft). He argued that animals and humans stand in a "systems" or "ecological" relation to the environment, such that to adequately explain some behaviour it was necessary to study the environment or niche in which the behaviour took place and, especially, the information that *epistemically connects* the organism to the environment. This account was at odds with the then dominant cognitive treatments of perception and was not widely accepted. However, subsequent developments in the cognitive sciences now tend to regard his basic position more favourably. Returning to HCI, Norman (1988) saw how affordance could be applied to design, then wrote that affordances are "*the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used*" (p. 9). From this perspective, our UX are the affordances of a device (and probably visually) which enable us to use the device directly which is why some vendors do not supply instructions with their products.

In reviewing the use of the concept of affordance, it has been observed that researchers have moved far beyond Gibson's original account. He saw affordance as a reciprocal relationship between object and action and that this could be characterised as part of the perception–action loop. This mechanism alone cannot account for the very wide range of affordances which have been discussed. Xenakis and Arnellos, for example, disagree and suggest that affordances were never just about (or "looking at" artefacts, they were always about inviting and guiding use). Thus, they have restated what an affordance is from an aesthetic perspective.

Heidegger's perspective on equipment also forces us to conclude that an affordance cannot exist in isolation. He has argued that we perceive/experience the world as an interconnected mesh of things which we can use. The totality of equipment means that each tool occupies a specific position in the system of forces that make up the world. The totality of equipment is the world. For Heidegger, equipment is context. Interestingly, Brézillon and Pomerol (2001) also equate context with *knowing how* which Heidegger regards as the basis of understanding—to understand something is to know-how to use it.

So, what does this mean for the design and evaluation of interactive systems, devices, and media? The difficulty of trying to apply this reasoning to everyday HCI engineering is that it is necessarily holistic. Use, affordance, and context are treated as a Gestalt (as "a whole") by both the Soviet philosopher Ilyenkov and Heidegger and to date (as far as I know) no one has managed to create holistic forms of design. The design of interactive systems requires the designer not to be involved with "use" per se but to be engaged with "design for use". Much the same is true for evaluation. This is the difference between specifying the materials and dimensions of a hammer and the act of hammering.

In conclusion, from a holistic or phenomenological perspective, affordance, use, and context are one. From a design perspective, affordance is not an intangible, elusive property of interactive systems, it might better be thought of as a boundary object between "use" and "design for use" recalling Wenger's (1998) remarks that all designed artefacts are boundary objects both between and within the communities of practice of designers and users.

We propose that familiarity with digital technology is another expression of being involved with it. Constantly living with technology and being surrounded by it means that we have become familiar with it. Nye (2006, p. 199) observes, "*a child born since 1950 finds it 'natural' to use electric lights, to watch television [...] and to use satellite-based communications. That child's grandparents regard such things as remarkable innovations that had disrupted the normal*". Technology has become like family—always present, as source of pleasure, and of irritation, and comfort.

The idea of a user model and consistency in interaction is now well-established but familiarity has been largely ignored. Yet it was familiarity with files, printers, trashcan, the processes of cutting and pasting and using "tools" like scissors, pens, and brushes which explicitly linked the operation of the GUI to the users' familiar worlds of artefacts and action which made this user interface accessible to every office worker. We have all used paper, we have all put paper into files or trashcans in the real world. We are familiar with paper. As we have already mentioned, the Xerox Star's interface sought to reproduce this visually (not metaphorically as is usually and mistakenly stated). The greatest strength of the GUI was that it operated in a manner which was like the real world and as such was familiar.

1.8 Familiarity with the World

The first time I became conscious of the importance of familiarity was during a safety briefing on a flight to London. Like most people, I was ignoring what the cabin attendant was saying until she said something about "most of you are familiar with this briefing … but some of you may be unfamiliar with this particular model of aircraft". It was something to do with the location of the emergency exits. I had always assumed that in the event of an emergency that I would panic. But no, like an astronaut I told myself had "over-learned" the evacuation procedure which I could execute without thinking. All I need do was to coolly check that the exit was where I expected it to be and then my familiarity would automatically settle into place.

Familiarity is a "readiness" to cope with the world and the technology it is filled; or, say, a room and the chairs it holds (by sitting on them). I have known about the world, and chairs and rooms from my earliest days. Heidegger describes this readiness as "*the background of … primary familiarity, which itself is not conscious or intended but is rather present in [an] unprominent way*".

For Heidegger, familiarity encompasses the ideas of involvement and understanding. Here involvement may be taken as something approaching a synonym for "being-in-the-world" while understanding should be interpreted as "know-how". Dreyfus (1990) notes that "*This know-how … is more basic than the distinction between thought and action*" and describes human beings as "*We are such skills*", thus directly equating humans with our know-how. In these terms, understanding interactive technology simply means being able to cope with it (i.e., use it skilfully).

So, while we may not have a detailed technical understanding of the technology involved, we can still get it to work and to use it effectively. For example, everyone can use a smartphone, but few know-how it works (at the level of network protocols, microwaves, or NFC), what is important is that our familiarity provides the means for the pragmatic use of technology.

Indeed, early (50 + years ago) personal computers presented such an unfamiliar world that the designers at Xerox invented the "desktop metaphor" (1981) and graphical user interfaces (GUI) to enable them to make sense of they were seeing. A panel at CHI 85 (1985) entitled, "*The Desktop Metaphor as an Approach to User Interface Design*" began with the following proposition:

> [The] one Xerox innovation that seems to be spreading throughout the industry is an approach to user interface design first brought to the marketplace in the 8010 Star Workstation and later given additional exposure via the Apple Lisa and Macintosh: the Desktop Metaphor. This design approach is intended to facilitate one's use of the system by making the manipulation

of information in the system analogous to the manipulation of physical objects on a desktop. The choice of office objects in particular is intended to facilitate learning by capitalizing on users' familiarity with such objects and with procedures involving them.

1.9 Automaticity

We have described our use of digital technology as coping which underpins routine activities, and which involve little or no thought, awareness, or attention, thus coping could be described as *automatic*. Schneider and his colleagues, working in the 1970s, proposed that our everyday behaviour is the result of two processes which they describe as being either automatic and controlled (e.g., Schneider and Shiffrin 1977; Shiffrin and Schneider 1984; Schneider et al. 1984). This is not to be understood as a mutually exclusive either-or but an intermix, with people alternating between them. These researchers also distinguished between the two processes in terms of the demands they made on our attention.

Automatic processing is fast, difficult to modify and is confined to well-developed, familiar tasks. In contrast, controlled processing is slow, under conscious control, effortful, and capacity-limited. Shiffrin and his colleagues regard automaticity as the result of repeated or habitual exposure and of controlled processes. Ericsson and Simon (1984) agree, telling us that attention is not required when the same cognitive process has been executed many times. Unlike automatic processing, we rely on controlled processing in unfamiliar situations.

Other accounts of automatic and controlled behaviour have been studied in the context of the skilled use of technology, for example, Rasmussen's (1983) *Skill, Rule,* and *Knowledge* model distinguishes between sensory-motor performance which, "*take place without conscious control as smooth, automated, and highly integrated patterns of behaviour*" and knowledge-based behaviour. In the latter mode, for example, when someone is learning to use the technology, they are conscious, careful, and controlled at every step. The differences between these two forms are summarised in Table 1.1.

Table 1.1 Knowledge versus skill-based actions (adapted from Reason 1990)

Knowledge-based (under conscious control)	Skill-based (under automatic/ unconscious control)
Unskilled or occasional user	Skilled, regular user
Novel environment	Familiar environment
Slow	Fast
Effortful	Effortless
Requires considerable feedback	Requires little feedback
Applying for a marriage licence or filing for a divorce	Checking a phone for calls or acknowledgement

As our actions can become increasingly automatic, so can the manner in which we think (Uleman and Bargh 1989). The more practice individuals have in thinking in a specific way, the more automatic that kind of thinking becomes, to the point it becomes unconscious.

1.10 Flow

Csikszentmihalyi (e.g., 1996, 1997, 2014) has been the primary student of *flow* for quite some time. Flow is the name he gave to the *optimal* experience which people experience when work is going so easily and well that they tend to disregard fatigue and discomfort.

Having studied a number of different groups showing this behaviour he wondered just what was the source of their motivation? To this end, he went on to study people playing games and contrasted this with the work of surgeons. With the former, we might expect to encounter intrinsic motivations (after all, games are both fun and competitive), whereas with the latter we might expect a role for generous remuneration and prestige. Surprisingly, he found similarities between game players and surgeons and was able to attribute their respective motivation to the perceived challenge or opportunities for action that stretched existing skills and clear, achievable goals with immediate feedback. Such situations he describes as examples of *optimal experience* or *flow*. Thus, people will *flow* when working or playing optimally. This optimal point is struck at the balance between the level of skill possessed and the demands of the task. If skills exceed the demands of the task, the individual may slip into relaxation and then maybe boredom. Conversely, if the task demands or challenges exceed skills then the individual may experience stress and become anxious. Csikszentmihalyi tells us that, "*The key element of an optimal experience is that it is an end in itself. Even if initially undertaken for other reasons, the activity that consumes us becomes intrinsically rewarding. […] It refers to a self-contained activity, one that is done not with the expectation of some future benefit, but simply because the doing itself is the reward*". He has also introduced the term *autotelic*[1] to describe our intrinsic motivation.

1.10.1 Creating Flow

Flow can be experienced while performing any activity, although it is most likely to occur when one is wholeheartedly performing a task or activity for intrinsic purposes. Passive activities like taking a bath or even watching TV usually do not elicit flow.

[1] The term "autotelic" derives from two Greek words, auto meaning self, and telos meaning goal. It refers to a self-contained activity, one that is done not with the expectation of some future benefit, but simply because the doing itself is the reward.

However, it is generally regarded that three conditions that have to be met to achieve flow. These are, firstly, involvement in an activity with a clear set of goals and progress and accompanied by clear and immediate feedback. Secondly, there must be a good balance between the challenges of the task and an individual's skills. Finally, the individual should have confidence in their ability to complete the task.

Despite the apparent ubiquity of *flow*, it tends to be associated with sports and games, perhaps because the goals and feedback in these activities are so well defined but, it does not feature in accounts of UX excepting the mentions in games and gamified applications, ecommerce/marketing, and e-learning. It is perhaps worth remembering that *flow* is based on the interaction between person and context, not person and technology. It is also defined a little narrowly in terms of tasks and skills, as Hassenzahl (2008) has observed, "*flow is the positive UX derived from fulfilling the need for competence (i.e., mastery); it is a particular experience stemming from the fulfilment of a particular be-goal*" but beyond this, there has been no attempt to integrate into mainstream UX thinking.

1.10.2 The Characteristics of Flow

Flow is experienced as intense and focused concentration on what one is doing at that moment and people report the loss of reflective self-awareness and a sense of the experience being rewarding. There are also frequently reported experiences of the apparent merging of action and awareness accompanied by the merging of action and awareness and a sense of control over one's actions.

From the evidence that Csikszentmihalyi and his colleagues have collected (e.g., Csikszentmihalyi et al. 2014), flow does not seem to be a particular rare or unusual phenomenon. A given individual will *flow* in almost any activity—working a cash register, ironing clothes, driving a car, and almost any pursuit such as a museum visit, a round of golf, or a game of chess can bore or create anxiety. Flow is frequently reported when people play digital games and has variously been described as "being in the zone". Overall, Donner and Csikszentmihalyi (1992) have reported that the employees they had surveyed experienced flow 44% of the time at work, boredom 20%, and anxiety the remaining 36%.

1.11 The Promise of *Mirror Neurons*

We cope with digital technology, and we learn to cope by becoming familiar with technology and by being exposed to it directly, by watching others, and by way of the media. This may also include formal pedagogy, and it may well not. And all of this would be a good deal easier if we had mirror neurons.

Mirror neurons are a type of neuron (brain cell) that respond equally when we perform an action and when we witness someone else perform the same action.

They were first discovered in the early 1990s, when a team of Italian researchers found individual neurons in the brains of macaque monkeys that fired both when the monkeys grabbed an object **and** also when the monkeys watched another monkey grab the same object. Mirror neurons are a type of brain cell that respond equally when we perform an action and when we witness someone else perform the same action.

Given this evidence, it has been proposed that exposure to technology is *cultural*, not in some loosely defined, arm-waving kind of way, but in a form which can be teased apart and understood. Following Tomasello (2009) we recognise that children learn to *imitate* the use of technology by just watching their siblings or parents, teachers, and other children using it and absorb all manner of messages, images, and stories from TV programmes, online videos, and advertisements. We should also mention the role of mirror neurons. They are also *instructed* (formally and informally) to use technology at school or college, often by the same people. Finally, of course, they are quite capable of learning, working, and playing cooperatively with other people. These three forms of learning differ—both imitative and instructed learning involve practice or instruction being passed from the adult (or equivalent) to the child or learner. Collaborative learning is different because it takes place in the absence of the teacher–learner dynamic with peers working together to solve concreate a solution to a common problem, but what is learned is internalised individually. The function of the mirror system is a subject of continued discussion, and they have been proposed to play a role in understanding and interpretation action (e.g., Rizzolatti and Craighero 2004; Cook et al. 2014); imitation and empathy (e.g., Iacoboni et al. 1999); emotion (e.g., Enticott et al. 2008); and in mediating social interaction in their role in the theory of mind (e.g., Ramachandran and Oberman 2006). See also Sect. 4.5 for a discussion of mirror neurons and aesthetics.

Tomasello makes one further observation, and it is to recognise that cultures change with time, and once a new practice has appeared, it can spread quickly and relatively faithfully. These changes are often (informally called) *memes*. So, for example, there was a time when mobile telephony was limited to the physical length of one's phone cable. Then, after technical and behavioural innovation, it was confined to the emergency services or appropriated by the rich and self-important (as a "car phone"), then inexpensive digital phones became available and popular (cf. Nokia), and then when expensive but highly desirable phones appeared all was swept before them (cf. Apple). Everyone needed a cell/smartphone. Thus, modified practice, artefacts and behaviour can be quickly acquired by others and as he has observed, they have a "ratchet effect", wherein each modification stays in place until further revisions are made (Tomasello 2009). A ratchet is a situation or process that is perceived to be changing in a series of *irreversible* steps.

1.12 The Changes to the Second Edition of this Book

This second edition has been extensively revised and updated and to my surprise it is a little shorter. It turns out that many of the projections and expectations of how, say, social robotics will turn out in the coming years have fallen a little flat and, in some instances, have just gone away. However, *pleasure* and smart bots such as ChatGPT have things in their own right. This book aims to capture what is meant by *UX* from a philosophical-psychological perspective which goes beyond mere cognition (to which the interested reader is direct at the companion volume *HCI Redux* (Turner 2016) which presents a comprehensive treatment of cognition in HCI), drawing upon perspectives from social psychology, evolutionary psychology, folk psychology, neuroaesthetics, neuropsychology, the philosophy of technology, and design. Our proposal here is that user experience arises from the synthesis of three interrelated elements: involvement, affect, and aesthetics.

Chapter 1. This chapter considers what it is to live in a world in part, defined by digital technology and digital products. And it will come as no surprise to learn that those digital products are mobile phones—all 22 thousand million (billion) of them.

Chapter 2. Here we define UX as comprising our **involvement** with what we now perceive to be *digital products* through our everyday familiarity with them; and our aesthetics appreciation of them (that is to what extent they please us) and finally, our affect evaluation of it (how they make us feel).

Chapter 3. We explore what it means to be involved with technology, that is, to live with it. In the course of living with technology, we exercise our propensity to anthropomorphise, endowing it with personality, feelings, and intentions and perhaps most importantly treating technology socially.

Chapter 4. We discuss how we judge the aesthetics of a digital product. Although we might recognise that all of our senses are capable informing us of whether something is pleasing (or not), we still tend to think of aesthetics as referring to the visual and for this reason we have included virtual experiences under this heading.

Chapter 5. How does digital technology make us feel? And, more to the point, what does it mean to feel? This chapter reviews the contribution of first impressions, emotion, feeling, and mood. We probably understand emotion best, emotion is for action. First impressions are made in a small fraction of a second, are usually accurate, and tend to last. How we feel is probably mentioned more and any affect state but is generally not defined and mood may be structural but is not well understood. There have been some like 2500 years of thought into how and what affect is and still so many questions.

Chapter 6. Finally, we discuss killing time which most young people describe what they do with their phones. This is not because young people are ideal but because our brains are organised that way, the *default network* is a set of neural pathways in the brain which are at their most active when we are not (e.g., Raichle 2015). This pathway is thought to responsible for creative thought and social interaction, indeed making us human.

As we have seen in this chapter, *user experience,* though intuitively appealing, has proved difficult to define. It is complex, multi-dimensional, and subjective—if not ineffable, and involves psychological dimensions which are not always clearly defined or understood.

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Chapter 2
Creating a Good Experience

2.1 Introduction

We now turn to the importance of good design to HCI. Historically, human–computer interaction was principally interested in designing interactive technology that was easy to use. This, of course, is still important but *ease of use* is now seen as a feature alongside a host of others such as being *aesthetically pleasing*, and *fun to use* which together offer a good, overall *user experience*. Commenting on this, Bloch (1995) observed that "*The physical form or design of a product is an unquestioned determinant of its marketplace success. A good design attracts consumers to a product, communicates to them, and adds value to the product by increasing the quality of the usage experiences associated with it*". He goes on to list Swatch wristwatches, the design of early Apple Macintosh computers, and the long-lasting appeal of *The Rolling Stones* (though what happened after their album *Exile on main street*?) as examples of the power of good design.

Stanford University has reported conducting a large-scale study (involving > 2500 participants) into how people assess the *credibility* of a website (Fogg 2002). At the heart of this was an investigation of the importance of its visual design. Fogg reported that, "*Nearly half of all consumers (46.1%) in the study assessed the credibility of sites based in part on the appeal of the overall visual design of a site, including layout, typography, font size and colour schemes …*". They found that while elegant graphic design could not salvage a poorly functioning Web site, it did (at least) establish a clear link between good design and site credibility.

And again, the Design Council in the UK published *The Value of Good Design* in 2017 which, as its title suggests, identifies numerous examples of how *good design* is significantly preferred by people in a wide variety of contexts. Specifically, *it seems that good design at the* front end *suggests that everything is in order at the "back-end",* and conversely, that *"problems with visual design can turn users off so quickly that they never discover all the smart choices you made with navigation or interaction design*". These judgements are supported by survey evidence that people tend to believe that a well-designed hospital will contribute to their recovery, and a

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well-designed school will improve the educational achievements of children, and a well-designed neighbourhood will benefit from lower crime and higher house values. So, good design is not just about the aesthetics nor is it limited to them.

The public as a whole is in step with these observations as 77% of people agree with the statement, "*people work more productively in well-designed offices*" (ref) and 72% of people agree that "*well-designed houses will increase in value quicker than average*" and so on. It is perhaps unsurprising that current design practice within human–computer interaction has sought to create interactive systems, services, and products which offer good experiences when they are used. As recently as the 1990s the focus of good design had been to create primarily *usable* technology and truth be said, we became pretty good at this (though there were enough glaring examples to the contrary) but it became clear that people demanded more of their technology: usability, utility, memorability are good but what about, is fun to use, and does it look attractive? The more the technology looks and feels like a *product*, the more likely that people will want it to be elegant, fun, shiny, wipe-clean, desirable, and available in blood red. In short, they want a good experience.

2.2 The Turn to Experience

So, what is an experience? We might expect to find arm-loads of psychology textbooks on the subject—after all, what else could psychology be other than an account of our experiences of the world, but no.

Philosophy, however, is happy to oblige. Dewey's *Art as experience* offers the following definition:

> ... the result, the sign, and the reward of that interaction of organism and environment which, when it is carried to the full, is a transformation of interaction into participation and communication (Dewey 1934, p. 22).

While this contains references to interaction and the environment, it is not very useful. I suppose we should remember that this is still an essay on philosophy per se. But philosophy does provide us with the term *quale* which is Latin for an instance of subjective, conscious experience, a "user experience" if you will. Examples of qualia include the taste of wine, or the feel of silk while the most famously quoted example of a *quale* is the redness of an apple. Dennett (1988) writes of qualia (the plural of *quale*) as follows (they are): ineffable; that is, they cannot be communicated, or apprehended by any other means than direct experience; and are intrinsic; that is, they are non-relational properties, which do not change depending on the experience's relation to other things. They are also private.

However, he also adds that experience can be understood by means of four "threads" and multiple processes. He emphasises that experiences are not composed of these threads but that they can be used to reason about experience itself. Again, not very useful. However, McCarthy and Wright's re-imagining this in their *Technology* *as Experience* helps. The following description of the structure of an experience draws upon Dewey's original and the re-imagined text.

The first thread of experience is the sensuous which is concerned with our sensory engagement with a situation, "which orients us to the concrete, palpable and visceral character of experience" (McCarthy and Wright ibid, p. 80). More than this, it draws us to experience the world prereflectively or intuitively. The authors explicitly link the importance of this thread of experience to children playing with "cyber-pets" or with their smartphones.

The second thread is the emotional. As McCarthy and Wright put it, "*[emotions] are the color shot through the experience that holds all aspects of the experience together and make it different from other experiences*" (2004, p. 83). Emotions are seen as qualities which colour particular experiences rather than being independent of them which is how we typically think of joy, anger or fear. The third and fourth threads are distinctly less compelling and are less well-developed.

The third thread is the compositional. Imagine we have been invited to look at a painting and in doing so to reflect on the relationships being depicted therein and to ask the questions, "what is this about?" and "where am I?". In essence, this is a reference to aesthetic experience and from a careful reading of McCarthy and Wright's analysis, it seems to prefigure some aspects of embodied or enactive aesthetics.

The fourth and final thread is the spatio-temporal. All experiences are said to have a spatio-temporal component. An intense engagement can affect our sense of time. Sitting in the dentist's chair time seems to drag; in contrast, an exciting movie is finished quickly. In addition to time, awareness of this component might also allow us to distinguish between public and private space, and the boundaries between self and others. While each thread is distinct, there is also a great deal of overlap and interdependency.

In addition to these four threads, Dewey proposed that there are the six sense-making processes. These are anticipating, connecting, interpreting, reflecting, appropriating, and recounting. In turn, *anticipating* refers to the expectations we might have prior to an experience; and *connecting* refers to the "immediate, preconceptual, and prelinguistic sense of a situation encountered"; and interpreting means discerning the narrative structure of an experience—what has happened and what is likely to happen. The remaining three processes are reflecting; appropriating and recounting. Reflecting, which occurs in parallel with interpreting, is concerned with making judgements of the experience. Appropriating is the process by which we make the experience relevant to the self. Finally, recounting is concerned with telling others about the experience. In all, this appears to be a fairly comprehensive account of experience but even with the extended gloss provided by McCarthy and Wright still has not been universally adopted.

2.2.1 Heidegger

If Dewey's pragmatism is not to your taste, there is always Martin Heidegger, working more or less contemporaneously with Dewey but in a very different philosophical tradition. Heidegger, an existential phenomenologist with a flavour of Eastern thought, perhaps shades of Zen Buddhism—see May (1996), who languished with little regard until Winograd and Flores were responsible for bringing his work to the attention of the HCI community in their *Understanding Computers and Cognition* (1986). Heidegger is famous for his obscurity and paradoxically for his treatment of our experience of the everyday. In many respects, his work is a natural choice for the student of user experience except for his use of language (which even for a philosopher is difficult), secondly, he did not really approve of "technology" much less "modern technology" and thirdly, he showed, if not contempt for psychology, a fairly open frustration with it, but on reflection, *contempt* is the best word. However, his work is brilliant and surprisingly relevant.

Heidegger's major work, Being and Time (1927/1962) is concerned with the question, "what does it mean to exist?" and his reply is an appeal to the practical and everyday. He avoids the abstract and theoretical, arguing that we have placed too much emphasis on these while our real focus should be on the mundane, everyday and concrete. So, to exist, is to be in the world—nothing to do with trusting or questioning our cognition, just being-in-the-world (incidentally, the hyphens between the words indicate that there is nothing standing between us and the world).

However, of the concepts Winograd and Flores introduced to HCI from Heidegger, among the most important are ready-to-hand and present-at-hand which are his descriptions of how we experience technology.

Heidegger's philosophy focuses on the nature of being—human beings in particular (who he describes as *Dasein* (usually left untranslated)). Dasein is "in-the-world", a world comprising everyday practices, equipment, and common skills shared by specific communities. Heidegger tells us that we are thrown into the world. This dramatic image captures a sense of being-there and we encounter the world either as ready-to-hand or present-at-hand; that is, we experience the world (technology included) as available as things which are ready to use (read-to-hand) or as things which can be thought about or admired (present-at-hand). Sitting at my desk writing this, I have the keyboard of my Mac, my ancient iPhone on which I listen to stories (using the Audible application) and my fountain pen (you may have to look this one up, but it does involve a glass bottle of liquid ink) for writing notes on the printed version of these pages. All of these I experience as ready-to-hand, and use without a thought or a moment of hesitation. There are also a couple of academic papers I have been reading as background, and a cup of coffee. The coffee is ready-to-hand, the papers are experienced as I switch between ready-at-hand and present-at-hand depending whether I am reading or thinking or note-taking.

My working world is filled (is defined by my stuff) which is familiar and available to me. I regard something is available when:

(1) it is defined in terms of its place in a context of equipment, typical activities in which it is used, and typical purposes and goals for which it is used, and
(2) it lends itself to such use readily and easily without need for reflection.

The core case of availability is an item of equipment that we know how to use and that "transparently lends itself to use". Having encountered technology as available we recognise that it can be used in-order-to do practical things. An in-order-to is equivalent to what Gibson (as discussed in Chap. 1) described as an affordance, thus when we make use of an in-order-to, it is equivalent to engaging with a task. This is without conscious thought.

However, our use of technology has (at least) one further consequence as it also serves to define who we are. Heidegger regarded the "self" as being indeterminate and contingent, which is why he calls us as **Dasein**. The self is grounded in what we do and in the variety of tools we use to do what we do, as these changes, so does our identity—from husband, to teacher, to cricket fan, to surgeon. These relationships are, of course, self-referential for example, a scalpel is that tool used by a surgeon and a surgeon is someone (**Dasein**) who uses a scalpel.

From this brief sketch, I hope it is clear (or at least possible) that Heidegger offers some ideas and vocabulary which enables us to talk about how we experience the world. We will adopt his perspective to shape the ensuing narrative and leaven it with a little American pragmatism from John Dewey.

2.3 The Move to UXD

Towards the end of the last century, there was a move from within the HCI community from interaction design and usability to user experience design (UXD).

Alben (1996) offers an early definition of UX when he wrote, (it encompasses):

> all the aspects of how people use a product: the way it feels in their hands, how well they understand how it works, how they feel about it while they're using it, how well it serves their purposes, and how well it fits into the entire context in which they are using it.

This is echoed by Blythe et al. (2003) when he observed: "… *the move in human–computer interaction studies from standard usability concerns towards a wider set of problems to do with fun, enjoyment, aesthetics and the experience of use*". We also witnessed the appearance and re-appearance of "funology" in HCI with its interest in designing for enjoyment and fun (Blythe et al. 2004).

In this early quotation, we find some of the enduring aspects of what is now recognised as *user experience*—with its concerns with *products*, and with application areas beyond the functional, and with its interest in *feelings* and with fitting the product to the consumer, and mention of aesthetics, and of being "engaged" and of being of value. This is quite a shift from plain, monochrome usability.

Use of the term "user experience" can be found in the HCI research literature as far back as the early 1990s—and arguably in Wixon and Whiteside's insightful 1987 paper which identifies the tension between *user experience* and *engineering*. However, the popular adoption of the concept may have been triggered by Donald Norman. In 1995, Norman and his colleagues Jim Miller and Austin Henderson presented an overview of their work at Apple, noting that their preferred alternative to "*human interface research and application*" had become "*user experience*". This new term was reflected in the titles of Apple's "*User Experience Architect's Office*", which worked across research and design divisions, and the newly introduced "*User Experience Requirements Document*" (see Norman et al. 1995).

2.4 Definitions of UX

We argue that UX might benefit from being updated to reflect to an underlying organising principle. Law and her colleagues (2009) have also reported the results of their own surveys of academics and practitioners which indicate that while the term "user experience" is widely used, "*it is not clearly defined nor well understood*" (p. 719). They go on to note that it is also "*associated with a broad range of fuzzy and dynamic concepts*". This state of affairs has not significantly changed in the intervening years. However, the most popular approach to defining UX is by way of a *list*. Usually a long list. Hassenzahl and Tractinsky (2006), for example, have proposed that UX:

> is about technology that fulfils more than just instrumental needs in a way that acknowledges its use as a subjective, situated, complex and dynamic encounter. UX is a consequence of a user's internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g., complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g., organisational/ social setting, meaningfulness of the activity, voluntariness of use, etc.)

An immediate question that comes to mind here is the nature of the *etcetera*'s in this definition. This can only mean that the list is both longer and not fully defined. A second question is how are we to unpack terms such as "expectations" and "voluntariness" or specialist psychological concepts like "*predispositions*" and "mood" which are not fully understood by psychologists themselves.

However, the appearance of Hassenzahl's work was to signal the beginning of interest in the pragmatic—hedonic dimension in UX. The pragmatic aspects of a digital product enable the user to get the job done (they are the usability and effectiveness aspects), while the hedonic aspects are a source of arousal and identification, in short, whether we like it. A couple of years later Hassenzahl (2008) offered another definition of UX claiming that it comprises a "*momentary, primarily evaluative feeling (good-bad) while interacting with a product or service*" and:

> Good UX is the consequence of fulfilling the human needs for autonomy, competency, stimulation (self-oriented), relatedness, and popularity (others-oriented) through interacting with the product or service (i.e., hedonic quality). Pragmatic quality facilitates the potential fulfilment of be-goals.

Hassenzahl is not alone in favouring detailed definitions as Robert and Lesage (2010) have also suggested that UX is both multi-dimensional and holistic. Their proposed dimensions are: functional, physical, perceptual, cognitive, social, and psychological. They also suggest two meta-levels being *sense-making* and *aesthetics*. They add, each experience has a unique and coherent set of dimensions meeting together according to variable ratios. They also add that UX is dynamic and situated. The most telling thing about all of these definitions is that they are not complete.

Donald Norman tells us that he coined the term "user experience" (UX) to refer to "*all aspects of the end-user's interaction with the company, its services, and its products*" (NNG website, n.d.). And, again, Forlizzi and Battarbee (2004) tell us that not only is the term "user experience" associated with a wide range of meanings, but also "*no cohesive theory of experience exists for the design community*". While Hassenzahl (2004) wrote that,

> A product can be perceived as pragmatic because it provides effective and efficient ways to achieve behavioural goals. Moreover, it can be perceived as hedonic because it provides stimulation by its challenging and novel character or identification by communicating important personal values to relevant others, p. 322.

Hassenzahl and Tractinsky (2006) revised this to read, "*UX is about technology that fulfils more than just instrumental needs in a way that acknowledges its use as a subjective, situated, complex and dynamic encounter. UX is a consequence of a user's internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g., complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g., organisational/social setting, meaningfulness of the activity, voluntariness of use, etc.)*".

In 2008, Hassenzahl updated his definition of UX to a "*momentary, primarily evaluative feeling (good-bad) while interacting with a product or service*" and "*Good UX is the consequence of fulfilling the human needs for autonomy, competency, stimulation (self-oriented), relatedness, and popularity (others-oriented) through interacting with the product or service (i.e., hedonic quality). Pragmatic quality facilitates the potential fulfilment of be-goals*".

This was quickly followed by Law and her colleagues who reported the results of a comprehensive survey of academics and practitioners into how the term UX was used, they concluded "*it is not clearly defined nor well understood*" (p. 719). Indeed, they gave no fewer than five sample definitions of UX and found that the most popular definition was "*The consequence of a user's internal state (predispositions, expectations, needs, motivations, mood, etc.), the characteristics of the designed system (e.g., complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g., organisational/social setting)*". In second place was a definition which emphasised the effect and affect produced by aesthetic experience, the meanings we attach to the product, and the feelings and emotions produced (Law et al. 2009).

2.4.1 A New Millennial Usability

Forlizzi and Battarbee (2004) have sought to make sense of this by grouping these definitions into (a) product-centred, (b) user-centred, and (c) interaction-centred but perhaps the most striking thing about them is that most authors ignore what it is to experience.

1. UX is basically a "new millennial usability". It includes usability, which is still the most important attribute, but also includes accessibility, and fun and aesthetics (and so on) depending on context. Arguably the most persuasive proponent of this is Sutcliffe (2009) who rejects the notion of UX per se in favour of engagement and tells us that aesthetics is simply "good design" for particular contexts. Quite simply, Sutcliffe prefers the expression user engagement rather than user experience.
2. UX is ineffable and, more or less, it is all but impossible to define adequately in words. As experiences are personal, of the moment, and cannot be repeated, all we can do is to recognise that they exist.
3. UX is a fresh way of thinking about digital products and any definition should not only recognise that they are a source of fun, aesthetics, and so forth but should also reflect the complexity of human psychology and the context of use too. These definitions inevitably tend to be rather unbounded, and elastic.

Even in the early usability checklists, there was a wild card, namely *subjective satisfaction* (e.g., Nielsen 1994). So, while objective measures were proposed to establish the usability of the digital product, there was always an option for the user to tell us whether or not they actually liked using it or thought it was well-designed.

This was to take form in one of the earliest definitions of UX which have now established themselves as UX staples. We see elements of this again in the ISO definition discussed below, in Kuniavsky's (2010) thoughts on UX and in Norman's (2005) *Emotional Design* as "*the totality of end users' perceptions as they interact with a product or service. These perceptions include effectiveness (how good is the result), efficiency (how fast or cheap is it?), emotional satisfaction (how good does it feel?), the quality of the relationship with the entity that created the product or service (what expectations does it create for subsequent interactions?)*".

2.5 A Formal Definition of UX

As we have seen, since the mid-1990s, (UX) has been the vogue in HCI and while the idea of delivering a "good experience" is intuitively appealing, but has proved to be surprisingly elusive. A sentiment with which van de Sand et al. (2020) would agree, observing "*products cannot simply be regarded as isolated items, which users experience only by actively using them: As user experience can occur before, during, and after use, customer experience and brand perception are important factors, which need to be considered holistically*" While a formal definition of UX as proposed by the

ISO[1] [is] 9241-210 (2010, clause 2.15) is: "*A person's perceptions and responses that result from the use and/or anticipated use of a product, system or service*". However, this attractively short definition has been amplified for clarification and comes with the following notes:

> Note 1: User experience includes the user's emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviours and accomplishments that occur before, during, and after use.
>
> Note 2: User experience is a consequence of brand image, presentation, functionality, system performance, interactive behaviour, and assistive capabilities of a system, product, or service. It also results from the user's internal and physical state resulting from prior experiences, attitudes, skills and personality; and from the context of use.
>
> Note 3: Usability, when interpreted from the perspective of the users' personal goals, can include the kind of perceptual and emotional aspects typically associated with user experience. Usability criteria can be established so as to assess aspects of user experience.

So, UX is the result of perceptions and responses to and of the use of digital products. And while footnotes 1 and 3 are amplifications of the initial statement, footnote 2 introduces a huge amount of additional verbiage from such things as "prior exposure", "context", and so forth.

Fortunately, UX's "white paper" (Roto et al. 2011) attempted to "*Bringing clarity to the concept of user experience*" and is worth considering because it introduces the notion of time. The white paper has two points of interest for the current discussion. It begins by telling us a number of familiar things about UX in that it is "*a subset of experience as a general concept*"; thus, UX is more specific, since it is related to the experiences of using a system. These encounters are recognised to be not only active, personal use, but also include encountering a digital product in a more passive way, for example, observing someone else using it. The authors also recognise that UX is influenced by prior experiences and expectations based on those experiences and UX is rooted in a social and cultural context. Then they introduce a timeline: they divide "time" into four categories or types: the first is anticipated UX may relate to the period before first use, or any of the three other time spans of UX, since a person may imagine a specific moment during interaction, a usage episode, or life after taking a system into use. Then comes momentary UX, followed by UX arising from a specific usage episode (episodic UX), and finally the UX which is a consequence of having used the system as a whole (cumulative UX). The white paper also focused on the use of digital products, with the word *use* cited repeatedly. As for its properties, the authors tell us that UX is personal and then use a number of expressions which are more usually associated with cognition. Use appears again a little later, when we find that, "*While the core of user experience will be the actual experience of usage, this does not cover all relevant UX concerns. People can have indirect experience before their first encounter through expectations formed from existing experience of related technologies, brand, advertisements, presentations, demonstrations, or others' opinions*". So, there we have it—core user experiences arise from direct use. Although there is no definition of "core" we can reasonably read it as the majority

[1] International Organization for Standardization.

situation from which user experiences arise. We shall further assume that by direct use they mean the ordinary, routine use of interactive, digital technology, but this presents a problem. The ordinary, routine use of products is typically automatic and unconscious.

2.5.1 Living with UX

Before we begin to consider the nature of user experience, we have identified a troublesome point which may have stalled the development of theoretical UX in recent years. This issue is that we are still largely treating technology instrumentally. Despite introducing fun, pleasure, and aesthetics along with "getting the job done" in our treatment of digital products, it is still fundamentally a matter of interaction. However, if we were to appreciate that our relationship with digital technology has changed, then we would recognise that we now, for example, live alongside technology just as Negroponte foresaw more than 40 years ago when he described computing "as living" in our homes, for example, we ask for medical advice from our digital assistants, with queries such as, "Alexa, my wife is having an asthma attack, what should I do?" which can now be handled with a first-aid application. In our cars (assuming that we are still driving them), we use our smartphones as a "sat-nav" which again tells us, in natural language, to turn right at the next junction. Gone or going are the road atlases and the skill to use them. We encounter, robots working in a 24 h coffee franchise. In short, we live with it and, all too often, we treat it as though it were another person. This is missing from most definitions of UX.

2.5.2 An Expert Opinion

To see how I was doing I asked ChatGPT, what is UX? It answered:

> User experience (UX) refers to the overall experience that a person has when interacting with a product, service, or system. It encompasses all aspects of the user's interaction, including their perceptions, emotions, and behaviour, as well as the usability and functionality of the product or service.
>
> Good user experience design focuses on creating products and services that are easy to use, effective, and enjoyable for the user. This involves understanding the user's needs, preferences, and goals, and designing products and services that meet those needs in a way that is intuitive and satisfying.
>
> UX design often involves a variety of techniques, including user research, persona development, prototyping, usability testing, and user interface design. The goal is to create a user-centred design that addresses the needs of the user and provides a positive overall experience.

Good to know. Not out of a job just yet.

2.6 Norman Gets Emotional

Norman has told us unequivocally that **attractive things work better** (2004), implying, perhaps, that aesthetics trumps usability. This claim has important consequences and may have had its origins with the work of two Japanese researchers, Kurosu and Kashimura (1995) and the subsequent work of Tractinsky in Israel (1997). The Japanese researchers developed and evaluated a number of different ATM (cash machines) keypad layouts which were identical in function, and the number of buttons they offered and how they worked, but differed in the attractiveness of the layout. They found that the attractively presented layouts were judged to be easier to use than the functionally equivalent unattractive ATMs. The story, as Norman tells it is that these results intrigued the Israeli researcher Noam Tractinsky who assumed that the experiment was flawed. Perhaps, he is said to have thought, the result may be true of Japanese, but this could not be true of Israelis. He suggested that aesthetic preferences are culturally dependent and "*Japanese culture is known for its aesthetic tradition*", but Israelis? Israelis, he tells us, are action-oriented—they don't care about beauty (his words). So, Tractinsky replicated the experiment after obtaining the Japanese ATM layouts, translating the Japanese into Hebrew, and designed a new experiment, with rigorous methodological controls (2004). However, not only did he replicate the Japanese findings, instead the results were stronger in Israel than in Japan, contrary to his belief that beauty and function "… were not expected to correlate".

Norman's subsequent work has been to investigate the role of aesthetics in design from the perspective of our affective response to it. His reasoning, that it is our emotional systems which provide us with feedback when we are solving problems—such as using a digital product. So, he argued, if we like the appearance of a digital product, this produces a change to our emotional state which is communicated to our cognitive system. Norman elaborates, telling us that,

> "What many people don't realize is that there is a strong emotional component to how products are designed and put to use", and that "the emotional design side of design may be more critical to a product's success than its practical elements".
>
> Norman (2004, p. 5)

So, this is why he tells us that attractive things work better and why his book on aesthetics is entitled *Emotional Design.* In an accompanying, TED talk, he also has proposed a possible mechanism for this, telling us that when we are anxious, we secrete neurotransmitters which encourage us to think depth-first. However, when you are happy.

> you squirt dopamine into prefrontal lobes which makes you a breadth-first problem solver: you're more susceptible to interruption; you do out-of-the-box thinking. That's what brainstorming is about, right? With brainstorming we make you happy, we play games, and we say, "No criticism," and you get all these weird, neat ideas.
>
> So, if we find the digital product, we are using to be a source of pleasure, we tend to tend to use it more creatively (from the transcript of Norman's TED talk 2003).

Norman's approach to emotional design has been developed (in part) from reflections on the design of his teapots. He tells us that he has a collection of teapots and he uses them to illustrate the different aspects of emotional design.

What he describes as the visceral level corresponds to the first impressions of a product. At this level, people do not think about a product, but spontaneously judge, if they like or dislike it. The visceral level is independent of cultural aspects and is equal for everyone. Norman locates this class of response in "*the simplest and most primitive part of the brain*" and describes it as "*genetically determined*" (p. 29). This definition distinguishes the operation of the visceral level from other treatments of first impressions. The visceral level does not reason (because it cannot) and, instead, works by "pattern matching". Norman then provides (which he describes as his "best guesses") two lists of situations and objects which we are genetically programmed to like or dislike (Norman 2004, pp. 29, 30): we like "*warm, comfortably lit places, caresses, attractive people and rounded, smooth objects*"; and we dislike "*sudden, unexpected loud sounds or bright lights, looming objects (that is, things which appear to be about to hit the observer), sharp objects, misshaped human bodies and snakes and spiders*". Norman concludes that these are predispositions rather than fully fledged mechanisms.

This next level of design is about use and is described as the *behavioural level*. He writes that people may seek to appraise a products functionality and issues such as ease of use of the product come to the fore. This level of use corresponds to what Norman describes in detail in his earlier *The Psychology of Everyday Design* (1988). While he calls this the behavioural level it might also be called the *cognitive* except that he introduces an incongruous aesthetic element. He suggests that function, understandability, and usability are three of the four major components of this level—which is consistent with his theory of "mental models" and then adds "physical feel" as a four component.

He also offers the image of someone showering and enjoying "*the sensual pleasure, the feel—quite literally—of the water streaming across the body*" (p. 70). Yet on the page before, he tells us that on this level, "*Appearances do not really matter*" (p. 69). So, visual appeal—classical aesthetics do not seem to be relevant here but haptic appeal—embodied aesthetics (perhaps)—are. This is a little difficult to square with his assertion that "Attractive things work better" which explicitly links appearance and use.

Finally, comes the reflective level which "*covers a lot of territory. It is all about message, about culture, and about the meaning of a product or its use. For one, it is about the meaning of things, the personal remembrances something evokes. For another, very different things, it is about self-image and the message a product sends to others*". So, at this level, consciousness takes part in the process, with people actively endeavouring to understand and interpret things often in the context of past experiences and imagined future actions.

It is important that we recognise that Norman is writing about design and not about psychology specifically, yet despite this, his model appears to be an rely on the discredited triune model of the brain as proposed by MacLean (1949). The triune brain account sees the brain as consisting of three phylogenetically distinct complexes or groups of neural structures. The most ancient is reptilian complex (the R-complex), next is the paleo-mammalian complex (limbic system), and finally is the neo-mammalian complex (neocortex). It is proposed that these structures have evolved sequentially, reptile, paleo-mammalian, and neo-mammalian. Although this is no longer held to be a credible account of the development of the brain, it has proved to be popular and enduring in popular science (cf. Carl Sagan's seminal (1977) *The Dragons of Eden*).

Using this account enables Norman to account for our emotional attachment to digital products. Attachment, then, is the result of the cumulation of emotional episodes with an artefact.

2.7 The Pragmatic-Hedonic Dynamic

The appearance of Hassenzahl's work (discussed in Sect. 1.4) was to signal the beginning of interest in the pragmatic-hedonic treatment of UX. The pragmatic aspects of a digital product are those which enable the user to get the job done (including usability, utility, efficiency, and so forth), while the hedonic aspects are a source of arousal (do you enjoy using the product, is it fun) and identification, (and whether we like or identify with it).

These speculations aside, the relationships between factors were tested empirically by Lee and Koubek (2010) who examined the relationships among usability/aesthetics features, perceived usability/aesthetics, and user preference through an experiment using four simulated systems with different levels of usability and aesthetics. They found that:

- *before* actual use, user preference was significantly affected by the differences in aesthetics but marginally affected by the differences in usability. In contrast.
- *after* actual use, user preference was significantly influenced by the differences in both usability and aesthetics.

And regardless of actual use,

- user preference was highly correlated with both perceived usability and perceived aesthetics, which were strongly interrelated. Finally,
- actual use had a significant effect on perceived usability, perceived aesthetics, and user preference.

Usability of these measured easily; but aesthetics is a "*predominantly affect-driven evaluative response to the visual Gestalt of an object*" (Hassenzahl 2008, p. 291). This description of aesthetics, unlike the ISO definition of usability, only focuses on users' subjective judgements.

2.7.1 Investigating Hedonic Properties Further

Hassenzahl (2004) conducted a series of studies which considered the interplay between/among: (user-perceived) usability, hedonic attributes, goodness, and beauty.

He proposed that when we make judgements about digital products, we do so on the basis of the product's features which include how it looks, its content, functionality, and interaction together with personal expectations or standards. These judgements in turn can be partitioned into two distinct attribute groups which he describes as, pragmatic and hedonic attributes. The pragmatic attributes are connected to the users' need to achieve goals and goal achievement requires utility and usability. So, a product that allows for effective and efficient goal achievement is perceived as pragmatic.

In contrast, hedonic attributes are primarily related to the users' self. They can be further subdivided into *stimulation* and *identification*. Yielding the factors, HQS and HQI: hedonic quality-stimulation and hedonic quality-identification.

Identification addresses the human need to express one's self through objects. This self-presentational function of products is entirely social; individuals want to be seen in specific ways by relevant others. Thus, a product can be perceived as pragmatic because it provides effective and efficient ways to achieve behavioural goals. It can be perceived as hedonic because it provides stimulation and/or identification by communicating important personal values. Thus, a product can be perceived as pragmatic because it provides effective and efficient ways to achieve behavioural goals. And … It can be perceived as hedonic because it provides stimulation and/ or identification by communicating important personal values.

Stimulation, novelty, and challenge are a prerequisite of personal development. Both pragmatic and hedonic quality have positive effects on goodness, but only hedonic quality has a positive effect on beauty. Designing a highly preferred product or system is a crucial issue for better product sales.

To examine these relationships, he constructed an experiment which he used four different MP3-player skins. A skin is a graphic file used to change the appearance of an application's user interface. Sonique skins, for example, substantially vary in presentational style and usability, although purpose and functionality remain constant. In a pretest, images of the skins were judged to be beautiful or ugly on a 7-point bipolar scale with the verbal anchors ugly and beautiful. While they were not judged to be particularly attractive eight were rated as ugly (i.e., their mean beauty was rated as being significantly below zero). Eleven were rated as neutral (i.e., no difference from zero) and only one skin, namely "QuickSkin", was rated as definitely beautiful (i.e., better than zero). Based on these pretest ratings, the two ugliest (Danzig, w98) and most beautiful (ts2-Razor, QuickSkin) skins were selected to establish the independent factor beauty (ugly, beautiful). Then a questionnaire, AttracDiff 2, was developed and employed to measure perceived pragmatic quality (PQ), perceived hedonic quality–stimulation (HQS), and perceived hedonic quality-identification (HQI). The results of this study show that, before actual use, user preference was significantly affected by the differences in aesthetics but marginally affected by the differences in usability.

Figure 2.1 is an image of the QuickSkin media skin.

The above skin is freeware and available from https://en.softonic.com/downloads/playerskin-for-windows. While the questionnaire is available from www.attrakdiff.de. The AttracDiff 2 questionnaire treats the hedonic as two streams, namely HQS and perceived HQI, and consists of twenty-one 7-point items with bipolar verbal anchors. As long as beauty and goodness stress the subjective valuation of a product, both were related to each other. However, the nature of goodness and beauty was found to differ. Goodness depended on both perceived usability and hedonic attributes.

Identification addresses the human need to express one's self through objects. This self-presentational function of products is entirely social; individuals want to be seen in specific ways by relevant others. Thus, a product can be perceived as pragmatic because it provides effective and efficient ways to achieve behavioural goals. It can be perceived as hedonic because it provides stimulation and/or identification by communicating important personal values. Thus, a product can be perceived as pragmatic because it provides effective and efficient ways to achieve behavioural goals. And … It can be perceived as hedonic because it provides stimulation and/or identification by communicating important personal values.

The results of this study (after detailed statistical analysis) show that, before actual use, user preference was significantly affected by the differences in aesthetics but only marginally affected by the differences in usability. Confirming Bloch (1995) suggested in the start of this chapter.

Fig. 2.1 An example of a media player skin (the original has a lime green foreground on a dark background)

2.8 Designing for User Engagement

At this point, we need to turn to Sutcliffe's case against UX which he describes in his *Designing for User Engagement* (2009). In this, we find an approach to designing for what might be described as "a good experience" without having to use that "diffuse" and "much over-used term", namely *user experience* (Sutcliffe, ibid). He proposes the expression "user engagement" (UE) to describe how people are attracted to use interactive products. Although this book is concerned with design, he begins it by critiquing Norman's writing on *Emotional Design* which, he claims, is based on only a partial understanding of UX. Sutcliffe tells us that emotions are reactions to events, objects and are a component in our understanding UX but are not enough in themselves.

He then considers the work of Tractinsky and of Hassenzahl. The former, he tells us has developed questionnaires for measuring user judgements about the quality of interactive products, producing measures for aesthetics, traditional usability, and pleasure. However, when the determinants of classic aesthetics are inspected, many relate to traditional usability concepts such as consistency and structural layout. Hassenzahl apparently has done something similar as his questionnaire-based approach to understanding the relationship between hedonic and pragmatic design qualities has revealed that hedonic qualities are more closely associated with aesthetics, while pragmatics is closer to traditional usability. However, most tellingly, these studies tend to ignore the fact that user judgement is context-dependent. Specifically, whatever the underlying constructs by which we judge products, our judgement depends on the context of use.

Sutcliffe's use of "*user engagement*" is primarily confined to explaining how and why applications attract people to use them within a "session" (lab) and whatever the underlying constructs by which we judge products, our judgement depends on the context of use. Sutcliffe based these conclusions on a series of studies wherein he compared interactive tech which shared the same functionality and content but differed in aesthetic and interaction design. He found that user judgement can be biased by the tasks they are given (serious versus less serious use), by their background and task, and by the order in which design information (positive/negative) is presented. These studies also drew on the so-called *halo effect* which is the tendency to bias positive judgements. So, the observation "what is beautiful is usable" depends on the context, and the reverse can also be true when users are given serious tasks; moreover, judgement of the same website can be swayed by the order in which the same information is given. Clearly, beauty is in the eye of the beholder, but it depends on who the beholder is and what they are doing. User judgement of user experience is a complex process, which is summarised as follows … On initial encounter, users assess the application according to their goals and the task domain. This stage will correspond to searching and locating a website or a software product.

Next, the users' goals and task influence the selection of the decision-making criteria. For example, in applications for serious use with more critical outcomes, content and usability will be favoured. Alternatively, for less serious use aesthetics and engagement will be favoured. The user's experience will be judged against the dominant criterion or criteria appropriate for the application. The decision-making process is iterative, and users modify their opinions as their experience progresses.

UE is, therefore, a complex multifaceted quality which may vary according to the application, the users' expectations and context of use. For example, in work and goal-oriented applications, functionality, utility and usability are going to be more important. When applications are mobile, adaptation and context sensitivity will be important: while if the brand is valued, this exerts a positive influence on other criteria such as usability and aesthetics.

For those he describes as "power users", the ability to customise and adapt the application are key criteria, while for those interested in games and entertainment aesthetics, metaphors, and interaction are likely to be dominant. The correspondence between judgement criteria and applications types, as well as user characteristics, is still largely un-researched, so few definitive guidelines can be given. To make a complex picture even worse, the criteria people use to make judgements probably shift as experience progresses.

For initial impressions, aesthetics may be important, but as interaction commences, usability and utility will dominate in task-oriented applications while action-feedback, presence, and metaphors are probably more important in games and entertainment domains. Experience is evaluated, resulting in positive or negative attitudes which feedback on the criteria. However, feedback involves a complex interaction between the dominant and non-dominant criteria, the task, and user background, all of which influence overall preference.

Models of user judgement point out that we sometimes make judgement by "gut reaction" or fast-path processing, involving little reflective thinking. In serious contexts, we make judgements more slowly with elaborate thinking. Work domains are more likely to involve slow-path decisions (deliberation) and usability/utility criteria whereas entertainment domains are more likely to be based on fast-path judgement. In summary, Sutcliffe argues: "fun" relies on first impressions, whereas work requires deliberation or reflection, while "fun" also depends upon the use of metaphor which may enable us to create a sense of presence.

2.9 UX = Involvement + Aesthetics + Affect

We propose that UX is the synthesis of Involvement + Aesthetics + Affect. Three key elements, rather than creating our own long list of loosely defined or ill-defined attributes we propose that it is better treated as an *ad hoc* category which might be constructed from only three (very broad) elements. UX results from the synthesis of our *aesthetic assessment* of the product, and our *affective response* to it and *our involvement* with it.

2.9.1 Ad Hoc Categories

Barsalou originated the idea of an *ad hoc* category from observing how people form and use highly specialised and unusual sets of things as a matter of their everyday coping with the world. These *ad hoc* (1983) or *goal-derived* categories (1985) and for the purpose of this discussion they will be treated as though they were synonyms. He found that people create such categories to achieve particular goals (e.g., Lucariello and Nelson 1985; Ross and Murphy 1999; Medin et al. 2006; Chrysikou 2006). These categories begin life as simple lists but they help achieve a relevant goal by organising the current situation in a way that supports the current goal. For example, the first time that someone packs an over-night bag, the category is "*things to pack in a bag*" is *ad hoc*. However, subsequent trips leave a memory of bag-packing. Barsalou has proposed that both conceptual and linguistic mechanisms have a role in forming *ad hoc* categories: from a conceptual perspective, people combine existing concepts from objects, mental states, properties, and so forth to form new conceptual structures while linguistically, people combine words in novel ways to index these concepts. The conceptual and linguistic mechanisms that formulate *ad hoc* categories are very flexible, as that components of these categories can be replaced with alternative values. He also notes that the instantiations of an *ad hoc* category are held in memory and become increasingly well-established through frequent use (Barsalou 1991, 2021). Overall, it is fair to say that *ad hoc* categories are ubiquitous in everyday cognition.

A familiar *ad hoc* category is a readymade (package) holiday. We are all aware that it is possible to purchase a package holiday of the form, "Experience Egypt" or "A weekend in New York" and we all generally understand what the vendors have in mind. An experience of this kind is not just a matter of flying there but would normally include sampling the local cuisine, enjoying the culture, the music, the history, the people, and on the list, goes depending on the extensiveness of the package and the enthusiasm of the holiday-maker. Despite the variety, we would expect the holiday to include common attributes such as transportation, accommodation, food, and drink. Here we have a holiday as an *ad hoc* category, comprising a class (or list) of things. We can also note that not all members of this category are equal, and that some are more representative than others. This degree of membership reflects the category's graded structure which seems to be a universal property of categories. We recognise that UX is an *ad hoc* category with a small number of strong attributes (members) and a host of other attributes which have a lesser degree of membership. Having proposed that UX can be thought of as an *ad hoc* category, we now argue that category is organised around a number of what define as core attributes. As we have already mentioned, we propose that UX comprises *three core attributes*, namely involvement, affect, and aesthetics which we now briefly describe (we also describe these in more detail in Chaps. 5, 6). We also discuss how this flexible treatment of UX can accommodate newer, unexpected attributes (such as elements of augmented and virtual reality).

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Chapter 3
Involvement (With Technology)

3.1 Introduction

As we have described, the context for user experience is our technologically informed society. Just about everyone owns and uses a cell phone (and nearly half of everyone owns a smartphone) and the success and ubiquity of these products is attributed to their ability to run apps. And while this technological explanation for their success is plausible, it is missing the all-important psychological perspective, that is, why do we find it/them so compelling? This question is always at the heart of the very many surveys into phone use. A spate of them has revealed that, for example, 55% of people check their phones while dining, and that 71% of Americans say they check their phones within the first 10 min of waking up; 48% of people say they feel a sense of panic or anxiety when their cell phone battery goes below 20% and a really rather sad 7% of people check their phones during sex. From which we conclude that our phones are embedded in everyday activities (as reported by iPass 2017; YouGov 2018). As part of this, we should point an accusing finger at the reward pathways in the brain and the role of the neurotransmitter *dopamine*. The percentages change from year to year but the central message does not.

While these statistics are becoming commonplace, try substituting the words "mobile computer" for "smartphone" and then see how odd these figures look, particularly, when we remember that these surveys are not directed at computer scientists or technology "geeks" but at the general public. And given this seemingly unlimited range of uses, a key question must be—how can everyone simply buy a phone and use it straight out of the box without being sold a getting started guide or a training course? Indeed, negotiating the contract with the service provider is the only real obstacle to getting online. Just what has happened to make digital technology such a fundamental part of everyday life?

Given this evidence, we recognise that exposure to technology is *cultural*, not in some loosely defined, arm-waving kind of way, but in a form which can be teased apart and understood. Following Tomasello (2009) we recognise that children learn to *imitate* the use of technology by just watching their siblings or parents, teachers,

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and other children using it and absorb all manner of messages, images and stories from TV programmes, or more likely, from TikTok or YouTube or whatever is fashionable offering online videos and advertisements. And, of course, we have already mentioned the potential role of mirror neurons. People are also *instructed* (formally and informally) on how to use technology at school or college, and, of course, they are quite capable of learning, working, and playing cooperatively with other people. These three forms of learning differ—both imitative and instructed learning involve practice or instruction being passed from the adult (or equivalent) to the child or learner. Collaborative learning is different because it takes place in the absence of the teacher–learner dynamic with peers working together to solve cocreate a solution to a common problem, but what is learned is internalised individually.

Tomasello makes a further observation and it is that cultures change with time, and once a new practice has appeared, it can spread quickly and relatively faithfully. These changes are often (informally called) *memes*. A meme is said to be a unit of cultural "information" spread by imitation. The term *meme* was introduced in 1976 by Richard Dawkins in his *The Selfish Gene*. Dawkins proposed a *meme* as a cultural parallel or equivalent of the biological genes. So, for example, there was a time when mobile telephony was limited to the physical length of one's phone cable. Then, after technical and behavioural innovation, it was confined to the emergency service vehicles or appropriated by the rich and self-important (as a "car phone"), then relatively inexpensive mobile phones became available and popular (cf. Nokia) and then when expensive but highly desirable phones appeared all was swept before them (cf. Apple). Everyone needed a cell/smartphone. Thus, modified practice, artefacts, and behaviour can be quickly acquired by others, and as he has observed, they have a "ratchet effect", wherein each modification stays in place until further revisions are made.

3.2 *Irreversible* Steps

Habits are to this discussion important to this discussion because, as Pollard (2006) observes, we often use "habit" as an explanation of everyday life, observing that, "… *we only think when our habits give out*" (p. 18). A sentiment with which William James himself might have agreed. James wrote, "*We must make automatic and habitual, as early as possible, as many useful actions as we can*". He even suggested, with impressive prescience, that "the young" will become mere walking bundles of habits (James 1890, p. 122). Thus, the habitual is a kind of behavioural "default".

So far, however, we have more or less equated habits with repetition alone, but Turner (1994, p. 16) has distinguished between habits and simple repetitive behaviours, writing that "*Habits are acquired, and there is something which persists between manifestations, a mental trace. The same kind of reasoning that we grant in the case of habits with directly visible manifestations, that there is an invisible 'mental' element by virtue of which the visible pattern of behaviour persists, may be extended to those "habits of mind", that we can identify and speak of only indirectly,* *through complex inferences*". So, habits are not just simple repetitive acts and the popular press often run features on the theme that we spend more time with or on our phones than with our spouses, boyfriends, girlfriends, or indeed almost anyone else. Magazine and newspaper even run challenges in which their ace reporters try to manage a day or even as much as a week without their smartphones. The participants often described themselves as bravely enduring "digital detox" pausing to reflect how much simpler life would be without a phone. The subtext, of course, is that they and by implication, most of us, are "addicted" to our phones. In the same survey, we quoted from (above) 47% describe themselves as "addicted", we regard addiction as being characterised by "uncontrolled use" and remember how many people have their phones ready-to-hand for hours and hours every day. Habits, as we all know, even benign ones are difficult to quit.

Further analysis reveals bewildering patterns of behaviour. For example, in reply to the question "How often do you check your phones?" The answer is an average figure of 344 times per day. As the number of minutes per day is $24 * 60 = 1440$, divided by 344 is approximately 4, which means, according to these data, a typical phone user checks their phone every 4 min.

3.2.1 Computers as Social Actors

It is an unavoidable fact that we are social creatures and tend to treat almost every situation, every encounter, socially. So, it is unsurprising that we also tend to treat digital products socially too. It is possible, if not likely that this is how we first experience them—as social beings.

Thirty years ago, Clifford Nass and his colleagues (Nass et al. 1994) argued that computers should be treated as social actors (this proposal became known as CASA—computer-as-social-actors) and presented simple but compelling empirical evidence to support this claim. These studies showed that while people *did not believe* that computers are human or particularly human-like, our response to them was nonetheless social. Their preliminary work also found that a variety of social norms were being applied to computers; and that our social responses to computers were automatic and unconscious. Studies of CASA have uncovered more details in subsequent years (e.g., a number of studies addressed the issue of "gender"), and this was subsequently extended to newer media forms such as Twitter (e.g., Li and Li 2014). However, digital products have continued to be developed which specifically invite social interaction (the so-called *relational artefacts*) and these are the social robots and digital assistants.

Some researchers are happy to tell us that we can have or do have social relationships with social media but this is not so. The technology underpinning of social media is undeniable but they are communications media, not our friends. Instead, they are the means by which we are in contact with our fellow humans (often constantly), they are a means to an end and that end is, unequivocally, other people. So, for example, we do not have a social relationship with twitter but twitter does enable potentially millions of other people to read our 140 characters worth of thoughts on whatever is current. As the term "social" is both loose, and ill-defined, we have adopted the more manageable (but longer-winded) "shared sense-making" to indicate this relationship.

When we use a digital product by pressing a button, or sliding a finger over a screen or speaking "Alexa" we are initiating a dialogue. The technology responds to the instructions by doing something and we in turn we may issue another command and it in turn responds—and this basic dialogue has (some of) of the hallmarks of being social (i.e., an interaction between two agents).

This is not the only means by which we are prompted to engage with digital products "socially" or as Nass and Moon (2000, p. 88) put it "*mindlessly*" but it does illustrate the point. The underlying mechanism involved in the concept of mindlessness relies on "… *individuals must be presented with an object that has enough cues to lead the person to categorize it as worthy of social responses, while also permitting individuals who are sensitive to the entire situation to note that the social behaviours were not clearly appropriate*".

Once faced with a situation which can or might be taken to be social, we quite naturally, and unconsciously, make use of our (shared) sense-making abilities to understand and anticipate the subsequent behaviour with it. We have identified three sense-making mechanisms which we will discuss here but recognise that there may well be are others.

1. The first of these is *ToM* (or **theory of mind**). Almost all of us have developed a theory of mind in childhood which embodies our beliefs (or theory) that other people have the same kind of rich internal mental life as we do and it would seem that we extend this to include digital products too. We need a ToM to understand what the characters in stories are doing and why and what our other people are talking about. It is believed by many that most people develop a theory of mind (usually abbreviated to ToM) by which we make sense of what other people do and think and this is based on the perfectly reasonable but unsubstantiated belief that they have the same kind of rich internal mental lives as we have. Baren-Cohen (2000) has suggested that a ToM may be more important than the appearance of bipedalism or tool use in our evolution. ToM is what Goldman (2012) calls "*the cognitive capacity to attribute mental states to self and others*", and it has also been proposed as a necessary condition for, and the basis of, no less a construct than culture itself. Despite the clear importance of ToM, most people are scarcely aware of it, as it is employed unconsciously. For hundreds of thousands of years, we have been cooperating with each other and fighting each other and deceiving each other all by virtue of our ToM. The presence of our ToM has enabled us to make sense of each other's affective states, habits, intentions, and we use it to anticipate and understand each other's plans and actions (Whiten 1991). The idea of people developing a theory of mind was originally proposed by Premack and Woodruff (1978) to describe the hypothesised ability of our cousins the chimpanzees to infer each other's mental states. It is described as a theory of mind because the relevant mental states are not directly observable

(i.e., they are theorised), and the observed behaviours of others are predicted and accounted for on this theoretical basis (Perner 1999).

3.2.2 *Effective "Mindreading"*

Baron-Cohen (1997) underlines the importance of an effective "mindreading" system from an evolutionary perspective: "*Imagine that you are an early hominid, and that another early hominid offers to groom you and your mate. You need to reason quickly about whether you should let him approach [...] Making inferences about whether his motives are purely altruistic or whether he might be deceitful is a reasoning strategy that you can apply in time to react to a social threat*" (p. 25). The hominid's mindreading provides him with information about the intentions of others, necessary to act quickly and appropriately. From this evolutionary perspective, ToM is an essential component of coping with the world, and Baron-Cohen has identified a wide range of intentional communications which depend on it. These are "*communicative acts that are produced in order to change the knowledge state of the listener*", so if I were to tell someone that green tea contains anti-oxidants, I am doing so in order to give them new information. I am doing this because I believe they do not have this information; and they might be interested in it; and they might want this information. In short, I am trying to change their knowledge state, and to do that I need a theory that others have minds that can be informed or uninformed or deceived just like me. We can witness this every minute of every day when, for example, we post images, or update our profiles, or send messages using social media on the clear understanding that one's "*friends*" will understand. Again, mirror neurons may help here as they have been proposed/implicated in the workings of ToM (e.g., Gallese and Goldman 1998 among others). Other examples of intentional communication include repairing a failed communication when we realise that the listener has not understood the intended message; and teaching is too, as it is concerned with "changing the knowledge state of the less knowledgeable listener" (though there is little evidence that this works in practice); and persuasion is the changing of someone else's belief about the value of something. Similarly, sharing a plan or goal with another relies on a "meeting of minds" and shared attention (as in hey, "look at that") requires that both people are aware of the other person being aware of looking at the same things at they are. If you find this a little unlikely, try getting your cat to look at the moon. Point at the moon and then tell Felix to "look at the moon". All that will happen is that Felix will rub his head on your hand. Overall, such observations have prompted Bruner to write, "*Social realities are not bricks that we trip over or bruise ourselves on when we kick at them, but the meanings that we achieve by the sharing of human cognitions*" (Bruner 1982, p. 837). We are now applying these hard-won skills to making sense of, and use a range of digital products, including robots, virtual agents, digital assistants, intelligent systems, animation, and cooperative systems to name but a few.

1. The second mechanism is what Reeve and Nass (1996) describe ***The Media Equation***. This equation is that we interpret new media just as we make sense of the cinema or TV or video games. This "new media = the real world" attribution proposed by Reeve and Nass is due to our "old brains". An old brain is not one that has seen better days but one which reflects its origins, and with our species, it means the savannas of Africa during the Upper Late Pleistocene. On the savanna, we used our brains to enable us to find food; avoid being eaten and to understand the behaviour of our fellow tribemates. So, we are using our old brains which have evolved to support the 4Fs (feeding, fleeing, fighting, and reproduction) to make sense of new media and this mismatch has resulted in the social-like perception and treatment of digital products. Nass and Moon (2000, p. 86) have written that "*the computer is not a person and does not warrant human treatment or attribution*" and point out that computers do not have faces or bodies—unlike, say, a child's toy, and are unresponsive to human affect, and never express emotion themselves. Yet for all of this, there is abundant evidence that people *mindlessly* (a term they emphasise) apply social rules and expectations to digital products. Their own empirical work has found that people tend to "*overuse human social categories*" (p. 82) such as gender and ethnicity, politeness, and reciprocity and behave as though computers have personality traits, such as friendliness. Mindlessness has also been defined as the over-reliance on habits from past experiences that are applied in a new situation. This over-reliance leads to the use of pre-existing "scripts" which may fail to account for the particulars of the individual and the situation, such as interacting with a computer rather than a human. As compelling as this is, it does cut across a number of different domains; for example, Reeves and Nass note that the media equation is automatic and unconscious and occurs with the most passive use of digital products. This suggests that this might be better thought of as a form of perception rather than deliberation or a response to the affordances offered by the product. This also suggests that it may be an example of System I thinking and there is some support for this when they tell us that people respond to what is present and immediate rather than what they know to be there.
2. The third mechanism relies on *folk psychology*. Malle (2004) writing about folk psychology tells us that, "*People make a number of assumptions about human behaviour and its relation to the mind. These assumptions are interrelated and form a network that is variably referred to as a common-sense psychology, naïve theory of action, theory of mind, or folk psychology*" (p. 30). Malle reminds us that, although we might expect that these different labels to refer to different "*slices of the phenomenon*", and there is indeed little consensus among researchers (e.g., we see ToM being mentioned again in this section). So, folk psychology might to better thought of as a network of knowledge and rules rather than a coherent model. The philosopher, Daniel Dennett (1988) writes, "*What I want to stress is that for all its blemishes, warts, and perplexities, folk*

psychology is an extraordinarily powerful source of prediction. It is not just prodigiously powerful but also remarkably easy for human beings to use" (p. 135). So, when explaining human behaviour people will often distinguish between intentional and unintentional actions. An evaluation of an action as stemming from purposeful action or accidental circumstances is one of the key determinants in social interaction. Others are the environmental conditions or precognitive matters. For example, a critical remark that is judged to be intentional on the part of the receiver of the message can be viewed as a hurtful insult. Conversely, if considered unintentional, the same remark may be dismissed and forgiven. Ravenscroft (2016) who tells us that folk psychology has a number of distinct forms, and primarily refers to a set of cognitive capacities which include "*the capacities to predict and explain behaviour*". Churchland (1990, p. 207) also describes our ability to understand one another as relying on an "*integrated body of lore concerning the law-like relations holding among external circumstances, internal states, and overt behaviour*". Thus, folk psychology is knowledge of how the (social) world works. Other examples of folk knowledge include: we know that if we do not eat, we get hungry; that if we injure ourselves it hurts; and the world is not fair. In short, folk psychology enables us to cope with the world.

As part of this collage of ideas, we should mention *theory-theory* because it is a great name and because it proposes that people have basic or "naïve" knowledge about the world and understand the rules which govern it. We use these to reason about the mental states of others, such as their beliefs, desires, or emotions, and to understand the intentions behind that person's actions and to predict their future behaviour. A central feature of this is "perspective taking" which enables one to infer another's inner state using knowledge about the other's situation.

The application of theory-theory, as a set of heuristics or rules derived from what we have learned about the world, other people and technology, is not limited to making sense of people and can be applied to the operation of technology. Interestingly, folk psychology does not necessarily require a human brain to operate and could, at least in principle, "run" on a computer or artificial intelligence.

Cutting a long story short and to bring this to a general conclusion, Bødker and Klokmose (2015) have written that "*Human beings surround themselves with many artifacts, in many everyday activities, and what artifact is 'natural' for them to use, is highly dependent on their individual past experiences, as well as of the shared practices in which they are part, and the technological possibilities offered to them, in (and outside) these communities of practice*". True to the spirit of Activity Theory, such ecologies are necessarily shared by a community, within which individuals develop praxis "*There is no user without other users who share their experiences with artifacts and materials, understanding, etc.*" Ecologies comprise multiple different devices which serve similar purposes, with no clear means of deciding between them: this is situated and depends on the characteristics of the ecology; both artefacts and activities in constant development. Again, for these authors, ecologies are dynamic.

3.2.3 Our Relationships with Technology

Having begun with “*parlour tricks*” like ELIZA and “toys” such as Tamagotchi, the range of relational artefacts has continued to grow to include, for example, Furbies, released by Tiger Electronics in 1998, who needed to be “taught” English (as a newly acquired furby only spoke furbish) to include those frighteningly realistic and demanding dolls such as “My Real Baby” (released by Hasbro in 2001), and social robots proper designed to help with autistic children (e.g., Cabibihan et al. 2013) and older people (such as the “mental commitment” robot seal, PARO, dating from 2001). More recently, companion robots have been evaluated for their usefulness in contributing to “well-being” (Ruggiero et al. 2022) and “personal healthcare” at the behest of “*The 3rd United Nations Sustainable Development Goal*” which aims to ensure healthy lives and promote well-being for all age groups. It is safe to say that this not just a technological fad as there is a growing market for these robotic products as the International Federation of Robotics predict (https://ifr.org/). Sheridan (2016) writing of human-robotic interaction in general, identifies four key application areas in this rapidly evolving field. These are:

- human supervisory control of robots (e.g., assembly lines, warehousing);
- teleoperation (that is, the remote control of space for non-routine tasks);
- automated vehicles; and
- human–robot social interaction of which he writes “*to provide entertainment, teaching, comfort, and assistance for children and elderly, autistic and handicapped persons*” (p.526).

Most recently, treatments using rehabilitation robots enable delegating more manual and repetitive therapy components to robotic devices, allowing a clinician practitioner to take care of more patients in a given time and improving the accessibility of therapy for patients remotely from the comfort of their homes through tele-rehabilitation. The data collected can objectively assess performance and document compliance and progress using artificial intelligence (AI), promoting data-driven therapy. Virtual reality (VR), combined with haptics, offers therapists more customisable treatment options in a safe environment.

There have been in the last twenty to thirty years very many robots created for a wide variety of reasons and it is not practical to review them all, and the technology has matured to the extent that social robots are now being created primarily as a potential solution to particular problems. In short, social robotics research has become a matter of applications rather than psychology. As we shall see, however, a hard line cannot be drawn between research and application: relational artefacts developed originally for research work have found a “second life” as commercial products, while social robots that are primarily products have supported significant research projects.

This chapter therefore discusses selected landmarks in social robotics research and development, in a broadly historical sequence. We consider firstly Cog, Kismet, and Kaspar, intended primarily as research tools to support the exploration of human–robot social interaction, then parallel developments in relational artefacts for entertainment, play or as therapeutic aids, and finally the emergence of humanoid robots whose generic social capabilities are designed to support a range of practical applications or (perhaps) to serve as companions. Taken together, this parade of robots illustrates four of Fong et al.'s (2003) categories of social robotic forms: the anthropomorphic, the zoomorphic, the caricatured, and the functional. Many of these robots come complete with "*personalities*" (e.g., Niculescu et al. 2013), or "*emotions*" (e.g., Breazeal and Brooks 2005; Winkielman et al. 2016), and "*internal psychological states*" (Breazeal 2002), and robotic receptionists have "back stories" (e.g., Gockley et al. 2007).

We give particular attention to human perceptions and experience of these technologies. As many researchers and developers are at pains to point out, acceptance is crucial to the success of social robotics applications.

A review undertaken by Hung et al. in 2019 analysed 29 studies on the use of PARO with dementia patients. Here the most significant reported benefits were the reduction of negative symptoms in patients, the enhancement of their social interaction and the promotion of positive mood, while concerns included costs, additional workload for staff, and ethical issues. The authors noted a lack of focus on the needs and experience of dementia patents themselves.

Hung and colleagues (2021) subsequently undertook an interview, focus group, and observational study with staff and patients in a dementia unit where PARO was used. Findings from their thematic analysis indicated that PARO served to support a sense of self, to support social connection, and to humanise the institutional setting. A longer-term interview-based study of adults with dementia elicited similar perceptions, finding that PARO supported social bonds, alleviated distress, and acted as a source of comfort (Chen et al. 2022).

3.3 Digital Assistants and Chatbots

We now move from relational artefacts in human or animal form, however approximate this may be, to intelligent digital products that are primarily manifest as disembodied voices. McTear (2002) tells us that the "*conversational computer*" has been a long-standing goal dating back 30 years from the time of his writing and had been the object of a number of research programmes, including the DARPA Communicator Project, Japan's Fifth Generation programme, and the European Union's ESPRIT and Language Engineering programmes. The impression and perhaps the expectation of effortless conversation with a computer can be blamed on the usual suspects in science fiction (inevitably, Star Trek comes to mind) but practicality of spoken language interaction with computers has only become a practical possibility due to advances in speech technology, language processing, and dialogue modelling, as well as the emergence of more powerful computers to support these technologies.

Potential applications for these natural language user interfaces may have been many and imaginative, but they have come to the fore with digital assistants.

3.3.1 Digital Assistants

Digital assistants (alternatively termed conversational agents, virtual personal assistants or intelligent assistants) have been around for decades. Clippy, the much-mocked Microsoft Word assistant in the form of a paper clip, appeared as far back as 1997. More recently, however, a number of talking technologies have become well-established and accepted. Of the major voice-based offerings, Siri was launched by Apple in 2011; followed by Microsoft's Cortana (2014), Amazon's Alexa (2014), Google's Now (2012) and Assistant (2017) and most recently, Facebook's M (2017). They often appear as applications, or as an integral part of their parent operating systems, or as a "smart speaker", such as Alexa. Their functionality includes interaction with applications, such as setting reminders and email, information searching, ordering pizza and communication with other connected devices. They are now also being integrated with in-car information systems. Unlike the social robots discussed above, however, all they have to rely upon for communication with their users, aside from minimal interface graphic devices, is their "voice" and any "personality" created by their designers. This necessarily, of course includes gender.

Most digital assistants have a female voice, although Siri has an option for a male alternative. Empirical support for this design choice may be found, inter alia, in Mitchell et al. (2011), who established that both men and women preferred a female voice, while the British Daily Mail (Daily Mail 2017) quotes an Amazon spokesman thus "*We asked a lot of customers and tested Alexa's voice with large internal beta groups before we launched, and this is the voice they chose … we believe Alexa exudes characteristics you'd see in a strong female colleague, family member or friend*". Alexa has also been given a new vocabulary of words including cowabunga, "bada bing", and whoops-a-daisy for English listeners of a certain age. The thinking for this was said to be that Alexa was seen as too robotic, and these "speechcons" would make her easily to engage with emotionally (The Times 2017b).

As for the other digital assistants, Siri's designers employed script editors to produce convincingly character-driven dialogue (Simonite 2013). Siri has been asked out on dates and has been asked to offer advice on where to hide a body. Love and Abutaleb (2015) in a Reuter's news item, report designers as having endowed Siri and Cortana with smart and detailed personas to engage their users. Siri, for example, has a thirst for knowledge, while Cortana prefers a very, very dry martini. On the other hand, Facebook's M and Google Now have been intentionally designed to be neutral but efficient functionaries, in the hope of avoiding irritated responses and unrealistic expectations.

Despite the rich potential of the field for exploring the experience of, and relationship with, this popular form of relational artefact, significant studies tend to be relatively rare, particularly in real-world contexts. Among the few instances which have been reported, Luger and Sellen (2016) conducted an interview-based study with 14 regular users of, variously, Siri (most users), Google Now, (rather fewer users), and Cortana (one sole user). Findings highlighted that most participants were initially drawn in by the playful aspects of interaction. (Siri can tell jokes, for example.) However, initial user expectations outstripped the assistants' abilities, particularly around the context of conversations, and users subsequently reduced demands on the assistant in terms of both complexity of speech and nature of the task. Luger and Sellen attribute this to a gulf of execution and evaluation, in Norman's (2013) terms. In one user's description, the experience was "*like having a really bad PA (personal assistant)*". An inverse relationship between task complexity/context dependence and satisfaction was also noted by Kiseleva et al. (2016). However, more recently, Cortana is ranked as the most popular virtual assistant for businesses, followed by Siri and Google Assistant. Alexa bringing up the rear (Spiceworks 2023).

3.4 Mind Your Language

Anthropomorphism, as voiced in the "*really bad PA*" comment and, for example, by describing Siri as "*sarcastic*" was most common in users who did not have a technological background, who were also more likely to ascribe gender to their assistant. Variation in anthropomorphism is also noted by Purington et al. (2017) in their analysis of user reviews of Alexa/Echo where users adopting a personified and social style of interaction, where Alexa was addressed by name and referred to by personal pronouns, were also more likely to be satisfied with the product.

Adult users may condense their communications to Siri to the point of curtness, but the London Times (The Times 2017c) warns that "psychologists" predict that "*children who are raised barking orders at submissive voice-activated gadgets could grow up 'rude and entitled'*".

While digital assistants may emulate the portfolio of accomplishments of a good personal assistant or the omniscience of a Jeeves, chatbots have been single purpose entities. Using natural language speech or text interaction, backed up by AI, they are becoming common interfaces to an increasing range of individual applications, data and services, from ordering a pizza to accessing CBT therapy, some aspects of the latter bearing a striking, if superficial, resemblance to interaction with Weizenbaum's ELIZA[1] Very large numbers of chatbots are now hosted on Facebook through the medium of its Messenger application. Most communicate through text, speech, or simple graphics, but many others—often termed embodied conversational agent—have sophisticated, animated visual embodiments, and some are able to identify, and respond to, user emotions as displayed by facial expression. It is debatable

[1] ELIZA was a natural language processing computer program created in the mid-1960 by Joseph Weizenbaum at MIT. It was designed to act as a "therapist" and proved so (superficially) successful that some people using it asked to do so in private as they were sharing personal data with it. It should also be noted that Eliza system relied on a teletype which was at the time (1966) was really very novel and "futuristic": personal computers (PCs) were not to appear for more than a decade.

how far many of these applications are genuinely relational or social, except in the minimal sense that they interact with users. Moreover, to date, empirical work on the experience of chatbots is fragmented and frequently confined to a particular instance of these relational artefacts. We now turn to a consideration of what underlies the strength of the tendency to treat relational artefacts as other social beings.

ChatGPT is in the press as I write (version 4 was released yesterday 14th March 2023). It was developed by an American AI research company, OpenAI, and has most recently been integrated with Microsoft's Bing search engine. Google is said to have done something similar in reply with their product *Bard.* ChatGPT is a chatbot which can provide answers to written (typed) questions with surprisingly appropriate dialogue. Users of this system report themselves so impressive about the level of (apparent) intelligence and the fact its responses sound uncannily human. I asked ChatGPT when we could expect the robots to arise up and kill the humans, and I was assured that this would not happen. I don't believe it but it did seem very sincere.

3.5 Appropriation

We describe appropriation as a process by which we make technology better suited to how we want to use it (that is, to give us a better user experience). Silverstone and Haddon (1996), and very many later studies drawing on their work, use the term "domestication" to describe appropriation as the way in which technologies are integrated into everyday life and adapted to match the demands of daily practices. They based these ideas on the parallel they draw with the domestication of wild animals for their use as sources of food, for clothing, for work, and for protection.

This also lets us use technology to say something about who we are or want to be seen as. Dourish (2003) stresses the practical and situated aspects of appropriation writing that, "*Appropriation is the way in which technologies are adopted, adapted and incorporated into working practice. This might involve customization in the traditional sense (that is, the explicit reconfiguration of the technology in order to suit local needs*) …" (Dourish ibid, p. 467).

Personalisation another forms of appropriation and is the process by which an artefact is endowed with greater significance by and for its user. Wells (2000) defines it as "*the deliberate decoration or modification of the environment*" and associates it with "*well-being*". Blom and Monk (2003) have shown that personalising the appearance of artefacts has cognitive, social, and emotional dimensions. Their account of personalisation was based on the analysis of three qualitative studies of the use of web-based personalisation in the UK, and a Finnish mobile phone users and of the personalisation of home PCs, again in the UK. They describe the cognitive aspects of personalisation as improving of ease of use, better recognition of the system and improved aesthetics (though this might have reasonably been treated as a category in its own right as the research was concerned with personalising the appearance of artefacts).

The social dimensions of personalisation are concerned with reflecting personal and group identity. Finally, the largest category of the three are the emotional effects on the user. These affective consequences include feelings of familiarity, ownership, control, fun, attachment, release from boredom, and other positive attachments. Later work by Oulasvirta and Blom (2007) suggests that personalisation enhances the experience of use and adds enjoyment in three ways, by supporting senses of autonomy, competence, and relatedness.

Authors in the field of sustainable interaction design have introduced the related concept of the ensoulment of objects, a property closely related to appropriation. Here, ensoulment signifies the properties of “well-loved” designs that embody meaning and reflect their owner’s identities and values (Blevis 2007; Nelson and Stolterman 2003). Jung et al. (2011) further develop the concept in their narrative-based study, identifying three contributory factors to ensoulment: intimacy accumulated over time; investment of effort; and reflection of personal values.

These three distinct faculties enable us to understand and predict the behaviour of others and, by extension, the workings of digital products.

Appropriation is also readily observable in our everyday use of digital products in that we make them our own. I have a pocket knife which looks more or less the way it did when I bought it. It shows the signs of use but little else. The digital products I own, in contrast, are far from being “factory fresh” as I have appropriated them. We appropriate digital products by making them a part of our lives, by personalising them, and by customising them. This can be trivial, for example, by selecting our own “wallpaper”, but in other cases, this can be fundamental and transformative. This appropriation can actually give rise to new and unexpected products in their own right.

3.6 Our Tendency to Make Everything Human-*Like*

The design of most social robots and other forms of relational artefacts draws—with varying degrees of sophistication—on many aspects of human psychology, including, but not limited to, theories of personality, emotion, proxemics, perception, language processing, learning, attention, social behaviour, and theory of mind. But our primary focus in this book is the psychology of the experience of digital products, and it is this we consider here in the context of relational artefacts.

As we have already argued, the success of relational artefacts is founded on our compelling tendency to treat other “beings” as human, in other words, to anthropomorphise.[2] This is of interest because its pervasiveness is intriguing and its relevance of the design of digital products is immediate (especially as we have seen with relational technology). Anthropomorphism is our tendency to ascribe human-like characteristics, such as intentions, motivations, emotions and appearance, to non-human agents, artefacts, systems and digital products. We freely, frequently and

[2] Or in the case of social robots in animal form, to *zoomorphise*.

ineluctably anthropomorphise. We quote from Epley et al.'s (2007) introduction to their account of anthropomorphism which tells us that there are 1,750,000 species, 10,000 distinct religions (each with its own supernatural beings) and an expanding number of technological artefacts on the planet at present. Yet despite this diversity, "*animals are imbued with humanlike intentions, motivations and goals. Spiritual deities are embodied with fingers and facial hair, complete with personality strengths and occasionally personality weaknesses. And even the most technologically savvy have wondered, at least for a moment, whether their computer is plotting against them*" (p. 864). Anthropomorphism has a powerful effect even with digital products with no explicit relational intent, as the following two examples from very different contexts illustrate.

Sung et al. (2007) have reported on trials with Roomba, (a robot vacuum cleaner of a simple circular shape) which revealed that "*Not only have his owners dressed him [the vacuum cleaner] up, they have also given him a name and gender*". More recently, Mourey et al. (2017) conducted work with Roomba which suggested that interacting with this type of "*anthropomorphic consumer product*" could mitigate some of the effects of social exclusion. Far from the domestic setting, Sandry (2015) discusses evidence of anthropomorphic relationships with Explosive Ordnance Disposal (EOD) robots which were operated under human direct control but valued and respected by army personnel as individuals, sometimes assigned names and referred to by gendered personal pronouns.

3.6.1 Mind and Personality

As we have already seen earlier in this chapter, we have the irresistible tendency to ascribe mind and agency to a variety of products which cannot possibly have them. Much of the literature investigating this can be found in the domain of product design, where studies have found evidence for the ascription of a wide variety of "personality traits" to everything from vacuum cleaners to coffee makers, cars, and toasters (e.g., Jordan 2002; Govers and Mugge 2004; Mugge et al. 2007).

Govers et al. (ibid), further developed by Mugge et al. (2009), provide a set of traits which can be attributed reliably to products, in this case, to motor cars and vacuum cleaners. This is an interesting list, namely aloof, boring, cheerful, childish, cute, dominant, easy-going, honest, idiosyncratic, interesting, lively, modest, obtrusive, open, pretty, provocative, relaxed, serious, silly, and untidy. So, this work tells us that people can reliably attribute the trait of aloofness to a vacuum cleaner.

3.7 Why Do We Anthropomorphise?

As we saw in an earlier chapter, Reeves and Nass (1996) have told us that our “old brains” have not yet caught up with the developments of the last 50 years or so. So, like it or not, we have the overwhelming propensity to treat digital products as people. A number of approaches have been adopted to explore the rationale for anthropomorphism. We begin with design perspectives.

Here DiSalvo and Gemperle (2005) have identified a number of different reasons why we anthropomorphise, these are familiarity, comfort, “best-bet”, species-specific group-level coordination system, object-subject interchangeability, phenomenological intersubjectivity, and command and control. Of these, the first two probably have the most support. The familiarity thesis is attributed to Guthrie (1993) who writes that when people anthropomorphise, they are making something familiar which is (or was) unfamiliar. Unfamiliar things require cognitive effort to explain them, but by relating them to something which is well known, this burden is diminished—and what could be more familiar than ourselves? Mapping ourselves (in some manner) onto something external, enables us to draw all manner of inferences which would not otherwise be available. The comfort thesis is Guthrie again but rather than suggesting that we anthropomorphise to make things simpler, he proposes that it provides comfort. He argues that we find comfort in dealing with things and situations which resemble us. He writes that anthropomorphism is, “an attempt to feel like we can define and influence the world if it is more like us than not”. The remaining proposals are a little sketchier and more speculative in comparison. Van Rompay and Ludden (2015) suggest an analogous motivation to that of comfort-seeking: they propose that discovering human characteristics in non-animate objects can be a source of pleasure or just simple fun.

Returning to technological artefacts, Kim and Sundar (2012) make the point that the anthropomorphisation of computers is rarely mindful, in the sense that people consciously believe that the computer is human or merits the attribution of human characteristics, but rather automatic and mindless (as suggested by Reeves and Nass), cued by exposure to a communication cycle which mimics that of human–human interaction and enhanced by social cues such as gendered voices and humanoid images.

3.7.1 Three Factors in Anthropomorphism

In contrast to these design accounts, Epley and his colleagues have proposed their own psychological theory (SEEK—Socialty, Effectance, and Elicted agent Knowledge) as to why people anthropomorphise. They start by recognising that anthropomorphism is a form of inductive reasoning and that the basic processes underpinning it should be no different from other forms of inductive inference. Having established this, they turn their attention to the likelihood that people will anthropomorphise, concluding that it is a consequence of the following three factors (these points have been adapted from *Zlotowski* et al. 2015):

1. Elicited agent knowledge—as people have more accessible knowledge about people than technology, they are more likely to use anthropomorphism as an explanation until (and if) they create an alternative mental model;
2. Effectance motivation—when people are pressed to explain behaviour the tendency to anthropomorphise increases';
3. Sociality motivation—people who lack social connection with others often compensate for this by treating non-human agents as though they were human.

Epley writes that this is not a theory of anthropomorphism as such but a theory of the particular form of inductive reasoning involved when we engage in it. Empirical work, much of it reported by Epley, Waytz, and their colleagues, suggests that the tendency to anthropomorphise is situationally dependent and unsurprisingly is subject to individual differences (e.g., Waytz Cacioppo and Epley 2010; Letheren et al. 2016). Not only that, but Waytz et al. suggest that such differences can determine, among other things, the degree of trustworthiness and moral accountability attributed to an agent. The Letheren study related literature in psychology, marketing and consumer psychology, and thereby derived items for a large-scale survey. The results indicated that those who are more prone to anthropomorphise are likely to be "*younger, single and have a personal connection to animals, as well as higher levels of openness to experience, neuroticism, conscientiousness and experiential thinking*". A predicted relationship with religiosity was not found, but the authors suggest this may be an artefact of survey design and deserve further investigation.

Alongside these psychological accounts, there have been neurological and biopsychological attempts to establish how the brain is responsible for anthropomorphism. A few selected examples give a flavour of different aspects of this work.

Focusing on the mirror neuron system (MNS—as introduced in Sect. 1.11), Gazzola et al. (2007) found very little difference in the activity of the MNS on seeing human and robotic actions; while Hoenen et al. (2016), comparing observation of a robot being verbally harassed with a non-harassed robot, identified greater MNS activity in the harassment condition. They interpret this as evidence that seeing a human interact with a robot strengthens perception of the robot as a social agent.

Waytz et al. (2010) established that increasing the unpredictability of a non-human agent or increasing the incentive for mastering it (i.e., effectance motivation) triggered increased activity in one of the areas of the brain—the ventromedial prefrontal cortex-associated with analysing the mental states of other humans. Their approach was complemented by researchers who take individual differences as their focus, among them Cullen et al. (2013). Their results indicated that participants who showed a greater tendency to anthropomorphise non-human animals and other non-human stimuli, as evidenced by a self-report instrument, were found to have a greater volume of grey matter in the left temporoparietal junction.

Finally, many accounts of anthropomorphism include some consideration of religious belief (e.g., Epley and colleagues 2008; Barrett 2000). The reasons for this are clear and obvious, particularly to unbelievers, as most religions have an anthropomorphic central deity, doing whatever gods do.

3.7.2 Detecting Invisible Agents: HADD

Guthrie (1980, 1993), drawing on evidence from psychology and anthropology, suggested that the evolution of a cognitive bias towards the detection of human-like agency in the environment, where this might not actually exist. This tendency would be particularly strong when information was sparse or ambiguous. Such a mechanism, Guthrie argued, would have clear survival value, since the consequences of overlooking an agent would be much more detrimental than the false identification of a non-existent actor. On this basis, Barrett posited an evolved cognitive mechanism which he called a "*hyperactive agent-detection device*" or HADD (Barrett 2000) which he later reformulated as the "*hypersensitive agency detection devic*e" (Barrett 2000, 2004) to provide a cognitive basis for religion. Agents, even of a counterintuitive nature, posited through as a result of the action of the HADD would be readily culturally transmitted.

The possible action of a HADD has clear resonance for any consideration of the attribution of human-like agency to relational artefacts. And in passing, we note that the conditions of ambiguity that Guthrie suggest give rise to the over-detection of agency are very similar to those simulated in the Waytz et al. (2010) study cited above.

3.8 A Fleet of Robots

The humanoid robots Kismet and Cog, designed at the MIT Artificial Intelligence Lab., are particularly important relational artefacts as they were explicitly designed to relate to people in human-like ways, to "*detect stimuli that humans find relevant … respond to stimuli in a human-like manner … [and] have a roughly anthropomorphic appearance*". MIT's Cog project began at the turn of the twentieth century, concluding in 2003 (Brooks et al. 1999; Breazeal and Scassellati 2002). MIT labs' introduction to the project describes Cog as "a set of sensors and actuators which tries to approximate the sensory and motor dynamics of a human body" (MIT n.d.). It aimed to bring together many facets of the current work in AI, the underlying premise being that Cog should "learn" and develop through interactions with humans and other beings in the world. In form, Cog had an upper body torso, including arms, and was equipped with visual, tactile, and kinaesthetic senses. Among other capabilities, Cog could visually detect people and objects, imitate movement, and point to visual targets. Kismet which was designed by Breazeal (2002), to have a cartoon-like appearance with large hairy eyebrows, big round eyes, and a broad metallic mouth. It also had Shrek-like ears (a popular animated Ogre). Its highly mobile face was used to communicate its nine facial emotions. Kismet not only displayed “emotional” states (e.g., anger, fear, sadness, etc.) but also different levels of arousal (e.g., excitement or fatigue). The robot was also verbal, emitting its own utterances as well as repeating words such as its name.

Turkle (2006) and her colleagues have described a group of 60 children, aged between 8 and 13, meeting Kismet and Cog in 2001. The project aimed, among other objectives, to explore how the children integrated the robots into their concepts of personhood, friendship, and intentionality. The children encountered Kismet and Cog in individual and group sessions. While Kismet engaged participants by verbalisation and facial expression, Cog responded by looking in a child’s direction and imitating arm movements. A debriefing followed where Cog was dismantled and its mechanisms explained. Despite many instances of communication breakdowns, the children persevered in attempting to communicate and excuse the robots’ failures to respond suitably. Secondly, most children anthropomorphised Cog and Kismet, considering them to be “*sort of alive*”. And finally, most resisted the demystification presented in the debriefing, preferring to maintain that they had a genuine relationship with the robots. Turkle et al. conclude that their findings raise fundamental questions about nature of authentic relationships.

The tendency to treat robots as fellow beings is not confined to children. Breazeal (2003), for example, reports a series of studies evaluating the effects of the “emotions” designed to be expressed by Kismet in its appearance and behaviours, mainly through variations in the ears, eyes, and posture. Typical of the results is the finding that after scolding Kismet “the robot’s saddened face and body posture were enough to arouse a strong sense of empathy”. The subject would often immediately stop and look to the experimenter with an anguished expression on her face, claiming to feel “terrible” or “guilty”. Emotional responses on the part of the user were explicitly invoked by Kismet’s designers in order to “*tune the human’s behaviour so that both perform well during the interaction*”.

The University of Hertfordshire’s series of Kaspar robots, share a similar aim of supporting research into human–robot interaction, and more specifically, companion robots (Dautenhahn et al. 2009). Kaspar was designed to be low cost, while being minimally, but effectively, expressive and to enable research into relationships beyond the caretaker-infant dynamic that underlies interaction with Cog or Kismet. Its expressions are intended to suggest happiness, surprise and so forth, allowing an interaction partner to interpret the facial cues presented. As will be seen again in the discussion of the robot dog AIBO, below, children had a particularly positive reaction to Kaspar and were readily engaged, while adults were more reserved and less playful. Kaspar’s “descendants” continue to support research into, for example therapy for social skills in children with autism (Mengoni et al. 2017).

3.8.1 Social Robotics for Fun

Sony's AIBO (*Artificial Intelligence roBOt*) is, or rather was, a robot dog which responds to noises, makes musical sounds to communicate and expresses different needs and emotions. As well as generating a convenient English acronym, aibo means "pal", "companion", or "partner" in Japanese. AIBO has a variety of sensors that respond to touch and orientation and also develops different "personalities" depending on how it is treated by its user. Later AIBO models were equipped with facial and voice recognition software which enable the AIBO to recognise its "primary caregiver". AIBO launched as an "entertainment robot" in 1999 and was among the first robotic products to be marketed to the general public. Figure 3.1 is an illustration of AIBO.

There are a number of interesting studies of how people perceive and interact with AIBO; Weiss et al. (2009) offer us a good example. These researchers set up a small enclosure in a shopping centre in Salzburg and invited adults and children to meet AIBO. Of those who played with AIBO, 147 people were randomly selected to answer questions related to their experiences with the robot. The researchers categorised interactions with AIBO according to Norman's (2004) three-level model of emotion (visceral, behavioural, and reflective). Children were reported as displaying an initial visceral enthusiasm for AIBO, manifest through remarks such as "Oh, what a nice dog", and "May I play with it", as well as by running towards AIBO. These positive visceral reactions persisted even in the face of difficulties: extraneous noise

Fig. 3.1 Aibo. Image by Brett Jordan on Unsplash

and children's parallel commands meant that AIBO did not always react at once. Indeed, children stayed longer and played more intensely when AIBO did not fulfil their expectations. At the behavioural level, children enthusiastically engaged with the dog, on average interacting with it for 20 min, only stopping when their parents told them to. Interestingly, children played longer and more intensely with the dog when AIBO did not behave as expected. Questionnaires elicited emotional experience at the reflective level. Here the results indicate that children readily ascribed cognition to AIBO: around 75% believed that AIBO could see them, while nearly 80% thought that it was able to understand them. Almost all believed that AIBO had emotional states: being capable of sadness (87%) or happiness (99%). There was great enthusiasm for AIBO as a companion: 92% of children would have it as a playfellow, and 90% would feel better when home alone if AIBO were there. The researchers suggest this indicates the attribution of emotional attachment.

As for adults, there was little observable evidence of a visceral response. Adults enquired about AIBO's functionality and largely watched it in action from a distance. At the behavioural level, those who did interact with the dog voiced positive emotions, although these largely concerned the perceived impressiveness of the technology. Reflecting on AIBO, the small number of adults interviewed were unenthused about its potential as a child's playmate. Other roles suggested were as a pet for children allergic to real animals or a companion for those in hospital. The authors speculate that adults may need longer to establish an emotional attachment to AIBO than children.

3.8.2 AIBO and Other Robot Dogs

Robotic dog companion animals continue to be the subject of investigation. A comprehensive review of research into interaction with robot dogs in general, and AIBO in particular, may be found in Krueger et al. (2021). The authors analyse some 15 studies of the user experience of AIBO spanning the first two decades of this century, concluding that users characterised the robot as analogous to a real dog, treating it as a friend, as part of the family, and endowing it with animal traits and a degree of intentionality. However, turning to the role of aesthetic qualities of robot animals, it is interesting to note the findings of Schellin et al. (2020) that AIBO was viewed less positively when introduced as a puppy rather than a robot, but presenting it in a fur suit was perceived as less scary. Similarly, Ihamäki and Heljakka (2021) found that the tactile, furry coat of the robotic golden retriever pup they introduced to elderly participants contributed to positive social and emotional experiences.

My Real Baby was broadly contemporary with AIBO, being launched as a commercial product by Hasbro in 2000. What is interesting about the Real Baby is that its child "parent" had to decipher Baby's inner states and moods, manifest through behaviours and facial expressions and act accordingly. Otherwise, it would become, for example, overtired and fretful. Baby could also "learn" language up to the production of 4–5 word sentences. Such capabilities drew on Brooks' earlier research at MIT and iRobot into a robotic doll (Bit) (Brooks 2002; Plowman 2004). Despite this pedigree, Plowman notes that My Real Baby proved unpopular as a product because of its relatively high selling price, frequent need for battery replacement and general unreliability and was eventually withdrawn from the market. Academic research exploring reactions to My Real Baby is scant, but Eberle (2009), as well as suggesting that Baby's lack of commercial success may be an instance of the Uncanny Valley phenomenon at work, quotes an anecdote of a development team member "unthinkingly rushing" from his office to fetch a bottle to sooth Baby's cries. The realism of the production version was reported to have been scaled back to allow child customers to better "exercise their imaginations". This is paralleled in a web review of My Real Baby cited by Plowman, where that the disappointed customer asserts that they will return to "dolls that do nothing" with which a child can "make believe that she is doing all the mommy things". Sheridan (2016) notes that a number of "connected toys" have also appeared complete with computer-based speech, speech recognition, and decision-making software. Mattel's new Barbie doll comes with an extensive speech and language recognition vocabulary that is linked via the Internet to the company server (Vlahos 2015).

3.9 PARO and Keepon

The robot seal PARO is described by its creators as a "mental commitment robot", intended to interact with human beings, stimulate emotional attachment and, overall, to bring solace in therapeutic contexts, originally those catering for the elderly. The form of a baby seal was adopted rather than more common domestic animals such as dogs and cats to avoid comparisons with the capabilities of a real pet while still being a recognisable and appealing animal. PARO is furry, battery operated and has senses of sight, hearting (including speech recognition), balance and touch, can move its neck, flippers, and eyelids and emits the cries of a baby seal. It is both proactive and in response to touch and speech and recognises its name. Stroking PARO in response to a movement, for example raising its head, will trigger it to "learn" to repeat that movement. Such responsiveness "allows its users to gradually build a relationship with it" and encourages them to "show their affection for PARO" (Shibata and Wada 2011).

A substantial number of trials have now been reported of the impact of interacting with PARO in educational and social care settings, both institutional and domestic, and including care facilities for people with cognitive deficits and dementia. Shibata and Wada (2011) in their review suggest that mood, social interactivity and behaviour in elderly people improved after interactions with PARO. Marti et al. (2005) conducted a study into the therapeutic benefits of PARO for young adults with severe cognitive impairment. Their initial results showed a clear role for the robot in mediating social exchange and stimulating attachment and engagement; the authors observe that participants engaged in such behaviours as feeding PARO or protecting it from cold, suggesting that it was regarded as an agent rather than an object. These effects were much less present in a comparison session when PARO was not turned on and thus not interactive. Consistent outcome improvements are not reported by all studies: Wagemaker et al. (2017), for example, do not find clear improvements in adults with severe intellectual disabilities after a treatment phase with PARO, but do suggest that for one person during interaction sessions an emotional connection with the robot and mood improvements were observable. Other reports indicate that participants can both attribute feelings to PARO and recognise that it is an artificial object, and that not everyone is willing to engage with the robot. However, PARO continues to be reported as having provided significant alleviation to chronic pain and dementia in elderly patients (Pu et al. 2020).

We should note here that although PARO is perhaps the best-known and most commercialised example, there are many other social robots that play a role in therapeutic contexts, including cats, dogs (such as AIBO), dinosaurs, and a spectrum of other forms from those which are clearly machines to those of a strongly humanoid appearance. Keepon (Kozima et al. 2009) affords a typical exemplar of a social robot which lies in the liminal area between machine, animal, and humanoid forms. It has a simple form of two spheroids on top of one another, the upper spheroid having a minimal face of two eyes and a mouth. Keepon was originally designed to support research into social development in children, using minimal non-verbal interaction, where it has proved valuable in exploring, among other aspects of social interaction, the importance of rhythm in coordinating social communication (Michalowski et al. 2007) and the development of theory of mind as a child matures. A simplified version of the research robot is now marketed as a toy.

3.9.1 ASIMO, Nao and Pepper

In 2000, Honda launched ASIMO as its most sophisticated autonomous humanoid walking robot. In its latest version, the robot has sophisticated bipedal locomotion capabilities, including running and stair climbing, coupled with the ability to reach for and grasp objects and to avoid moving as well as stationary obstacles. Its more social graces include the understanding of, and response to, voice commands, and face recognition. All-in-all, ASIMO is intended, eventually, to have sufficient range of movement and capability to help with everyday tasks, such as care for the elderly, household tasks and assisting at stations or airports, although there are no reports of real-world use so far and Honda suggest that this is still some years away. It is therefore unsurprising that studies of the experience of encountering ASIMO are lacking, but Rosenthal-von der Pütten and Krämer (2014) have included ASIMO as one of the 40 robot examples, presented as standardised images, in a large online survey of perceptions of these digital products. The results placed ASIMO in a cluster of robots perceived to be likeable, humanoid on-threatening, not particularly human-like, and somewhat submissive–alongside Nao, which we will consider next.

Nao's first version was released by Aldebaran (now Softbank) Robotics in 2005 and the technology continues to evolve as an "interactive companion robot" (SoftBank Robotics n.d.(a)). A number of variants of the 58 cm tall, humanoid, robot exist, most being walking bipedal models. Speech and language processing, kinetic and haptic sensors, object recognition, and Internet connection are all present. Somewhat disquietingly. It has apparently been demonstrated that Nao can show a degree of self-consciousness (Bringsjord et al. 2015). Nao has been used in a number of real-world customer service, therapeutic, and educational contexts as well as a vehicle for academic robotics research.

Because Nao's functionality and characteristics are programmable, it has been used in many hundreds of empirical studies exploring the design space for social, humanoid robots. Among the more strongly psychologically informed themes in this very large body of work has been the investigation of the relationship between perceived robot personality, the attribution of traits to the robot, user personality, and user preferences. There is reported evidence of both preference for robots with a similar personality to the user's own (similarity attraction theory) and robots with differing personalities (complementary attraction theory). Much of this work has centred on the extraversion-introversion personality dimension. Among the more robust examples of such studies, Aly and Tapus (2012) report results of robots providing restaurant advice that support similarity attraction theory, while Weiss et al. (2012) suggest that the nature of the task in hand (in their study, teaching, patient care, and discussing a balance sheet) and cultural influences may be significant in determining preferences, Joosse et al. (2013) who studied perceptions of robots engaged in cleaning and tour guide tasks also argue for the effects of perceived appropriateness of particular personality types for particular tasks and roles.

Nao's more fully productised counterpart, Pepper, has thus far attracted relatively few published research studies. Pepper—humanoid, but not bipedal, 1.2 m tall and equipped with an interactive screen—can detect, display and respond to emotion, speak, and move autonomously, as well as having what is now the established range of humanoid robot functionality. Furthermore, its manufacturers state that "*Pleasant and likeable, Pepper is much more than a robot, he is a genuine humanoid companion … You can also personalise your robot based on your mood or the occasion … Pepper gradually memorises your personality traits, your preferences, and adapts himself to your tastes and habits*" (SoftBank Robotics, n.d.(b)). These functionalities have supported Pepper's practical use in work contexts where social interaction is important: typically, receptionist, or sales promotion roles, where the robot has been deployed by a number of Japanese organisations, but also in nursing or caring settings. Figure 3.2 is an image of pepper.

It is also evident that Pepper is marketed as a companion, where the promotional material and press coverage (e.g., The Telegraph 2015) seem to position Pepper in a niche somewhere between that of a child, a pet, and a personal assistant. Among the few examples of Pepper to date, a field study in a shopping mall conducted by Aaltonen et al. (2017) found results reminiscent of the Weiss et al. (2009) AIBO report: children were keen to engage with Pepper while adults were more interested in its functionality, while Dereshev and Kirk (2017) report that potential users exposed

Fig. 3.2 Pepper out and about. Image by Lukas from Unsplash

to advertising material for Pepper found its quasi-human form more disconcerting than robots of animal or machine-like morphology.

While Pepper and its counterparts continue to play a part in lab and real-world studies, more recent additions to the robot population have achieved an increasingly human-like appearance, for example the creations from Hanson Robotics (2023) which aim to mimic human skin and musculature. Evidence suggests that human-like appearance and social skills can increase levels of trust and acceptability in those who interact with them (Song and Kim 2020; van Pinxteren et al. 2019).

Studies of user experience with robots in education, health, and social care settings predominate. There are, however, also numerous instances of Pepper and similarly social robots in retail environments. Some more recent studies among many include:

Song and Kim (2022), who review factors in the acceptance of a range of service robots, noting *inter alia* the presence of Pepper in mobile phone stores, Nescafé coffee shops, Pizza Hut, HSBC bank, and shopping malls. Using Nass and Moon's CASA as theoretical underpinning, they identify robots' usefulness, social capability, and appearance as major contributors to interaction experience, but observe also that pre-existing anxiety about robots in consumers can moderate the positive character of such relationships.

Carros et al. (2022) carried out a 3-month study of the regular deployment of social robots in a care home to stimulate and support interactions between care-workers and residents. Here the most popular uses involved applications for music, dance, and "other playful activities". The authors stress the need for both residents and care-workers to get to know the robot and to match its use to what care work actually comprises. The care-workers seem to have regarded Pepper as a tool, while reactions of residents not reported.

3.9.2 Androids

Alongside the development of autonomous humanoid robots with practical skills, the first decade of this century saw the development of android robots: machines designed to mimic the appearance and behaviour of human beings as closely as possible. The demands of this apparent near-humanity, however, mean that thus far almost all android robots to date are tele-operated. Best-known among a growing population of Androids are Ishiguru's Geminoid H-1 and its successors (Ishiguru n.d.; Nishio 2007). A European model, DK-1, modelled on a Danish professor, also exists. These androids are modelled to resemble their human progenitor in minute detail, but movement, speech, and other interactions are controlled by an operator. While they are primarily intended as tools to support research into fundamentals of human–robot interaction, the Geminoids have served to "attend" meetings and give lectures remotely. In Ishiguru's view, after some degree of initial caution, people interact with the Geminoids in much the same way as with a human partner (Guizzo 2010). More advanced androids are now emerging with at least some degree of autonomy: Ishiguru's Erica, equipped with on a composite "beautiful and neutral" female face, has some autonomous conversational abilities, while Nadine and Sophie, developed at Nanyang University, have speech recognition and production, emotional expression and some bodily movement (Magnenat-Thalmann and Zhang 2014).

Academic research exploring the experience of encounters with android robots has very largely focused on aspects of the "*uncanny valley*" phenomenon, discussed later in this chapter. However, it is interesting to note that the photo-based study by Rosenthal-von der Pütten and Krämer (2014), cited earlier, found Geminoid H-1 to be judged the most threatening of the 40 robots presented, while the wider range of androids presented was generally thought to be both threatening and likeable. The authors speculate that these highly humanoid androids are judged by similar criteria to human facial appearance, and that Geminoid H-1's stern expression may have influenced the ratings.

3.9.3 Dogs and Robots

Perhaps there is just something about robots, perhaps we are mesmerised by them. Yet, from quite a different but interesting perspective, researchers have compared our understanding of dog emotional expressions with those of a PeopleBot robot (Bethel and Murphy 2008). A set of canine expressive behaviours that had been used in previous studies of dog–human interactions namely, (joy, fear, anger, sadness, and neutral) and the actions of the robot. In their answers to open-ended questions, participants spontaneously attributed emotional states to both the robot and the dog. They could also successfully match all dog and all robot expressions with the correct emotional state. While the researchers in this study were interested in the design insights they could gather from it, we might conclude that we have a tendency to rely on our social cognition.

From the accounts just discussed, we can see that in many cases our perceptions of, and behaviours towards, social robots closely resemble our interactions with other human beings. Robots are treated as social agents and thus fit within the Computers as Social Actors (**CASA**) framework which we saw earlier. We discuss the underlying reasons for such anthropomorphism later in this chapter. Children seem to engage readily with these forms of relational artefact, while adults may be more reticent. Some of the extremely humanoid robotic forms have been found to be a source of disquiet. Again, this topic is explored further below.

To these observations, we can add some further empirical findings which concern general issues in our experience of social robots. As with so many aspects of human psychology, it is unsurprising that perceptions of robots are permeated by individual and cultural differences (e.g., Fischer 2011; Weiss et al. 2012). The degree of human-ness judged to be necessary or appropriate also varies by the context of use and role of the robot (Lee et al. 2016; Broadbent et al. 2012). Broadbent and colleagues supply the example that a lifting robot is not required to look human, but a robotic surgeon should do so. We have also seen how individual, cultural, role, and task characteristics influence whether a robot's perceived personality should be complementary or similar to that of its human user.

This being said, it remains the case that the application of psychology has been predominantly in the service of the better design of social robots and/or in analysing user reactions and with a few exceptions, among them Broadbent (2017), there has been little systematic or deep consideration of the psychology of the user experience.

It remains the case that, as Dautenhahn et al. observed in 2009, the development of "believable, socially interactive robots, in particular robots that can positively contribute to society as companions and assistants, remains a challenging (research) issue". We would add that not only is such development challenging, but so is the understanding of the human experience of relational artefacts more generally.

3.9.4 Creating Relational Artefacts

To recap: a social robot is an autonomous robot that interacts and communicates with humans or other autonomous physical agents by following social behaviours and rules attached to its role.

We have seen how these digital products have been designed to live with us as companions (e.g., Wada and Shibata 2009), or to augment health care or to help educate children (e.g., Hsiao et al. 2015; Agrigoroaie et al. 2016) or to be useful in the home (Sung et al. 2007). So, for the designer, social robotics is about designing these products to be sociable, helpful, useful, responsive to affect and eye gaze and perhaps even able to generate something which simulates "affect" themselves (cf. like the fictional HAL 9000). This chapter has introduced just a few of the very many relational artefacts of a multitude of different forms which have found a place in our everyday life, confined to screens or speakers or in physical incarnations from simple mechanoid bipeds, through cartoon-like characters, dogs and seals, to those which are very near human form.

Let us consider for a moment the issues we might encounter in constructing such a relational artefact. On the face of it, this should be fairly straightforward: it just has to be like us and we know ourselves and others pretty well. And, even if we have problems articulating particular aspects of our make-up—at least we will recognise it when we see it, or talk to it, or are in the same room as it. This is, after all, basic of social cognition which everyone has been developing from birth.

3.9.5 Friends or Fantasy?

So, having proposed that creating a relational artefact should be easy, Turkle, for one, is adamant that these products will never return our love or any other expression of care, indeed, the very idea of reciprocation is, as she puts it, "pure fantasy". John Searle (2014) agrees writing: "*Computers have […] no intelligence, no motivation, no autonomy, and no agency. We design them to behave as if they had certain sorts of psychology, but there is no psychological reality to the corresponding processes or behavior […] The machinery has no beliefs, desires, motivations*". So, designing relational artefacts should not present us with too many problems except the end result is inauthentic (which is academic language for "fake"). In this view of the world, no meaningful relationship can ever exist.

Indeed, the literature on the adoption of social robotics makes it clear that no participant believes that these social agents are alive, or that they reciprocate human feelings of affection. And yet there are very many examples of apparent care for robotic companions. To take just one, here is an elderly woman speaking to PARO the seal robot on her return from hospital "*I was lonely, PARO. I wanted to see you again*" (Wada et al. 2005).

In Flesh and Machines (2002), Brooks describes a visit to his laboratories by Sherry Turkle and quotes from her *Life on The Screen* where she wrote:

> Cog "noticed" me soon after I entered its room. Its head turned to follow me and I was embarrassed to note that this made me happy. I found myself competing with another visitor for its attention. At one point, I felt sure that Cog's eyes had "caught" my own. My visit left me shaken—not by anything that Cog was able to accomplish but by own reaction to "him". For years whenever I had heard Rodney Brooks speak about his robotics "creatures". I had always been careful to mentally put quotation around the word. But now, with Cog, I had found the quotation marks had disappeared. Despite myself and despite this research project, I had behaved as though in the presence of another being.

Brooks observes that Turkle had responded to Cog despite herself. Not quite pure fantasy. Our overwhelming tendency to anthropomorphise coupled with ever-more sophisticated technical developments in relational artefacts means that such digital products have a growing presence in everyday life. Turkle in her TED talk, "*Connected, but alone?*" tells us a little of what it means to be-with technology.

Her view is that communication technologies have changed what people do, but more importantly who we are. A consequence of this is that regular communications users may be developing problems in relating to other people, but more importantly for Turkle, they have lost the ability to be alone and engage in reflection. From Turkle's own research, she has found that people are beginning to expect more from technology and less from other people. She observes that digital products which have been designed to provide companionship, such as just about all of the social robots we have discussed in this chapter, do so without "*the demands of friendship*". She argues that we have are losing or have lost basic conversational skills and with-it interpersonal skills. Her analysis, she claims, is that these digital products promise us (i) that we can put our attention wherever we want to, and that (ii) when we're connected, we will always be heard. Because of this, "we'll never have to be alone". In conclusion, she believes that people prefer the simplicity that technology offers whereas human relationships are complex.

3.10 How Technology Has Changed Us

A number of commentators, journalist, and academics have speculated as to the consequences of the growing ubiquity of digital technology and have proposed that the current generation of young people and children will be afflicted with the inability to think for themselves (e.g., Carr 2008) or may come to enjoy enhanced cognitive abilities (e.g., Thompson 2013), or suffer from mental illness (e.g., Thomée et al. 2010), or diminished social skills.

It is worth remembering that similar predictions were made of the "baby-boomer" generation, with respect to watching TV or of "generation X" for playing violent video games and little has come of them (the predictions that is, not the children).

3.10.1 Digital Natives and Generation Me?

Twenty years ago, Prensky (2001, 2006) coined the term "digital native" to describe how exposure to this technology may have affected students (though many of his remarks may apply to the wider population). He wrote, "*Today's students represent the first generations (sic) to grow up with this new technology. They have spent their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age. Today's average college grads have spent less than 5000 h of their lives reading, but over*

10,000 h playing video games […] Computer games, email, the Internet, cell phones and instant messaging are integral parts of their lives". Prensky claims that these "digital natives" may be so expert with digital technology that they may prove to be impossible to teach by "non-natives". So, that's what it was.

Twenge, in contrast, has used the terms "Generation Me" (2014) and more recently, *iGen* (2017) to speak of similar groups of people. For example, iGen, "*… were born after 1995. They grew up with cell phones, had an Instagram page before they started high school, and do not remember a time before the Internet. They are different from any generation that came before".*

Unsurprisingly Twenge and Prensky's definitions share a number of features and while these generational arguments are interesting, they do seem to require regular revisions which suggests that the predictions made of these groups are not as simple as some might suggest. The Dutch researcher, Kirschner and his colleagues (e.g., Kirschner and Karpinski 2010; Kirschner and Karpinski 2015) have suggested that calling young people "digital natives" may actually be misleading and even harmful. Kirschner has argued that educational policy and practice are often based on the faulty premise that students who were born in the age of digital media are fundamentally different from previous generations of students. Indeed, he claims that there is neither evidence for them being "digital natives" nor is there any reason to suppose that they are more technologically savvy than older generations. Further, Tait (2019) suggests that these simplistic definitions of generations tend to obscure class, gender, and race and thus downplay inequalities; and that "*older generations also adapt to new technologies arguably making the differences not as stark as they might first seem*" (p. 21).

However, Prensky has responded by saying that the term "digital natives" is intended to be treated as a metaphor though we should nonetheless recognise that young people today are part of a new "digitally enabled" culture. Irrespective of the usefulness or validity of these claims we can, at a minimum, recognise that as a society we have all become familiar with computers and the modern magic of worldwide communications, and instantaneous access to the sum of all knowledge in ways that none of us expected and that this has transformed the ways in which we think about, use and value technology and has created a "digital culture".

There is also evidence beginning to appear of people who describe themselves in similar terms (Pew Research 2018). If this is so, the use of technology must necessarily interrupt and fragment what is left of their non-digital lives (assuming that there is anything left). Unsurprisingly, this fragmentation of attention has been seen to reduce work performance (Leroy 2009), increase task error rates (Bailey and Konstan 2006), and induce stress (Mark et al. 2008). Given the number of applications (and associated hardware) we use, Mehrotra et al. (2015) have estimated that a typical phone user receives up to 100 notifications every day.

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Chapter 4
Aesthetics

4.1 Introduction

This chapter is concerned with our aesthetic experience of digital products. These are the "*I like this*" and "*I like the look (feel or smell or shape)* of this" *or "I love your new phone" or I feel that I am present there* moments.

Here we see affect and aesthetics overlapping considerably and to tease them apart is not always entirely meaningful. However, research has revealed that aesthetics may have a role not very different from the way we think about affordances (Sect. 1.7). Add to this the recent appearance of neuroaesthetics, and we may have the means of distinguishing feelings from appearance.[1] Cognitive scientist, Mark Johnson, was similarly inspired by Dewey's extensive understanding of aesthetic experience. "*Aesthetics concerns the patterns, images, feelings, qualities, and emotions by which meaning is possible for us in every aspect of our lives*" (Johnson 2015, 23). According to

[1] An introductory caveat. Imagine a friend has bought herself a new smartphone and she asks you whether or not you like it, and let us suppose that you do (or you are too polite to tell her the truth). Is this an *affective* or an *aesthetic* response? Clearly it involves an appraisal, which is common to both affective and (as we shall see) aesthetic experiences, but how do we distinguish between them? It should, of course, be easy. Affect is our "emotional" response to something, whereas aesthetics is about how something looks (which is literally what the word means). In addition to this common-sense difference, we also know that they are also neurologically distinct and academically, affective science is quite separate from aesthetic science. Despite these differences, some affective researchers consider that aesthetic experiences rely on specific type of appraisal, namely a judgement of intrinsic pleasantness (Scherer et al. 2001), while not to be outdone, some affective researchers speak of aesthetic emotion (e.g., Leder and Nadal 2014) and, of course, UX researchers such as Hassenzahl write of the hedonic properties of digital products in the context of discussing their aesthetics. And, as an author, I have the very real and practical need to separate affect and aesthetics into two chapters in this book, and deciding what goes where has proved to be no simple matter. So, from a pragmatic perceptive—research relating to our attachment to digital products, is described in this section as emotions about technology. This division is not perfect, but it is practical. In yet another example, of the paradoxical nature of UX research, it is evident that most of the research into the emotions we experience about digital products is instrumental and primarily concerned with their measurement.

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Johnson, aesthetics is a "field of inquiry" that supplies meaning to affordances, which emerge from the ways we engage with the world we inhabit (ibid., 28). Aesthetics, according to this interpretation, extends well beyond the exclusive confines of the fine arts or objects considered as art. Additionally, both Shusterman and Johnson (1992) consider aesthetics a dynamic category of activity which cannot be contained by a static category of fixed values. We extend this to include the aesthetics of virtual environments too. Such environments offer the experience of feeling as though you were there. The where in question is often essential to creating a sense of place. For example, we see this frequently in video games which offer the experience of being-on part of a D-day landing on a Normandy beach (call of duty WW2) or roaming the wild west (e.g., Red Dead Redemption) or hanging out in the mean streets of a west coast city (Grand Theft Auto) or any number of science fiction locations (e.g., killing monsters in the labyrinths on Mars in the Doom franchise). Indeed, games are long been rated for their visual appeal and one of the first (that I remember) was Myst (1993). Myst is really quite lovely to look at and the gaming critic agreed. Myst was very well received when it was released with the magazine Computer Gaming World (CGW) writing that it had "mesmerising" and "stunning" graphics. The following year, the magazine called it an "artistic masterwork" (CGW 1994). The "artwork" and appeal of the game-worlds created for the game is essential to the playability of the games (and their commercial success).

However, and as is all too usual, there is no readily available psychology of aesthetics to draw upon. There is, instead, a pluralistic jumble of overlapping ideas, frameworks, theories, and proposals, and again, there is the perennial, and all too familiar problem of agreeing the definition of key terms and concepts. We might also have had the expectation that the philosophy of aesthetics is long established and a deep well of thought to draw upon (surely there is ancient Greek thought), whereas it is actually relatively new, Carroll et al. (2012, p. 31) tell us that aesthetics "*was born as a branch of philosophy in 1735 with Baumgarten's use of the term*". However, the fairly recent appearance of neuroaesthetics, as Zeki (1999) has argued, brings the prospect of creating a more complete account of aesthetics (singular) with an understanding of its neural basis.

Aesthetics is intrinsic to our experience of digital products and has attracted the attention of researchers who have written of it in remarkably similar ways but using widely divergent language. We might, however, begin by noting that aesthetics cannot be thought of as separate from any given digital product. Aesthetic objects as Saito (2001) has observed are not a set of special things, but rather are determined by our attitudes and experiences. A consequence of this view is that, as Stolnitz (1969, p. 27) claims, "*anything at all, whether sensed or perceived, whether it is the product of imagination or conceptual thought, can become the object of aesthetic attention*". Hallnäs and Redström (2002) agree when they recognise that with the growing ubiquity of computational things that we need to be clear what it means for something to be present in our lives, as opposed to something we just use. They suggest the terms "use" and "presence" to distinguish between the two, and we should note that this is yet another reminder that "interaction" is an inadequate description of our relationship with digital products. While *use* refers to a general description of a thing in terms of how it is employed, presence refers to existential definitions of a thing based on how we invite and accept it as a part of our digital world. From this perspective, they see aesthetics as providing a rationale for the choices we make (e.g., "I like this one more than the purple one").

Petersen et al. (2004) have proposed a similar distinction within aesthetics, but this time they have distinguished between "use" and "appearance". They begin by presenting an overview of the concepts of aesthetics in HCI so as to situate their proposal for "*aesthetic interaction*" which is based in a pragmatist aesthetic (cf. Shusterman 1992). Drawing upon artistic theory as well as human computer interaction, they locate aesthetics in the everyday, writing, "*In a pragmatist perspective aesthetics is a part of everyday life. It stems from a use-relationship. Aesthetic Interaction comprises the views that aesthetics is instrumental and that artefacts are appropriated in use.*" Continuing this theme, Petersen et al. (2008) have also observed that the ubiquity of digital technology in everyday life has changed the ways in which we interact with it. As computer systems change from being very specific tools for work to ubiquitous computational objects, the nature of the interaction changes too. They give an example of the interactive pillow designed by Redstrom (2008) to illustrate this, "*Interactive Pillow is a reinterpretation of what it means to hug a pillow [it is transformed] into an act of communication … These pillows come in pairs that are wirelessly connected to each other, and when one of them is hugged, the other will light up. We are dealing with new devices and new qualities of use which are […] related to emotional qualities, to experiential qualities, and to aesthetic qualities …*". In contrast, to treating aesthetics as a pattern of use–perception–appearance, Lavie and Tractinsky (2004) have sought to differentiate between classical and expressive aesthetics. The former, they describe as referring to traditional aesthetic notions which emphasises orderly and clear design, while expressive aesthetics is associated with the design's creativity and originality.

Classical aesthetics embraces principles such as consistency and the use of a structured layout, symmetry, clean, and clear design (this is quite like the definition of *use* proposed by Hallnäs and Redström); whereas expressive aesthetics is "*manifested by the designer's creativity and originality and by the ability to interface qualities, such as 'beautiful', 'challenging' and 'fascinating'" (*again, recalling "presence").

However, Ulrich et al. (2008) defines the aesthetics of an artefact as the immediate feeling(s) evoked when experiencing it via the sensory system(s). He considers aesthetic responses to be different from (other) cognitive responses in that they are rapid and involuntary (rather like first impressions). Aesthetic responses are an aggregate assessment biased either positively (e.g., beauty or attraction) or negatively (e.g., ugliness or repulsion) and not a nuanced multi-dimensional evaluation. This, of course, brings us full circle by equating the aesthetics of an artefact with perception, remind us that the word aesthetics from the Greek aisthesthai "perceive".

4.2 The Aesthetic Turn

The place of aesthetics in digital products began to be an issue in the early years of the millennium as witnessed by the publication of the *Aesthetic Computing Manifesto* (Fenwick 2003) which itself was a result of the Dagstuhl Aesthetic Computing Workshop held in 2001.

In the main, aesthetics within HCI/UX has tended to been regarded conservatively, so much so that it had managed to be neglected pretty comprehensively. On those occasions when it was noticed, it was largely limited to the visual modality. This is very much a case of "*aesthetics is about how it looks*" which, of course, is resonant with the original meaning of the word. However, as we have seen in the preceding chapters, the last 40 years or so have witnessed successive attempts to incorporate non-utilitarian aspects, such as aesthetics, into our use with digital products.

Udsen and Jørgensen (2005) have claimed that we have witnessed a *turn to the aesthetic* within HCI. They suggest that this turn has taken four forms, towards the cultural; the functionalist approach; the experiential approach, and finally towards what they describe as the "techno-futurist" approach.

Udsen and Jørgensen highlight Brenda Laurel whose most celebrated work has been to suggest a parallel between the use of technology and a theatrical performance which she describes in her *Computers as Theatre* (1993). She has also suggested that interactive systems should provide the users with "pleasurable engagement" through the use of interface metaphors of "both emotional and intellectual appeal". In all, she argued for the interface to be treated as an "expressive form" and a highly composite hybrid of cultural experimentation and emerging (HCI) standards—gone is the dull, neutral screen. In contrast, the functionalist approach is typified by Jordan's *Designing Pleasurable Products* (2003) which explores the relationship between product design and user pleasure. Beautiful user interfaces have become the means to an end, with pleasure naturally coming from which ease of use.

The experiential approach, the authors tell us, concerned "*promoting new ways of communicating immaterial messages and experiences through emotional frictions, engaging interactions and seductive means*" (p. 209). An example of this seduction is offered, in Plumb Design's *Visual Thesaurus* (Thinkmap 2017) which shows the result of a text search as a "*moving, organic structure that encourages users to examine related words*"—the visual presentation acting as the "vehicle of seduction" (Khaslavsky and Shedoff 1999).

The final category is described as "techno-futurist". Of the four perspectives, this is the least well defined and is described as "philosophically inspired". The argument is that as technology becomes truly ubiquitous (following Weiser's paradigm), our experience of it will change. Here, the work of Paul Dourish comes to the fore (cf. his *Where the action is* 2001) with its emphasis on issues such as embodiment and the phenomenological traditions of Husserl and Merleau-Ponty.

While recognising that these four forms have their own philosophies, traditions and have been realised in different kinds of user interfaces, Udsen and Jørgensen also conclude that the aesthetics of these digital products is now just a matter of everyday life which is very much the perspective we have adopted reflecting the work of Hallnäs and Redstom and Petersön. In the context of digital products, we must highlight Apple and the work of their head designer Jony Ive. Perhaps most memorably was Ive's design for the 1998 iMac. This had a translucent candy coloured shell and a rounded exterior design. The design also reshaped the processor to fit the exterior shell, greatly shrinking the computer's footprint.

4.3 The Origin of Aesthetics

Our sense of the aesthetic is (arguably) a product of our evolution which Dennis Dutton, in turn, argues we need to "reverse-engineer" to explain. Following this advice, we will approach the origins of aesthetics from this evolutionary psychological perspective but in doing so prompts a caveat. While it must be the case that any given specific sense or capability is the product of our evolution, it is difficult to avoid the feeling that we are reading a modern "just-so" story of the "How the elephant got his trunk" variety (Kipling 1902). Of course, in a very real sense this is precisely what we are doing but there is (surely) a place in scientific discourse for these kinds of stories. After all, we could describe a "just-so" story is an hypothesis wrapped in a compelling narrative. Anyway, back to the evidence.

The usual starting point for this kind of analysis is to assume that the aesthetics sense provides a reproductive advantage to our ancestors, an example of which is that we find symmetry attractive in potential mates. This preference is supported by the evidence that facial symmetry, for example, is correlated with reproductive health (e.g., Scheib et al. 1999), and so it is *plausible* that preferring symmetrical faces is an aesthetic adaptation that is likely to result in higher reproductive success (e.g., Thornhill and Gangestad 1993). Then, in the minds of evolutionary psychologists at least, this preference for symmetry can be seen as an adaptation which we have extended to the creation and enjoyment of works of art, entertainment, and the design of the latest smartphone.

However, Dutton (2009) reminds us that evolution has at its disposal a number of different mechanisms, the "big two" are natural selection and sexual selection.

Natural selection relies on random mutation and selective retention and can explain our fondness for fast food and sugary snacks and our revulsion at the smell of rotting meat, or our fear of spiders. However, sexual selection contradicts this, and the most famous example is the origins of the peacock's exuberant tail. The tail did not evolve for survival (as it is cumbersome and awkward) but instead it is the result of the mating choices made by peahens. Peahens prefer flashy tails (the number of eye spots appears to be the crucial element), so peacocks with such tails have a chance to reproduce with spot-loving peahens before being eaten by the local wild dogs.[2] Thus, the experience of beauty is one of the ways that evolution has of

[2] This either natural or sexual selection has been challenged. Zahavi (1975) has pointed out that only the fittest peacocks would be able to maintain the weight and inconvenience of large tails.

arousing and sustaining interest, in order to encourage us towards making the most adaptive decisions for survival and reproduction or has he puts it, "*Beauty is nature's way of acting at a distance*".

And, we can see the hand of nature all too easily, as management (our bosses at work) often assume that beautiful people are more likely to be more successful in their jobs; and that the beautiful people are judged to be better parents solely on the basis of their looks. Eagly et al. (1991) have reported evidence from their meta-analysis that shows that people believe that a person's beauty is positively related to their social competence, and their … adjustment, potency, intellectual competence, and general "goodness".

4.3.1 The Savannah Hypothesis

Orians (1986) has proposed the "savannah hypothesis" to account for some of our aesthetic preferences, specifically the type of landscape which we all would find intrinsically appealing. Dutton notes that the original idea dates from the work of Appleton and his *The Experience of the Landscape* (1975). The original hypothesis is that this landscape has much in common with the savannahs and woodlands of East Africa where much of our early evolution occurred. A savannah provides open spaces of low grasses interspersed with thickets of bushes and groupings of trees and the presence of water directly in view, or evidence of water nearby or in the distance. This landscape ideally also has an opening in at least one direction to an unimpeded vantage on the horizon, together with evidence of animal and bird life; and a diversity of greenery, including flowering and fruiting plants. These preferences turn out to be more than just vague, general attractions towards generic scenes, instead, they are notably specific. African savannahs are not only the probable scene of a significant portion of human evolution, they are to an extent the habitat meat-eating hominids evolved for; savannahs contain more protein per square mile than any other landscape type. Moreover, savannahs offer food at close to ground level, unlike rain forests, tropical or temperate, which are more easily navigable by tree-dwelling apes. Human beings are less attracted to absolutely open, flat grasslands, and more towards a moderate degree of hilly undulation, suggesting a desire to attain vantage points for orientation. The type of savannah that is ideal appears to be the very savannah imitated not only in paintings and calendars but in many public parks and golf courses. Figure 4.1 illustrates such a landscape.

There is another source of support for this hypothesis which comes from Komar and Melamid (1999) who surveyed the artistic preferences of people in ten countries. Participants in their study were asked what they would like to see a picture of, whether they preferred interior or landscape scenes, what kinds of animals they liked, favourite colours, what sorts of people they enjoyed seeing depicted—famous or ordinary, clothed or nude, young or old—and so forth. At the end of this process, Komar and Melamid claimed to have captured a reliable report on the artistic preferences

Fig. 4.1 A Savanna-type landscape. Photo by Magda Ehlers from Pexels

of “close to two billion people”. The output took the form of creating paintings reflecting the “most” and the “least wanted”.

The composition of the most-wanted painting was a landscape with water, people, and animals, and the world’s favourite colour appears to be blue. Their creation of America’s Most Wanted, comprised George Washington on a grassy area beside a river or lake. Near him are three young people, and in the water, is a pair of deer. This preference for a lush blue landscape type which is found across the world is claimed to be evidence of our innate preference for it.

4.3.2 Elegant but Useless

A final evolutionary perspective can be found in Dutton’s TED talk (2009) on Acheulian hand axes. These axes were originally found in the Olduvai Gorge in East Africa, and may be as much as 2.5 million years old. They were created by people to a design which remained, more or less, unchanged for about one million years, until a more advanced form of humanity was to emerge. Dutton tells us that they have been unearthed in their thousands, scattered across Asia, Europe, and Africa, indeed almost everywhere Homo erectus and Homo ergaster roamed. He argues that, the sheer number of these axes suggests that their use cannot simply be limited to butchering animals, particularly as, unlike other Pleistocene tools, the axes show little evidence of use and indeed some are too big to use for butchery. In answer

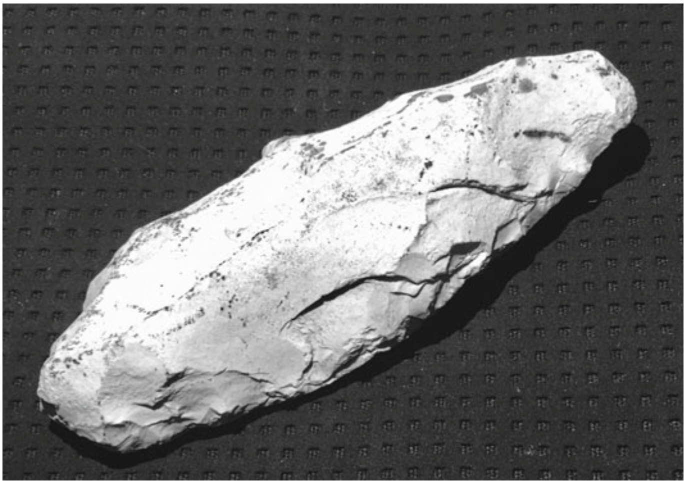

Fig. 4.2 A hand axe. From the author's own collection

to question, "what were these artefacts for?"—he proposes that is these may be the earliest known works of art, that is, objects which have been created so that they could be admired for their craftsmanship.

Some archaeologists have voiced similar sentiments, for example, Corbey et al. (2016) have estimated that 1 or 2% of finds shows symmetry and regularity beyond practical needs (these are enormous numbers, given the total amount of hand axes). Currie (2009) is a little more sceptical but not entirely unsympathetic as he describes a particular hand axe as, "*a piece of worked stone, shaped as an elongated tear drop, roughly symmetrical in two dimensions, […]. In size and shape it would not have been a useful butchery implement, and is worked on to a degree out of proportion to any likely use*". For Currie, this is not "early work of art" but does suggest evidence of an "aesthetic sensibility".

Figure 4.2 is an image of a Neolithic hand axe which is joy to behold and to handle. It was created for a right-handed individual and may have been put to practical use. In contrast, Fig. 4.3 is an image of a possibly ceremonial, non-utilitarian polished stone axe from 3000 BC, it has been carefully formed from volcanic basalt and is wonderfully smooth. Both axes are, of course, very aesthetically pleasing.[3]

Burke and Ornstein (1997), in their *The Axemaker's Gift*, develop Dutton's proposition where they argue that the use of tools has had a very significant and enduring effect on our species, writing, "*In prehistory, when human beings first began to make tools, they changed* […] "*natural selection*" permanently. […] the axe introduced an artificial change in the way individual talents developed (p. 19). This change to natural selection relied on the fact that those who could make tools were in greater

[3] The reader is encouraged to watch this talk as it is filled with wonderful animated cartoons created by Andrew Park, search on "Denis Dutton Acheulian hand axes TED talks" (active as of 2 April 2023).

Fig. 4.3 A polished stone axe head. From the author's own collection

demand than those without such skills and were rewarded proportionately. Consequently, their offspring stood a better chance of surviving and passing on these talents. They go on to speculate that the physical and cognitive skills acquired from the preparation of flint tools which requires a very precise sequence of steps may have found expression elsewhere. For example, they suggest that the alphabet, the sequential ordering of phonemes, made "*a special contribution to the human ability to dissect and reshape the world*" (1997, p. 71). With the Greek alphabet we had, for the first time, an easy-to-use external storage medium replacing oral traditions (and the much more difficult to use hieroglyphic systems) which allowed us to separate thinker from thought and within this the beginnings of philosophy. Calvin, who quotes Kathryn Morton (ref), draws attention to the range of abilities which depend on sequencing "*the first sign that a baby is going to be a human being and not a noisy pet comes when he begins naming the world and demanding the stories that connect its parts. Once she knows the first of these he will instruct his teddy bear, enforce his worldview on victims in the sandlot, tell himself stories of what he is doing as he plays and forecast stories of what he will do when he grows up. He will keep track of the actions of others and relate deviations to the person in charge.*" (Calvin 2006, p. 88).

4.4 The Experience of Aesthetics

Historically, the psychological study of aesthetics has been subject to a series of fits and starts. It got off to a promising beginning with Fechner's work in the 1870s, and as Leder and Nadal (2014) note, he developed the theoretical and methodological foundations for understanding both art and aesthetics writing that "*Structurally, works of art demonstrate concepts at both higher and lower levels, which can be interrelated, and as a result diversity can result not just from greater variety in the underlying sensory contents, but also from a greater number of higher-level relationships; that is, as it were, from both the breadth and the height of the structure*".

However, the study of aesthetics was not to flourish as it was subject to the heavy hand of Behaviourism which effectively snuffed it out until Berlyne's revival in the late 1960s. Daniel Berlyne was an interesting psychologist who proposed a number of unusual psychologies, including humour, curiosity and, of course, aesthetics. As regards aesthetics, he observed that although psychologists have considered the production of art, their focus has primarily been on the artists' motivation or various measures of their creativity. Berlyne (1974) was to revive the empirical interest in art by creating his own theoretical framework based around an arousal-pleasure dimension which parallels Hassenzahl's (2004) contemporary treatments of hedonism.

More recently, Leder and Nadal (2014) have usefully distinguished between art and aesthetics, observing that the terms are frequently used almost interchangeably within the psychological literature, and while their association is understandable, they are most definitely not synonyms. Art, for example, is often appreciated for reasons other than its aesthetics and many non-artistic objects, of course, can be appreciated for their aesthetics. They write that the psychology of art "*aims to characterise the psychological mechanisms involved in the appreciation of art, such as grasping an artwork's symbolism, identifying its compositional resources, or relating to it to its historical context*" (p. 445). This stands in contrast with the psychology of aesthetics which "*aims to identify and describe the psychological mechanisms that allow humans to experience and appreciate a broad variety of objects and phenomena, including utensils (sic), commodities, designs, other people, or nature, in aesthetic terms (beautiful, attractive, ugly, sublime, picturesque and so on)*".

4.4.1 An Aesthetic Experience

Cinzia and Vittorio (2009, p. 682) define an aesthetic experience as to "*perceive-feel-sense*" which foregrounds the respective roles of the sensorimotor, emotional, and cognitive systems. Chatterjee (2011) prefers to define it as "*the perception, production, and response to art, as well as interactions with object and scenes that evoke an intense feeling, often of pleasure*". In contrast, Bergeron and Lopes (2012) suggest that there are three dimensions to an aesthetic experience, namely the evaluative, the phenomenological (or affective), and a semantic dimension. They also note that there is no reason to suppose that all three dimensions are required in every instance. Chatterjee and Vartanian (2014) also offer their own "aesthetic triad" proposal (this time from a neurological perspective) suggesting that aesthetic experiences arise from the interaction among sensory-motor, emotion-valuation, and meaning-knowledge neural systems.

However, perhaps the most comprehensive treatment of aesthetic experiences is from Leder et al. (2004), which was reviewed and revised in 2014 (Leder and Nadal 2014) in the light of new experimental methods which were developed in the interim.

An aesthetic experience, Leder tell us, begins before the actual perception, with the "*social discourse that configures expectations, anticipations, and an aesthetic orientation*" (p. 445). An aesthetic experience also occurs in context, which also serves to shape those expectations and orientation and to create an environment that can contribute to heightening the artistic status of an object. Unlike many other accounts, Leder's model situates the psychological mechanisms in context. This model is represented in Fig. 4.4.

The model is complex, and if we confine ourselves to the psychological aspects, we can see that in relies on several stages of perceptual processing which is concerned with grouping, symmetry analysis, and a range of other perceptual features that are relevant to aesthetic appreciation. The next stage involves the analysis of familiarity, prototypicality and meaning and the integration of information from memory. The subsequent stages are concerned with classification and interpretation. Finally, the "output" from the cognitive system is an aesthetic judgement while the affective system produces an "aesthetic emotion".

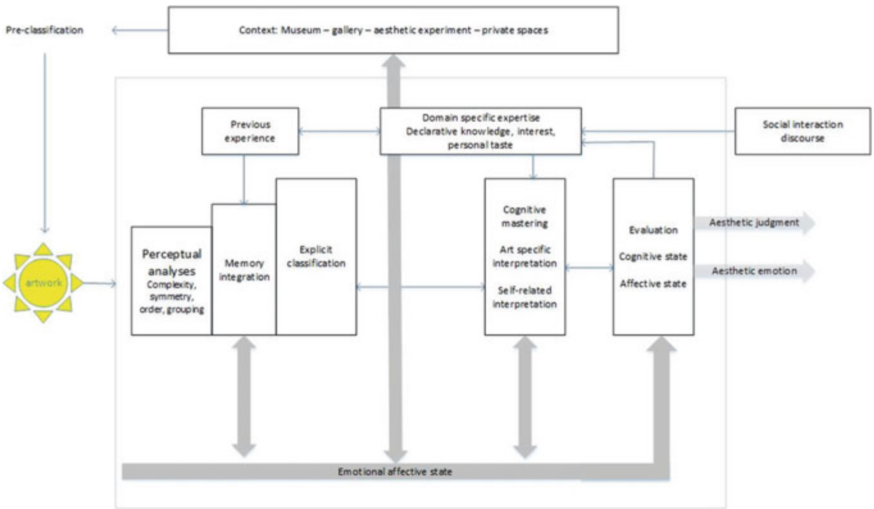

Fig. 4.4 Aesthetic experiences, redrawn from "Model of aesthetic experiences" (Leder and Nadal 2014)

4.5 Mirror Neurons and Aesthetics

We introduced mirror neurons in Sect. 1.11 as they are a ***potentially*** important part of our treatment of user experience. Here we reference the fact of our embodiment and the part this plays an aesthetic experience, an observation which is unlikely to come as much of a surprise to the great artists. Michelangelo, for example, is said to have endowed his sculptures with the impression that they were struggling to free themselves from the blocks of stone which held them. Similarly, Jackson Pollock's "action paintings" embodies their creation, his work reflects the physical act of painting with his scattering, spraying, dripping, or pouring (of paint) being implied and captured on the canvas. As Pollock himself puts it, "*The painting has a life of its own. I try to let it come through". However, research and reflection also suggest that people feel (empathise) a physical response or resonance to images of, for example, injury or mutilation and the same mechanism may to be at work when men enjoy pornography* (Bocher et al. 2001).

A key theme in embodied aesthetics has been the proposed role of mirror neurons. Mirror neurons are potentially important to many aspects of our cognitive, affective, and aesthetic lives, and Ramachandran (2000) has gone so far as to claim that they may have enabled us to create nothing less than culture itself. In humans, brain activity consistent with that of mirror neurons has been found in the premotor cortex, the supplementary motor area, the primary somatosensory cortex, and the inferior parietal cortex. A number of neuroscientists consider that this system to provide the physiological mechanism for the perception–action coupling and are important for understanding the actions of other people, and for acquiring new skills by imitation. Some researchers also speculate that mirror systems may simulate observed actions and thus contribute to development of a theory of mind, while others relate mirror neurons to language abilities.

Kaplan and Iacoboni (2006) have argued that the mirror neuron systems help us understand the actions and intentions of other people and have reported that they could discern if another person who was picking up a cup of tea planned to drink from it or clear it from the table. In addition, Iacoboni has argued that mirror neurons are the neural basis of the human capacity of empathy.

Freedberg and Gallese (2007) have written of the implications for embodiment and like a number of others describe it as a "challenge [to] the primacy of cognition" (p. 200). However, what is of particular interest here is their discussion of mirror neurons as a credible mechanism for our understanding our emotional and empathetic response to art. They reason that as the observation of a goal-oriented action leads to the activation of the same neural networks that are active during its execution, this, in itself may account for our feelings of empathy for the movements portrayed in artistic pieces. Further, mirror neurons have now also been shown to respond to actions that are implied thus they enable the understanding of the action of others by means of what is described as "embodied simulation".

Studies in macaques and humans have demonstrated that mirror neurons are also involved in understanding the intentions that underlie action and this applies to the observation of (static) images of actions too. The observation of pictures of a hand reaching to grasp an object or firmly grasping it activates the motor representation of grasping in the observer's brain. Calvo-Merino et al. (2004) have found evidence that the mirror neuron system is also involved in the understanding of bodily movement (including dancing). Based on this, it is proposed that a similar motor simulation process can be induced by the observation of still images of actions in works of art. It is not surprising that felt physical responses to works of art are so often located in the part of the body that is shown to be engaged in purposive physical actions, and that one might feel that one is copying the gestures and movements of the image one sees—even in cases where the action seems to serve as the outlet for an emotional response (as with scenes of mourning and lamentation, for example). This hypothesis, reflecting longstanding thought in phenomenology, stresses the empathic nature of the relationship automatically established between artworks and beholders. This hypothesis has two components: firstly, the relationship between embodied simulation-driven empathic feelings in the observer and the representational content (the actions, intentions, objects, emotions and sensations portrayed in a painting or sculpture); secondly, the relationship between embodied empathic feelings in the observer "reliving" the artist's work.

4.6 Gestalt, Neuroaesthetics, and Rasa

However, before we consider the current thinking in neuroaesthetics, we begin by reminding ourselves of the contribution of the Gestaltists. The Gestaltists, of course, were a group of psychologists working in the early years of the twentieth century who, are probably best remembered for their "laws" of perception. These laws were based on observations about the apparent regularities in the ways in which our visual perception works. The Gestaltists noted, for example, that objects appearing close together in space or time tend to be perceived together, so, if objects are carefully spaced, they will be perceived as being organised into either columns or rows. These regularities (which became "laws") include the effects of continuity, similarity, closure, and so forth. Although these laws are most frequently cited with respect to visual phenomena, they also apply to auditory perception too so, for example, the proximity of auditory "objects" are perceived as a song or a tune. However, to avoid a proliferation of these perceptual "laws", Koffka (1935) proposed a fundamental, organising principle which he described as Prägnanz which is, the "psychological organisation will always be as 'good' as the prevailing conditions allow" and he commended this proposal with the note that "*On the whole the reader should find no difficulty in seeing what is meant her*e". Figure 4.5 is an example of the Gestalt law of continuity. It shows …

Figure 4.6 is another example of a Gestalt law. This time it illustrates the principle of similarity.

Seventy years later, Sonneveld and Schifferstein (2008) ask us to consider the sensation of touch. They observe that touch brings together the contributions (inputs)

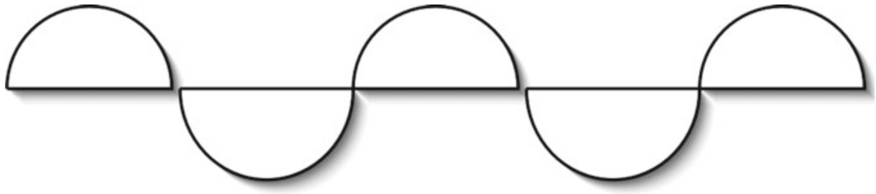

Fig. 4.5 An example of Gestalt (continuity)

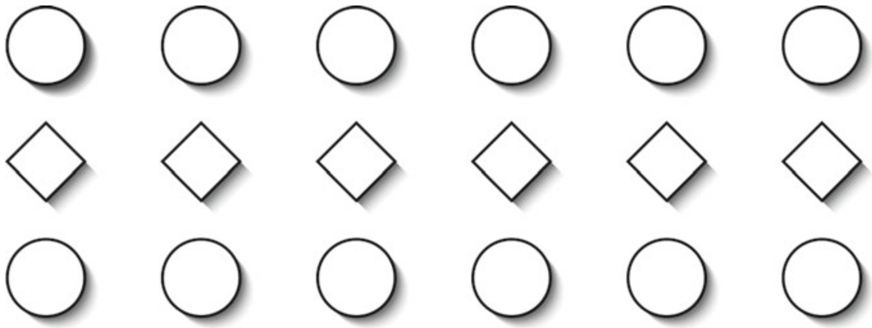

Fig. 4.6 An example of Gestalt (similarity)

from several different sensory systems including pressure, temperature, vibration, pleasure, and pain which is experienced as a single Gestalt percept (this is not to say that the different components cannot be individually distinguished). Katz agrees and tells us that what we experience as "wetness" (for example) is "the synergistic activation of different combinations of receptors" in what have been described as "touch blends" (Katz 1925/1989). However, as Wagemans et al. (2012) note, currently Gestalt psychology occupies an ambiguous place in that its appeal declined sharply in the 1950s. In part, this was due to the discovery of single neurons being tuned to primitive stimulus attributes (e.g., line orientation, motion direction, the "monkey's paw" detector, and so forth) which led to a predominantly atomistic approach in neuroscience, and around the same time, computers models appeared to provide testable, mechanistic accounts of mental operations. Nonetheless, most psychology and HCI textbooks still contain a chapter on the Gestalt perceptual laws as they map remarkably well onto a number of modern user interface designs (either the designers have been reading the textbooks or there may be something to these laws). This is set to change.

4.6.1 Neuroaesthetics

Chatterjee (2011) writes that visual neuroaesthetics rests on two principles, namely visual aesthetics has multiple components and secondly, that aesthetic experiences emerge from a combination of responses to these different components.

It is now well established that the nervous system processes visual information sequentially and (Marr 1982) established that this is further divided into early, intermediate, and late vision. Visual information is also processed in parallel. Early vision is responsible for extracting simple elements from the visual environment, such as colour, luminance, shape, motion, and location, while intermediate vision creates coherent regions from this chaotic sensory array. Finally, late vision is responsible for recognising objects and understanding what they meaning. In parallel, Chatterjee tells us, any work of art can also be decomposed into its early, intermediate, and late vision components. Aesthetic perception can distinguish between form and content with form being processed by early and intermediate vision, whereas content is processed by later vision. Thus, looking at something artistic, we would see its colour and spatial location first, and these elements would be grouped intermediate vision and so on. A good illustration of this work is Chatterjee and his colleagues (Chatterjee et al. 2009) who were interested in our responses to beauty in the form of attractive human faces in particular. Their methodology involved showing attractive human faces to people and used fMRI to measure neural involvement. They found that neural involvement was widely distributed and involved the dorsolateral frontal and medial frontal cortices. They concluded that visual neuroaesthetics is hierarchical and comprises a number of stable hierarchical organised subsystems. They also note that it is this very organisation which makes neuroaesthetics possible.

Iigaya et al. (2020) suggest that the improvements in neuroimaging make the measurement of brain activity during aesthetic experiences possible for the first time. Here we briefly discuss some of the key questions that have been investigated to date and highlight some of the outstanding issues: how reward and pleasure operate in aesthetic processes and how to disentangle individual differences from broadly perceived aspects of a stimuli and evolutionarily conserved neural pathways.

Early studies in the field of neuroaesthetics focused on identifying the brain regions involved in aesthetic liking or pleasure. A key finding of these studies is that many brain regions associated with aesthetic liking (such as the ventromedial prefrontal cortex and the ventral striatum) were also fundamental in processing rewards. This pattern of results has been widely reported in the literature for an array of stimuli that can invoke an aesthetic experience, including viewing of pictures and drawings (Kawabata and Zeki 2004) or listening to pleasant music (e.g., Salimpoor et al. 2011). Thus, the component of aesthetic processing that involves positive affective responses to a stimulus appears to display very similar neural substrates as stimuli that act as rewards like money or pleasant tastes and smalls. These finding place stimuli that evoke aesthetic pleasure firmly in the realm of other rewarding stimuli. In the reward field, evidence has been presented to suggest that a region of medial prefrontal cortex is involved in a domain-general manner in encoding the value of different rewards (Chib et al. 2009), consistent with the implementation of a "common currency" for reward value in that brain area. Intriguingly, an ostensibly similar region of medial prefrontal cortex has been found to be involved in representing subjective liking across a diverse array of stimuli (Lebreton et al. 2009).

The term "*neuroaesthetics"* was coined by Zeki (1999) to refer to the study of the neural bases of the perception of beauty in art, while Chatterjee (2011, p. 53) tells us that it refers to the, "*domain that has something to do with the properties of the brain as it emerges in aesthetics*" and Ramachandran (2012, p. 192) speaks of it is the study of "*how […] the human brain responds to beauty*". These are all, understandably, broad and inclusive definitions but more than this, neuroaesthetics is also said to be a "gathering force" (Skov and Vartanian 2009) and as it grows, it faces the challenge of being both true to its scientific roots while being relevant to aesthetics. As we have seen, aesthetics encompasses the perception, production, and response to art, as well as interactions with objects and scenes that evoke feelings, and although neuroaesthetics generally is confined to the visual medium, its principles should apply to music, dance, and literature.

Finally, Skov and Nadal (2020) write to clarify that "*Empirical aesthetics and neuroaesthetics study two main issues: the valuation of sensory objects and art experience. These two issues are often treated as if they were intrinsically interrelated: Research on art experience focuses on how art elicits aesthetic pleasure, and research on valuation focuses on special categories of objects or emotional processes that determine the aesthetic experience. This entanglement hampers progress in empirical aesthetics and neuroaesthetics and limits their relevance to other domains of psychology and neuroscience. Substantial progress in these fields is possible only if research on aesthetics is disentangled from research on art. We define aesthetics as the study of how and why sensory stimuli acquire hedonic value. Under this definition, aesthetics becomes a fundamental topic for psychology and neuroscience because it links hedonics (the study of what hedonic valuation is in itself) and neuroeconomics (the study of how hedonic values are integrated into decision making and behavioural control).*"

To continue, beauty is commonly used to refer to positive evaluative appraisals that are uniquely human. Little is known, however, about what distinguishes beauty in terms of psychological function or neurobiological mechanisms. Our review describes recent empirical studies and synthesises what behavioural, cognitive, and neuroscientific experiments have revealed about the nature of beauty. These findings suggest that beauty shares computational mechanisms with other forms of hedonic appraisal of sensory objects but is distinguished by specific conceptual expectations. Specifically, experiencing an object as pleasurable is a prerequisite for judging it to be beautiful; but to qualify as beautiful, an object must elicit especially high levels of pleasure and be matched to internal learned models of what counts as beautiful (Skov and Nadal 2020).

Finally, Ramachandran and Hirstein begin their account by discussing "the logic of art", that is, identifying the rules or principles governing art; secondly, they consider why these rules are they as they are; and finally, which parts of the brain are involved. In the process of answering these questions, they go on to propose a number of principles of artistic experience. The precise number of these seems to vary between different publications but include peak shift, perceptual grouping and binding, contrast, isolation, perceptual problem solving, symmetry abhorrence of coincidence/generic viewpoint and metaphor. We will briefly consider the first three of these, *peak shift*.

4.6.2 Rasa

The phenomenon of peak shift stems was first observed in animal research. Rats and pigeons can be trained to respond to the presentation of rectangles, and not to squares (the animal will press a lever or peck a button on seeing a rectangle but ignore squares). Once trained, it has been observed that if these animals are presented a rectangle with exaggerated length (as compared to the original target rectangle), they will respond more vigorously to these new rectangles. This is the peak shift phenomenon. It has been argued that squares and rectangles only differ along one dimension (let's call it their width) and if this is amplified, so too is the animal's response to it. Ramachandran and Hirstein compare the peak shift effect to the Sanskrit word "*rasa*", which they translate as "*essence*".

They continue that the artist creating, say, a stone carving of a female extracts the "rasa" of the female body shape by exaggerating it in a direction that takes it away from the male body shape, and it is this which makes the sculpture more aesthetically pleasing. Figure 4.7 illustrates such an intention.

They suggest this extraction and exaggeration can be found in the work of the artist François Boucher who is famous for his nudes. Boucher exaggerated the rosy glow of womens' skin colour to make them more attractive than those who were accurately portrayed. They claim that supporting evidence for this can be found in other domains such as Thornhill and Gangestad's (1999) research into the attractiveness of artificially produced faces. They found that women (during periods of high fertility) prefer faces with exaggerated masculine features to average faces. This peak shift even applies to the behaviour of seagull chicks which will peck for food at a stick with a red dot at the end (painted to resemble an adult gull's beak). The chicks will peck most at a stick with three red stripes. The stick only has one feature in common with an adult bird's beak and that is the red spot and that has been exaggerated.

As for grouping and contrast, Ramachandran and Hirstein tell us that they must be rewarding. They argue that once the visual system has identified objects in the visual field, then it must bind or group features relevant to it, examples of this include extracting figures from visually noisy scenes (such as picking out the figure of a Dalmatian dog from a spotty background—as discussed by Gregory (1970) or seeing the "other" figure in an ambiguous drawing such as Jastrow's duck-rabbit (1899). They note that once we have seen the other figure, we cannot but help see it again and again.

Fig. 4.7 An illustration of an Indian figure from a temple (and rasa). Photo by Kinjal Maulin Salvi from Unsplash

Fig. 4.8 Barbie. Photo by Alexa from Pixabay

It is well established that the visual system is primed to identify edges and changes in contrast. Ramachandran and Hirstein observed that this contrast extraction itself may be intrinsically pleasing to the eye and like grouping, rewarding. They suggest that this automatic process may be enjoyable (or pleasing) because (and here I am summarising) edges are more interesting than dull homogeneity.

Ramachandran and Hirstein (1999) have developed a neurological theory of aesthetic experience with Ramachandran contributing his personal reflections on Indian erotic art (specifically carved stone female figures). Ramachandran specifically refers to these figures in his *The Tell-Tale Brain* (2012) which he described as having shocked the British army when they first came across them in the eighteenth and nineteenth centuries. The figures are characterised by exaggerated female forms complete with large breasts, very narrow waists, and large hips. Both Lara Croft and Barbie dolls bring the same kinds of exaggerations to mind. Their distance from real female forms has been described by Galia Slayen writing for the Huffington post who tells us that, "*If Barbie were an actual woman, she would be 5′ 9″ tall, have a 39″ bust, an 18″ waist, 33″ hips and a size 3 shoe*". Figure 4.8 is a picture of Barbie.

Like affect, aesthetics have appraisal at their heart. We find things attractive because they offer the promise of good design/or are potential mate/or a sign of a desirable skill set or political persuasion. Aesthetics are an outwards sign of "good things" below the surface, and from the perspective of design, Xenakis and Arnellos (2013, 2014) have proposed a model that relates the aesthetics and affordances in the design process.

As Xenakis and Arnellos have indicated, aesthetics is an evaluative process that is borne from the intersection between oneself and the world and provides greater awareness of how one engages with one's world (Xenakis and Arnellos 2015). Recognising discomfort as somaesthetic points to the possibility of training oneself to recognise contexts that tend to cause bodily discomfort. Further, such recognition allows for training in "somaesthetic reflection", honing skills that enhance abilities to reflect upon and remedy feelings of discomfort.

4.7 Virtual Experiences

Some of the most striking and engaging experiences we can have of digital technology do not exist within the real world as such but in either augmented ("augmented reality") or "mixed reality") or wholly synthetic environments ("virtual reality"). This section very briefly sketches some of the experiences we might have using this technology.

The original concept for virtual reality lies with the work of Sutherland and Sproull in the 1960's though the name *virtual reality* was not introduced until 1984 by Jaron Lanier. So, the technology underpinning virtual reality (VR) has been with us for about 50 years ago and comprises a head-mounted display (HMD), a system to track the movement of our head and a computer to generate virtual world.

Figure 4.9 illustrates someone wearing an HMD (which is a light weight and light-proof helmet) which excludes the real world but allows its wearer experience a stereoscopic, high-resolution computer-generated virtual world. This virtual world or environment might be synthetic, photorealistic, or game-like. This experience is generally well reviewed but incidents of simulator sickness (feelings of dizziness—like seasickness) persist. As good as these modern HMDS are they are still not quite what Sutherland (1965) had in mind with his *ultimate display*. Sutherland having hoped that VR, "*With appropriate programming such a display could literally be the Wonderland into which Alice walked*".

In addition to the HMD where you are looking is tracked for the position, motion and the orientation of the head so that the system is able to update the scene you are looking at (i.e., move your head and the scene moves with you). In the early

Fig. 4.9 A VR-equipped user. Photo by Minh Pham on Unsplash

days of technology development, tracking and refresh rates posed problems. The practical problems of having a projector and screen strapped to one's head are not to be underestimated. The HMD also provides sound and the better the sound quality (e.g., stereo vs mono) the more effective the experience.

Well, that is two of our senses replaced by technology but what of the others?

4.7.1 Smell

Phylogenetically, smell is very old. Indeed, the brain itself can be thought of as a thickening of the olfactory bulb (the part of the modern brain dedicated to making sense of what we smell).

Smell in the context of VR has received attention for some years (Nakamoto 2013) and has witnessed the creation of technologies such as olfactory displays and interfaces. An olfactory display should be able to generate (and/or blend) odours and to diffuse them to a user for a particular purpose. Such systems have also been developed by and for the museums (to present the smell of unwashed peasant as part of historic recreations—e.g., Aggleton and Waskett 1999) and the military (to improve the realism of VR displays for its soldiers (e.g., the smell of jungles and swamps comes to mind along with the smell of smoke from ordinance and fires). The use of odours is varied and can be used to alert or warn people, to attract attention (e.g., Dozio et al. 2021); smell can also act as a memory booster—a “recall stimulant” (historically, the English chief minister Thomas Cromwell (1485–1540) used to crush and sniff rosemary leaves to boost his memory) and smell can act as a mood enhancer (e.g., Herz 1998).

4.7.2 Touch

The virtual replacement of touch and the tactile senses is much more complex—as it involved feeling with the receptors in our skin which vary considerably in sensitivity (compare finger tips with the space between our shoulders) and in their ability to distinguish between textures (e.g., compare the feeling of silk versus sandpaper). And touch is also active and passive—e.g., the feeling of being stroked or sliding on a glove as compared with stroking a cat (and being scratched) and feeling the subsequent pain.

The review of haptic interfaces for VR presented by Wee et al. (2021) highlights the complexity of designing for touch, noting four main types of human haptic receptors: mechano-receptors, nociceptors, and thermo-receptors, all located in the dermis or epidermis, and kinaesthetic receptors found in muscles, tendons, and ligaments. The range of available interface devices is also broad, comprising hand-held devices, wearables, “encountered types” (such as robotic arms), physical props and “mid-air haptics”, which support interaction through gesture. Among the main research challenges presented, the authors identify the need to better understand the characteristics of human haptic receptors and the perception of contact forces; accessibility and a requirement for underlying theoretical models and frameworks. These observations are supported in the slightly later review work of Gallace and Girondini (2022), who observe that progress in developing the haptic aspects of VR still lags substantially behind achievements in the visual modality, particularly where social interaction is involved. Interestingly, at a VR academic conference more than 20 years ago, a noted professor in this field stated that we will have succeeded with VR when we can “shake hands across the Atlantic” and it feels real. Another academic matched this by suggesting that when we can tele-operate a bone saw reliably across the Atlantic, then we will have succeeded.

4.7.3 Gesture

While gesturing with our hands is usually treated as an adjunct to verbal communication, there are a very substantial number of studies which indicate that this is too narrow an understanding. Why should we be interested in gesture as we can no longer

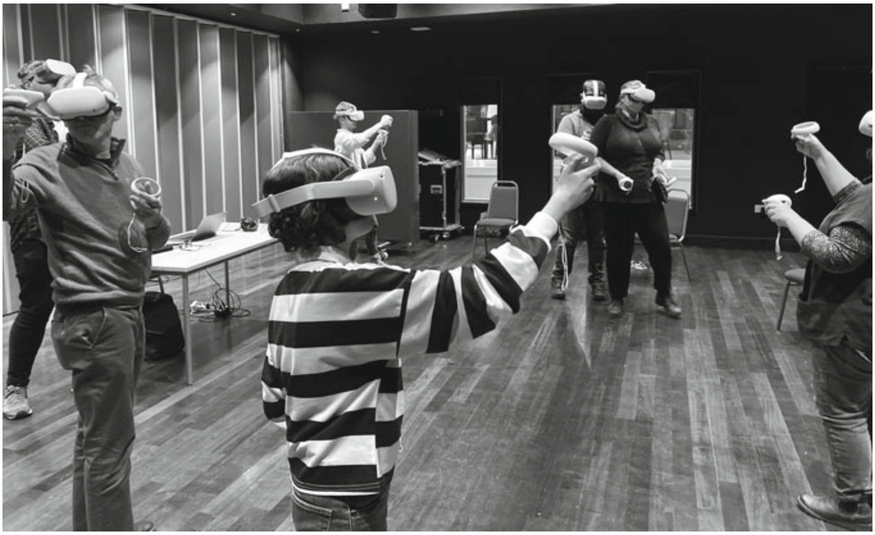

Fig. 4.10 VR out of the lab (courtesy of Leo and Hyde)

see our hands in VR? Well, we do know that we gesture while making a voice-only phone call, and we continue to gesture at night and in the dark.

Figure 4.10 is an image of a group of people experiencing VR in an arts centre organised by the theatre group “Leo and Hyde” who, as part of their range of interactive performances enabled their audience to experience virtual reality. As part of this and despite not being able to see each other, people continued to gesture and highlight aspects of the virtual environment to other which they alone could see.

The literature on gesture is surprisingly diverse and multi-disciplinary, and these few words can barely do it justice. However, that being said, gesture has been identified as a complementary strategy which is another way of saying epistemic action (Kirsh 1995b) and as a means of lightening cognitive load (e.g., Goldin-Meadow et al. 1991, among very many others); as an example of simulating action (Hostetter and Alibali 2008); and as part of our wider cognitive system (Clark 2008).

Kirsh defines gesture as a complementary strategy which recruits external elements to reduce cognitive load, and he includes examples of gesturing and thinking with our hands in this. He suggests pointing, arranging the position and orientation of artefacts so as to simplify perception.

Rauscher et al. (1996) also found that when people are prevented from gesturing when describing a spatial scene they showed significantly poorer fluency in their descriptions and those who were. These findings neatly making a lie of the old admonition, “look with your eyes not with your hands.”

Goldin-Meadow and her colleagues have established a considerable body of work in this area and among their findings is evidence that gesturing lightens cognitive load for both adults and children; and that gesture is tightly linked to the development of spoken language. While Wang and Nass (2005) have reported studies which have demonstrated that physical mobility appears to be directly linked to increased creativity.

4.7.4 Presence

Presence is usually described as the feeling of *being-there* and this is often complimented with a reference to *social presence* which is the feeling of *being-with* other people and a third form arising from *being-alongside* a non-human something (such as a toy, pet or robot) is also recognised. These definitions are, of course philosophical in origin and while being-there, being-with, and being-alongside have a "family resemblance", they are quite different. From these simple definitions, it should be clear that the experience of presence is astonishingly ubiquitous: walking into a place or by being-with another person or having the cat sit on our lap should offer a sense of presence (unless you don't like cats). We will refer to the feelings of presence (being-there, being-with, and being-alongside) as lived presence as they are experienced by being alive in the world.

However, when we introduce digital technology to this mix, being-there can be experienced without going there in person; and we can be-with other people at a distance; and having a non-human, digital companion can remain alongside us providing it is, for example, portable or self-propelled. Presence research also reflects this astonishing diversity, but a major theme has been to understand lived presence and then to reproduce these experiences as mediated, enhanced and extended by digital technology. We will refer to these mediated forms as mediated presence.

Thus, we can enjoy the feeling of mediated presence which comes from reading or listening to fiction, or watching a movie or playing a "video game". But, importantly, the first of these different forms of mediated presence have history: we have, in different ways, enjoyed them for millennia and in doing so, have invented rules and conventions (e.g., turning-taking, role playing, disapproval of cheating) and metaphors have developed such as how stories are told and the *n* different forms they take, and how games are played. These backgrounds provide a context which regulate, support, direct, and constrain the feelings of presence they might offer.

Furthermore, there is no longer a clear divide between those digital products which can offer (or boast) these experiences, instead there is an increasing overlap between the range of digital products which offer experiences such as immersion, engagement or sense of being-there (or the feeling of presence). The feeling of presence can be experienced in a variety of different ways. We can all feel present getting home after a long journey, the key slides into the lock, you push the door open, it looks and smells like home and there is the murmur of familiar voices coming from the kitchen—it feels like home. This complex, layered feeling is not a simple matter as can be seen in this extract from Downing (2003):

> [The kitchen] was also a place of sensuous delights, a place of fragrances: mouth-watering roasts, mashed potatoes, homemade breads, and pies that were to-die-for. The aroma of food wove through the intimate dramas of our gatherings and makes this place one my nose and

> mouth can re-create before my mind's eye can conjure it visually… It was also a place of family history.
>
> Downing (2003, p. 215)

This is an example of presence as *being-in*, as in being-in a virtual recreation of the Tomb of Tutankhamun or being-on (?) the surface of Mars. These are further examples of being involved with technology. As for examples of different types of presence, there is the feeling of *being-with* other people (as in Heidegger's *Mitsein*; or *nearness* to use IJsselsteijn's term. These are arguably the most important. The being-in variety may be the most visually striking but being-with connects people globally—and people like people. This feeling of social presence is made available to us by just *being-with* others. We can experience this by way of a phone call, a text or via an app such as Zoom (videotelephony). The study of this social presence had its origins with the use of telecommunications in the 1970s and there remains a sense of legacy about some of these studies which recall (unresolved) issues from research into computer-supported cooperative work (which was popular in the 1990s and also involved people working together using telecoms), and of course, the appearance of world-embracing social media. This experience of *social presence* is, of course, a common consequence of companionship, and friendship but something resembling this, (but not quite) can also be experienced when your cat greets you with a raised tail. This has also been termed para-social presence, as is another form of presence is also recognised which relies on the companionship of digital technology (*being-with* it) such smart speakers such as Amazon's *Alexa*. However, the canonical and most popular form of presence is the *being-there* variety. This has been explored recently by Tjostheim and Waterworth in their *The Psychosocial Reality of Digital Travel: Being in Virtual Places* (2022). But in addition to real places there is an abundance of "fictional places" or "universes" which are created for us to enjoy, for example, an effects-heavy, big-budget movie may be located in the fictional universe of a particular franchise (e.g., Star Wars or Star Trek or Marvel or DC). So, the wholly fictional has its own experiences to offer too.

Exploration of the various forms has given rise to a vast body of research from a 50-year history of work, the scope of which is a domain in itself and beyond the scope of this review of user experience. The interested reader is referred to the journal *Presence* and the series of Presence workshops and conferences. Most recently, the experience of presence has begun to overlap with the experience of the everyday, for example from the migration of Facebook to Meta, or the recognition that the binge-watching of online boxsets results in feelings of flow and presence.

4.7.5 AR

Yet another form of technology which has arisen in relatively recent years is AR, or augmented reality.

The appeal of augmented reality is the manner in which components of the digital world are perceptually blend into a person's experience of the real world. This is not as a simple scrolling display of data, but in a way in which they are perceived as natural parts of an environment. The earliest functional AR systems that provided immersive augmented reality experiences were created in the 1992, by the US Air Force and this is the form with which we are all familiar (*sic*) from the movies and video footage from real world combat. We may also be familiar from AR apps running on our phones. Although education (of course, or do I mean, *as usual*), and medicine, and entertainment have all shown interest in AR, it has been the success of Pokémon or "pocket monster" which has attracted most attention. Pokémon GO, is a location-based game which uses an app running on a smartphone. The player walks about the real world until he or she sees a Pokémon with which they interact. The game itself is surprisingly complex and can involves Poké coins, Pokémon candy, star dust, and experience points.

Figure 4.11 is an augmented reality screen shot from someone playing Pokémon GO. It shows the player where the nearest Pokémon character might be found.

Museums, managed historic and rural spots have also been equipped to provide a variety of experiences involving *being-there* or *being-with* using augmented reality (AR) technology. While these exhibitions in museums are numerous (and growing), they tend to follow a recognisable theme. The Mary Rose museum, for example, in Portsmouth (on the south coast of England) provides is an excellent demonstration. Their use of AR is part of a multi-sensory AR trail-based game in which a player adopts the role of an investigator into the loss of the Mary Rose (one of Henry VIII's ships lost in 1545). As a visitor and armed with their "magic spyglass" (your mobile phone) and a "scent pack" which releases clouds of location appropriate smells you undertake the investigation.

But if treading a Tudor trail does not appeal, you could instead visit a freshly excavated site on South Uist (an island in the Outer Hebrides, Scotland) where AR technology is being used to enable visitors to visit a virtual Cladh Hallan, complete with its roundhouses and a sense of how things were some 3000 years ago.

4.7.6 Abba

With a heart-felt "my-my", Autumn 2021 saw a reunited Abba announce their first new album in 39 years with an accompanying show in the form of a live VR performance. A specialist visual effects company had been retained to use motion capture to create four avatars ("Abba-tars"), which perform to a soundtrack provided by the live band. NME gave the show a 5-star review, saying "*Whatever sorcery this is, it works—and then some. Their movements, their shadows, their clothes, the way the sequins shimmer in the light... how can this not be real? The ABBAtars roll through the majestically dark 'The Visitors' and 'Hole In Your Soul', and then the impact really hits when the (immaculately skilled) real-life band appears beside them,*

Fig. 4.11 Pokémon GO in play. Photo by Mika Baumeister on Unsplash

playing instruments and providing backing vocals, and you can't tell the difference between man and machine".

In conclusion, Slater and Sanchez-Vives (2016) have written of how VR has been and will be used to "enhance our lives" across a vast range of applications—"*from medicine to business, from psychotherapy to industry, from sports to travel*". Here we must be careful to observe that if we have not seen much evidence of these enhancements in recent years, try not to worry about it. I have learned to live without a working cell phone.

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Chapter 5
Affect

5.1 Introduction

This chapter discusses our affective relationship with digital products.

Barrett and Bliss-Moreau (2009) tell us that the word *affect* "*means to produce a change*". They continue, "*… In the science of emotion, "affect" is a general term that has come to mean anything emotional. A cautious term, it allows reference to something's effect or someone's internal state without specifying exactly what kind of an effect or state it is. It allows researchers to talk about emotion in a theory-neutral way*".

Further, philosophy, psychology, the arts, anthropology, games research, and the cognitive sciences have all, in their own ways, contributed to this by devising any number of theoretical and empirical positions to account for them. So, perhaps the only thing which we might agree upon is that, no matter what we call it or which aspect we focus on, affect matters to us.

What's more, any discussion of affect takes place in the context of at least 2500 years of thought, reflection, argument, and controversy about it, indeed Oatley and Johnson-Laird (2014) have described affect as the "*gunpowder and the glue*" of human society.

5.2 Affect in HCI

Traditionally there have been two popular treatments of affect within human–computer interaction (HCI) which are "affective computing" (Picard 1997) and "emotional design" (Norman 2004).

Picard's publication of *Affective Computing* prompted the creation of a new field of research (of the same name) which is the study and development of systems and devices that can recognise, interpret, process, and simulate a range of human emotions. It is a multi-disciplinary field which relies upon contributions from

P. Turner, *A Psychology of User Experience*, Human–Computer Interaction Series,
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computer science, psychology, and the cognitive sciences. Picard herself admits that her initial belief was that emotion should be kept out of computing, was later to find that it plays an essential role in "*rational decision making, perception, learning and a variety of other cognitive functions*" (p. x). Since its formation, affective computing has diversified into the design of new ways for people to communicate their affective-cognitive states to both technology and other people.

Emotional design, in contrast, may be described as a design approach where a positive emotional response to a product is regarded as evidence of a "good design" and which may offer the promise of a "good user experience". Emotional design shares many of the characteristics of user-centred design which Norman helped establish some twenty years earlier and has since become an important aspect of digital product design (Norman and Draper 1986).

There are, however, advocates of a third approach to emotion within HCI who regard it as an essential part of cognition and/or an experience itself. Isomursu et al. (2007) are among those claiming that emotion is an essential component of those experiences arising from using digital products. Their position develops the ideas of Forlizzi and Battarbee who themselves drew inspiration from Carlson's *Experienced Cognition* (1997, p. vii). Carlson's argument is that any successful theory of cognition must "*begin with, and account for, cognition as experienced by the individual*" (ibid, p. 4) and in addition to the familiar components of cognition (e.g., memory and attention) he recognises a place for emotion. He identifies and proposes three functions of emotion which are involved in the shaping of our plans and intentions; the organisation of procedures related to these plans and the evaluation of the outcomes of those plans. Forlizzi and Battarbee read these as indicating that emotion shapes how we plan to use digital products, how we actually interact with them, and the perceptions and outcomes that surround those interactions—while we see these themes repeated throughout the chapter, it all underlines the centrality of affect in UX and the fact that it cannot be separated from experience.

Similarly, Mahlke and Thüring (2007) have also proposed that emotion is central to user experience, and suggest, a little self-referentially, that emotion affects a user's appraisal of a product. They tell us that a user's perception of the qualities of the digital product affects their emotional state and consequently their overall experience of the product. This echoes Dewey's view, "*emotion is the moving and cementing force. It selects what is congruous and dyes what is selected with its color, thereby giving qualitative unity to materials externally disparate and dissimilar. It thus provides unity in and through the varied parts of experience*" (Dewey 1934, p. 42). As can be seen from this quotation, he describes emotion as providing a unity to an experience. This can be can be demonstrated very easily and informally. Try answering the following question: "how was your holiday?". Many people (in my experience) will answer this with a single appraising word, such as "great", "disastrous", "dull", "dysentery", and so forth. Indeed, this can be extended to a surprising number of situations such as "what was your last job like", "what is it like to bring up children?" or "how was prison?". Each question can be answered in a word or two which often provide it with an appraisal and an emotional unity. For Dewey, emotions do not exist independently of an experience but tell us about the quality of the experience itself.

Given the range, complexity and importance of affect, it has been surprisingly poorly represented and understood within HCI and user experience. In an everyday sense, Boehner et al. (2007) are right to observe that affect is often seen as the "dual of cognition" and write that if cognition within HCI is recognised as a social, interactionist phenomenon, then this must also be true for affect. Indeed, affect, for all its differences from cognition, can nonetheless be located within the "same information-processing frame" (p. 275) and is susceptible to measurement. If this were so, then we might have expected the development of something equivalent to GOMS[1] but nothing like it has been proposed.

However, their point is made well enough and their proposed alternative, which would recognise the emotion of "national pride, justifiable anger, or shame" which has both social and cultural origins is really a plea to look at affect afresh.

It would be convenient to blame psychology for failing to present a coherent model of affect, after all, psychologists do not even agree on how many emotions there are, but that would be unfair. If affect is both the complement of cognition and is cognitive in its own right, the current state of understanding is no worse than we find in the many competing and complementary accounts of cognition (per se) that have been proposed. In short, this is difficult.

Hyde and Smith (1993) observe that Heidegger recognised emotions as "*vehicles for the active sensibility of human beings; that is, they provide the perspectives for seeing the world as interesting, as something that matters and that warrants interpretation*". They write that Heidegger does not see emotion as a psychical phenomenon but as the result of interaction between a person and the world concluding that, "an emotion orients a person towards the world in a *concernful* manner". From this perspective, emotions are a manifestation of our involvement with the world, and an appraisal of how things are going.

5.2.1 The Scientific Treatment of Affect

Approaching modern times, Evans (2002) identifies *sentiment* as a topic which held the attention of many of the key Enlightenment philosophers of the eighteenth century. *Sentiment*, he tells us, was used at that time to mean emotion. Smith (1759/2010), for example, took time out from inventing economics to write of his theory of *Moral Sentiments* in which he claimed that emotions were a thread which held

[1] GOMS is the best known of the modelling techniques created to predict human performance (John and Kieras 1996). John (2003) describes the GOMS family as consisting of ideas for analysing and representing tasks in a way that is related to the stage model of human information processing (italics in the original). The components of GOMS are goals—operators—methods and selection. A GOMS analysis begins with the user's goals and identifying the necessary operators and methods he or she will need to employ to accomplish those goals. On those occasions when there is more than one possible means of achieving a goal, a selection rule is applied.

society together cf. "gunpowder and glue", concluding that to be rational is to be emotional. Perhaps this was an early recognition of affect as being cognitive. And to which William James's famous (academic) paper entitled, "What is an emotion?" (1884) added significantly to the debate when he proposed that emotions were bodily changes which occurred in response to emotive stimuli, asserting that the very idea of "*a purely disembodied human emotion is a nonentity*" (p. 194). So, there is no thing as "pure emotion".

5.2.2 The Range of Affective States

We are able to experience and recognise a variety of forms of affect, including (first) impressions, emotions, feelings, and moods. Each can vary in intensity, duration, variety, and our understanding of their underlying neurological mechanism. Each is associated with a variety of definitions, and each has received very different levels of investigation (research). Given their intrinsic diversity and patchwork of research it can come as no surprise that they do not fit together particularly well and that not everyone agrees with their characterisations or definitions. The former social media giant Facebook has supplied its subscribers with a list of feelings (their term) with which to describe their current affective state. It is a long list and more than anything else eloquently defines the scale of the challenge faced when writing about affect. The list of Facebook's feelings is as follows:

> accomplished, aggravated, alive, alone, amazed, amazing, amused, angry, annoyed, anxious, awesome, awful, bad, beautiful, better, blah, blessed, bored, broken, chill cold comfortable confident drained, confused content cool crappy crazy curious excited, depressed, determined, disappointed down drunk ecstatic emotional energized exhausted, fantastic fat free fresh frustrated full funny, good, grateful, great, guilty, happy, heartbroken, helpless, hopeful, hopeless, horrible, hot, hungry, hurt, impatient, in love, incomplete, inspired, irritated, lazy, lonely, lost, loved, lovely, lucky, mad, meh, miserable, motivated, nervous, nostalgic, OK, old, optimistic overwhelmed, pained, pissed, pissed off, positive, pretty, proud, pumped, ready, refreshed, relaxed, relieved, rough, sad, safe, satisfied, scared, sexy, shocked, sick, silly, sleepy, sore, sorry, special, stressed, strong, stupid, super, surprised, terrible, thankful, tired, uncomfortable, upset, weak, weird, well, wonderful, worried.

There was also the option to "add your own". While not all of these would be generally recognised as feelings or emotions ("drunk?") they may indeed serve to describe social media users' affective states. And if not theirs, why not ours (assuming we are two identifiable groups).

5.3 First Impressions

Wundt, one of the founding fathers of psychology (first psych lab, first textbook, lots of solid empirical work), was the first to write about our first impressions:

> When any physical process rises above the threshold of consciousness, it is the affective elements which as soon as they are strong enough, first become noticeable. They begin to force themselves energetically into the fixation point of consciousness before anything is perceived of the ideational elements ... They are sometimes states of pleasurable or unpleasurable character, sometimes they are predominantly states of strained expectation ... the clear apperception of ideas in acts of cognition and the recognition is always preceded by feelings.
>
> Wundt (1897, pp. 243–244)

So, for Wundt, affect appears before the apperceptive (we would probably use the term "cognitive" now) and there is abundant contemporary evidence for this.

5.3.1 What We Make of Each Other

Of the many studies, most, though not all, have been concerned with the first impressions we form of each other. These first impressions we form of other people allow us to form rapid, accurate, and reliable impressions of each other in a fraction of a second and well before we before consciously aware of these judgements.

We can, for example, accurately and reliably form an impression of another's sexual attractiveness (e.g., Berry 2000); and their sexual orientation (Rule and Ambady 2008); and their physical attractiveness (Cunningham 1986). And it's not just about sex—well, it is actually in one way or another, as we also form impressions of people's trustworthiness (e.g., Basso et al. 2001); political affiliations (Ballew and Todorov 2007); personality (Borkenau et al. 2009); and competence (Abel et al. 2008). In short, we form first impressions of those we encounter, finding them attractive, trustworthy, threatening, or not. These affective responses may reflect what Searle (1983) calls *intentions in action.* Interestingly, these responses are not simple like/dislike judgements but are more complex. They can reasonably be interpreted as a means of readying the organism to cope with the world and other people in particular. Although first impressions are formed quickly, they have also been shown to be reliable and accurate in a variety of test/retest situations (e.g., Zajonc 1980; Willis and Todorov 2006).

Xux (1996) has also suggested that there is an emotional "logic" is at work, concluding that "*objects in the world may not necessarily be defined by their objective identity: what matters is how they are perceived*" p. 116. Norman (2004) has made similar observations in his account of emotional design (and user experience) the foundational level of which is the *visceral*. He also describes this level as being prereflective and independent of culture (and learning).

Finally, first impressions become lasting impressions (e.g., Sritharan et al. 2010) because, it is thought, that we store expectancy-violating experiences as exceptions-to-the-rule, such that the rule is treated as valid except for the specific context in which it has been violated.

Zajonc (1980) has also demonstrated that preferences can be developed with minimal stimulus exposure in times as brief as 1–5 ms. This is not so much "first impressions" but "mere exposure". However, comparing the descriptions of what Norman has in mind for his visceral design level and the very many mere exposure studies, it seems that these are likely to rely on different mechanisms.

Over the years, these very brief exposure effects have been shown to be extremely robust and it has been suggested that these may be the source of the "feeling" which accompany emotional responses. These impressions are affective, involuntarily and can occur, as we have already said, preattentively, that is, before the organism has had a chance to become aware of the stimulus or stimuli, for example, Ekman et al. (2013) has shown that emotional expressions begin to show in changes in facial musculature within a few milliseconds after exposure to a stimulus.

As we have already noted, LeDoux (1996) has proposed a neural mechanism which he calls the "amygdala shortcut" which enables us to form first impressions. The amygdala has been described as the gateway to sensory processing of emotions and is also known to play an important role at the interface between cognition and emotion (Kret and De Gelder 2012). A small bundle of neurons has been identified that lead directly from the thalamus to the amygdala, allowing it to receive direct inputs (this is the shortcut) from the sensory organs and initiate a response before the stimuli have been interpreted by the neocortex. Hence, an affective response can be triggered far more quickly than a reasoned response. This idea has been further developed by Daniel Goleman in his *Emotional Intelligence: Why It Can Matter More Than IQ* (1996) and described as the "amygdala hijack". Goleman uses the term to describe emotional responses from people which are immediate and overwhelming, and out of proportion with the scale of the stimulus. Evidence supporting this "shortcut" has also been reported by McFayden (2019).

As we have emphasised, first impressions are formed quickly, and most studies have been the impressions we form of one another. So, ability to form first impressions so very quickly may have evolved to allow ourselves to detect and evade another person, quickly. While this ability may have limited usefulness in an art gallery, our genes were not to know about the development of art. Lindgaard et al. (2006) have demonstrated, for example, that people are able to decide on the aesthetics of a webpage, that is, whether they liked it or not, in as little as 50 ms—one twentieth of a second.

PARO (the robotic seal we discussed in Chap. 3) had its first public outing in 2001, is now in its 8th generation and has been employed therapeutically in Japan, Korea, Europe, and the USA. Some cross-cultural differences have been reported in the descriptions human–robot interaction: a survey-based evaluation, for example, showed high positive ratings for the factor "comfortable feeling like interacting with real animals" by European users while people in Asia rated "favourable impression to encourage interaction" more positively (Shibata et al. 2009). The authors speculate that such differences may originate in the portrayal of robots in popular culture (more positive in Asia than in Western countries) and in the relative familiarity of real animals as therapeutic aids in the West.

This, of course, is an impression not a reasoned ("cognitive") position but it does also suggest something like the uncanny valley phenomenon. This phenomenon is a *feeling* not an *impression* per se, but as the name suggests it is the feeling of unease which people occasionally have when they encounter a humanoid robot. This is more fully discussed in Sect. 5.5 (“odd feelings”). According to Mori (1970, 2012), who identified this response, at some point our usual warm acceptance of a humanoid robot, drops sharply to “errrh, get off”, creepy or uncanny feeling. Mori called this the “*bukimi no tani*” (*ibid* 1970), which is translated as the now familiar “uncanny valley” (Reichardt 1978).

There are other (related affective phenomena) which have been identified in recent years such as the rubber hand phenomenon[2] (Botvinick and Cohen 1998) and the enfacement illusion[3] (e.g., Porciello et al. 2018) which seem to draw upon this first impression/odd feelings/anthropomorphism interplay.

5.4 Feelings

How we feel about something or someone is often the most important thing to an individual, but finding a definition of what we mean by “feeling” is all but impossible. At one end of the scale it is the inspiration of sentimental love songs, such as “*Feelings/Nothing more than feelings/Trying to forget my feelings of love/Teardrops rolling down on my face …*” *from Feelings (Morris Albert 1974)* to the unexpected and dramatic, such as the, *“unheralded germinators of human culture*” from Damasio discussed in more detail below.

In short, feelings may overwhelm an individual or leave them speechless.

For example, imagine asking an undergraduate student, after three years of attending classes how they have found their course (programme) to have been (“Your course—how do you feel?”). Unless the student is unusually loquacious, it would not be unusual to receive a one-word answer, such as “fine” or “ok”. Feelings are demonstrably evaluative.

The dictionary entry for *feelings* in the American Psychological Association (APA dictionary 2007) agrees, but tries a little harder and notes that a feeling is

> a self-contained phenomenal experience. Feelings are subjective, evaluative, and independent of the sensations, thoughts, or images evoking them. They are inevitably evaluated as pleasant or unpleasant, but they can have more specific intrapsychic qualities, so that, for example, the affective tone of fear is experienced as different from that of anger. The core characteristic

[2] The illusion comes on when the real and fake hands are stroked at the same time and speed for a minute or two. In combining the visual information with the touch sensations, the brain mistakenly concludes that the rubber hand must be part of the person’s body. When questioned about the feeling, the volunteers said it seemed that their own hand had vanished and the fake hand had become their own. This is best appreciated from watching a video. Search on rubber hand illusion. This is discussed further in Sect. 5.5.

[3] Enfacement is an illusion wherein synchronous visual and tactile inputs update the mental representation of one’s own face to assimilate another person’s face. Again, this is best understood from a video. Here is a good example: enfacement https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiUu4qkqIv-AhW6hv0HHaYYCAsQtwJ6BAgLEAI&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DFB2FCD3uNBE&usg=AOvVaw1R-nUp9aTtxY5O9qhLlRhy.

that differentiates feelings from cognitive, sensory, or perceptual intrapsychic experiences is the link of affect to appraisal.

The APA entry continues, "*Feelings differ from emotions in being purely mental, whereas emotions enable us to engage with the world. They are inevitably evaluated as pleasant or unpleasant, but they can have more specific intrapsychic qualities, so that, for example, the affective tone of fear is experienced as different from that of anger*".

5.4.1 Damasio on Feelings

Damasio and Carvalho (2013) write … *Feelings constitute a crucial component of the mechanisms of life regulation, from simple to complex. Their neural substrates can be found at all levels of the nervous system, from individual neurons to subcortical nuclei and cortical regions which arise as the brain interprets emotions, themselves physical states arising from the body's responses to external stimuli. (The order of such events is: I am threatened, experience fear, and feel horror.)*

Damasio has also suggested that consciousness itself, whether ranging from the primitive "core consciousness" of animals to the "extended" self-conception of humans, requiring autobiographical memory, emerges from emotions and, of course, feelings. Though we have a good understanding of what emotions are, and the purpose they serve, this is less true of our feelings. Feelings are more elusive and psychology per se may have neither breadth of vocabulary and conceptual underpinnings to account for them. Instead, we might turn to contemporary cognitive science.

Although these new cognitive scientific treatments of feelings are typically broad in their approaches ranging, it is the work of the neuroscientist Damasio (2001, 2019) which is the most striking. Damasio has sought to link biology and social science in terms of homeostasis—(which, he claims, is) the balance that underpins our physical existence, ensures our survival, and is the basis of our success as a species.

So, what is a feeling? A feeling tells us how things are. Our feelings offer us, whether we like it or not, an assessment of our current situation, our lives as a whole, our jobs, and our partners and friends or the problems that having an egregious manager causes. So, for example, Han Solo instituted a running joke with his, "*I have a bad feeling about this*" usually announced just before something goes wrong.

Damasio notes, "*How and what we create culturally and how we react to cultural phenomena depend on the tricks of our imperfect memories as manipulated by feelings*". He continues, without feelings, we would unable to respond to beauty—which he calls "*our mightiest conduit of connection with the living world*"—from which he concludes that we would be unable to recognise and classify things as beautiful; we would be unable distinguish between pleasurable and painful experiences; we would not have ideals that motivate us to reach beyond ourselves. He continues "*we would not be able to register the rewarding gratification of making a discovery or exercising generosity or creating something new, and therefore would not be impelled* *to do those things*". Damasio also notes that this impressive list stands in contrast to the conventional contrast between affect and reason, which he attributes to a narrow conception of emotions and feelings as largely negative and capable of undermining facts and reasoning.

In his *The Strange Order of Things* Damasio, as we have already noted, also makes a case for feelings being "*the unheralded germinators of human culture*" in that we have distinguished ourselves from all other beings by creating a spectacular collection of objects, practices, and ideas, collectively known as cultures. These collections include (deep breath) the arts, philosophical inquiry, moral systems and religious beliefs, justice, governance, economic institutions, and technology and science, all of which are reliant on our feelings.

Feelings, as the word itself implies, potentially concerns haptics and a role for the body. We feel emotions, though Colombetti and Thompson (2008) tell us that feelings are not separate constituents of emotion, but are emergent feature of emotional interpretation, and Prinz (2004) has described feelings as embodied appraisals. It is perhaps the enactive approach which offers the most radical and exciting prospect to understand feelings. Doing so, however, may mean accepting that they arise from the organisation of life itself which, of course, means that every man, woman, child, and bacterium (sic) experience them.

And we have Damasio and Carvalho (2013) who write from a neo-Jamesian perspective that "*Feelings are mental experiences of body states. They signify physiological need (for example, hunger), tissue injury (for example, pain), optimal function (for example, well-being), threats to the organism (for example, fear or anger) or specific social interactions (for example, compassion, gratitude or love)*".

In contrast, Schwarz (2010) proposed "*Feelings-as-information theory*" which conceptualises the role of subjective experiences—including moods, emotions, metacognitive experiences, and bodily sensations—in judgement. It assumes that people attend to their feelings as a source of information, with different feelings providing different types of information. Whereas feelings elicited by the target of judgment provide valid information, feelings that are due to an unrelated influence can lead us astray. The use of feelings as a source of information follows the same principles as the use of any other information. Most important, people do not rely on their feelings when they (correctly or incorrectly) attribute them to another source, thus undermining their informational value for the task at hand. What people conclude from a given feeling depends on the epistemic question on which they bring it to bear; hence, inferences from feelings are context sensitive and malleable. In addition to serving as a basis of judgment, feelings inform us about the nature of our current situation and our thought processes are tuned to meet situational requirements.

From another and well-respected philosophical perspective, of the other thinkers and writers, Nussbaum offers an interesting account of feelings framed in terms of the humanities and literature in particular. She writes than feelings are an indelible part of our reason.

The neglect of affect impoverishes the description of human nature. No satisfactory account of the human cultural mind is possible without factoring in affect. And yet feelings are not some mental abstraction that operates above and beyond our creaturely being—feelings are rooted in the elemental machinery of the body, literally arising from the gut. Damasio writes: The circumstances, actual or recalled from memory, that can cause feelings are infinite.

James claimed that various somatic and visceral responses to stimuli that can prompt conscious emotional experiences, Lange had a specific emphasis. To Lange, emotion was a cardiovascular event (Lang 1994). Nonetheless, both scientists agreed that emotion did not begin with the conscious experience of an emotion, but bodily responses to external events.

In addition to this, James in his philosophical writings subscribed to the position that physiology (the body) underpins the structure of intentionality. This is, unusually, very convenient as to feel present, we must have a body.

Bodies persist, bodies have a sense of self and of ownership, i.e., my feelings, your feelings and our or their feelings. Bodies have a history as feelings can persist and can, for example, be hurt and ignored. Unlike emotions (which can be very short-lived and fickle). We propose that feelings are a meta-stable psychological structure, able over time, to change or mend.

5.5 (Odd Feelings)

I have parenthesised the words "odd feelings" because an odd feeling is a little, well, odd. We have argued that a feeling tells us how we are doing, so what does the modifier "odd" add to this?

We experience "lived presence" by virtue of being alive in the world while most other forms are "mediated" requiring mediating media of some sort, for example, a book, game, or virtual environment. This mediation, in turn, relies on a representation of some kind which itself raises a good number of problems which need to be addressed. How, for example, do we acquire the representation which affords mediation? A typical "solution" is to propose that the representation is held as a "mental model". In an everyday sense, feeling present enables us to express our emotions but in our technological culture, feeling present enables to have those specific, all-important "user experiences" which developers and vendors value. In brief, if we did not feel present, we would be unlikely to regard our phones as the pinnacle of aesthetic expression, or whatever.

5.5.1 The Uncanny Valley

While the near-irresistible tendency to anthropomorphise may be convenient for those who design or deploy social robots, a significant obstacle to untroubled acceptance may lie in the phenomenon of the uncanny valley. According to Mori, the more robots and other synthetic beings resemble humans, the more positively we feel towards them. However, at some point of high similarity (but not perfect resemblance), this

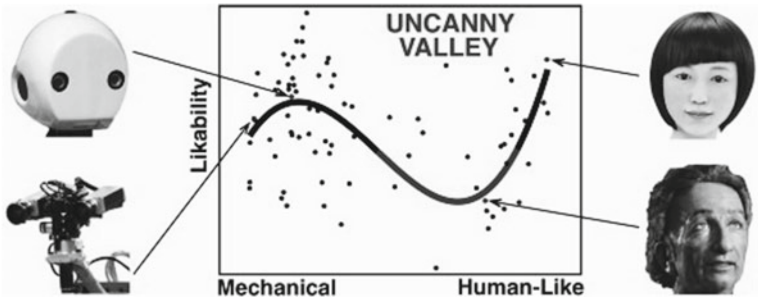

Fig. 5.1 The Uncanny valley

acceptance drops sharply and the product will be rated as unfamiliar, eerie, or uncanny (Mori et al. 2012). Then with greater human-likeness, positive perceptions return and increase sharply.

The phenomenon has given rise to a large body of research in psychology and social robotics, many more recent studies following Bartneck et al. (2009) in preferring likeability to familiarity as a more accurate index of the uncanny, and supplementing this dimension with ratings of eeriness and coldness. There remains lively debate about, and much current investigation of, the social and psychological antecedents of perceived uncanniness and equally of how this might be mitigated.

Among the major factors suggested have been: category uncertainty, i.e., the conflict arising from uncertainty as to whether, in this case, an object is human/animal or robotic (e.g., Green et al. 2008; Burleigh and Schoenherr 2014), including evidence from neurophysiological studies (e.g., Saygin et al. 2012); repeated engagement with robots (e.g., Zlotowski et al. 2015) and prior experience, robot task, and task context (e.g., Rosenthal-von der Pütten and Weiss 2015). Factors which may mitigate uncanniness include display of appropriate emotions by the robot (Koschate et al. 2016) and embedding encounters with a robot inside a framing story (Mara and Appel 2015). We might add a gloss to these lists: experimental materials and design, unsurprisingly, vary greatly between studies, so direct comparisons of their results are problematic. All that being said, there is considerable and robust evidence that the Uncanny Valley is a real phenomenon, so much so that Mathur and Reichling (2016) remark that it may prove to be an "*inherent and insurmountable feature of human category perception*" with consequences for how far trust can be achieved between a human being and a robot partner. Mathur and Reichling's representation of the Uncanny Valley can be seen in Fig. 5.1.

5.5.2 What Our Feelings Tell Us

Unconsciously we employ a variety of brain systems to the balance between our sense of self and the external environment. In the main this is achieved by processing and integrating a range of disparate bodily (sensory) inputs including the visual, auditory, vestibular, somatosensory, motor, visceral, and so forth and providing an online representation of the body in the world. In this view, the body representation in the brain is a complex crossroad where multi-sensory information is compounded in order to build the basis for bodily self-consciousness (Haggard et al. 2003; Jeannerod 2007; Metzinger 2008). Many behavioural studies over the last two decades have used techniques imposing multi-sensory conflict as a means to manipulate some components of self-consciousness. For example, the "rubber hand illusion" paradigm showed that by manipulating local aspects of body perception, it is possible to induce an illusory sense of ownership of a fake hand (e.g., Botvinick and Cohen 1998; Pavani et al. 2000; Ehrsson et al. 2004; Tsakiris and Haggard 2005; Tsakiris et al. 2007). In particular, if participants observe a rubber hand being stroked synchronously with their own (hidden) hand, they tend to report self-attribution of the rubber hand, as if it was their own hand. This illusory self-attribution is often accompanied by a "proprioceptive drift" towards the location of the rubber hand. Specifically, participants report a change in where they feel their real hand to be located (review in Tsakiris 2010). Similarly, if a participant holds one palm against that of someone else and simultaneously strokes the dorsal side of both her/his own and the other's index finger, an illusory feeling of numbness for the other person's finger can be perceived: the so-called numbness illusion (Dieguez et al. 2009). Furthermore, it has recently been shown that illusory self-attribution is not limited to the hands, but extends to other body parts including the face (Sforza et al. 2010). For example, the experience of having one's own face touched whilst simultaneously (the spatial and temporal sense) seeing the same action applied to the face of another, elicits the so-called enfacement illusion: that is an illusory sense of face ownership is induced and the other's facial features are incorporated into the participant's face (Sforza et al. 2010). All of these findings on illusory self-attribution support the idea that low-level multi-sensory processes can influence bodily self-consciousness. However, the self and bodily self-consciousness is globally associated with the body, rather than with multiple different body parts (Lenggenhager et al. 2007; Metzinger 2008; Blanke and Metzinger 2009). Recent behavioural studies showed that, beyond local aspects of body perception and self-attribution (rubber hand illusion, numbness illusion, face illusion), multi-sensory conflicts can also be used to manipulate more global aspects of body perception (Ehrsson 2007; Lenggenhager et al. 2007, 2009; Petkova and Ehrsson 2008; Aspell et al. 2009, 2010). These studies showed that it is possible to investigate more global aspects of bodily self-consciousness and described several different components thereof, such as self-location, first-person perspective, and self-identification.

5.5.3 Presence and Self-presence

The feeling of presence is not a fleeting emotional state nor does it feel that way. It persists, I feel present and it stays that way until I receive a crack on the head rendering me unconscious or I drop a tab of acid (LSD). It is wholly distinct from a fleeting emotion ("I was angry but now I am calm") and in other respects it is quite unlike a mood. A mood for the American philosopher John Dewey persists and "colours" everything. Whereas in Heidegger's (1927) *Being and Time*, moods are described as essential structures which enable humans to exist in a familiar everyday world that is always already intelligible to us. Characteristically, Heidegger identifies everydayness with "Befindlichkeit" which is how one might greet an acquaintance in German, e.g., "Wie befinden Sie sich?" or, "How do you find yourself?" which has the same ring of oddness as the formal English greeting, "How do you do?" to which one replies "How do you do?". But the feeling of presence is more than a point of view (it is more like a mood) and more specifically, we need a body to be able to feel it.

Biocca's (1997) definition of self-presence identifies three "bodies" present in a virtual world: the actual body, the virtual body, and the body schema, or the person's interna representation of themself. He argued that when we see a graphic representation of ourselves within a virtual environment, the representation evokes mental models of our body as well as our identity. Moreover, because these mental models of self are open to change (Fisher 1970), embodiment in a virtual world can alter both mental models, especially when the environment makes the embodied self-salient. In other words, the logic argues that experiences of self-presence can alter both our self-image of our body as well as our social identity—an intriguing possibility in the light of the growing popularity of games where players assume fantasy identities.

The potential influence of embodied experiences seems far-reaching. New game technology can provide redundant forms of simultaneous cross-model sensory activation in a manner that closely maps a player's body movements. This should cultivate a mental model of being inside the game environment (Biocca 1997). A significant advancement in this area has been the incorporation of first-person point of view (POV) into games. First-person POV exploded onto the gaming scene with the release of Wolfenstein 3D in the early 1990s. In this game, the player-character walked around a labyrinth to fight Nazis and other enemies. Unlike other action offerings at the time, however, the walking was done through the eyes of the main character. Instead of the character appearing on the screen and moving, the environment moved as if the player was travelling around in it. In addition, a representation of the hands of the main character holding a weapon was included at the bottom of the screen, mainly to make the player feel more in the "space" of the game (McMahan 2003). Today these features have been incorporated into many games as part of the highly successful 3D first-person shooter genre. In the future, we can expect even stronger perceptions of self-presence as VR technology increases its ability to completely coordinate virtual body movement with tracking devices, thereby reducing problems with proprioception that could otherwise terminate feelings of presence (Slater and Usoh 1994). Though discussion of self-presence in this sense focuses on body schemas created in first-person POV games, we should not overlook the fact that like all forms of presence, self-presence is first and foremost a product of cognition. As such, it is not determined solely by first-person POV and game technology's ability to limit problems of proprioception. For example, some new game technologies generate representations of players inside the virtual environment without creating first-person POV. The most notable example of this type of technology is the Sony Eyetoy, a small camera that captures the images of players and puts these images into games. Also notable is the ability of mapping to induce feelings of self-presence. Biocca (1997) suggested that close mapping of a virtual body to a user's actual physical body has a strong influence on both experience in VR environments and outcomes from experience. We can expect that game makers will continue to pay close attention to developing technology that creates graphic representations of the player and/or the sensation of being inside the game environment. As electronic games continue along this path, the role of self-presence as a critical factor in shaping future game experience will escalate.

5.6 Emotion

Emotion is probably the most relevant aspect of affect to UX as emotions can be thought of as a direct result of using a digital product, for example, we are happy with our new phone, we are excited by the game, we are frustrated by virtual reality and so on (e.g., Frijda 1986). As we can readily see from these simple examples, an emotion relies on an appraisal, that is, at its simplest, whether or not we like the something including digital products.

It was Charles Darwin who was to establish the scientific study of emotion in his *The Expression of Emotions in Man and Animals* published in 1872. This project is also noteworthy because it was the first to use photography as part of Darwin's scientific method. He used photographs to show how the expression of emotions is universal (or at least, accurately recognised from culture to culture), thus lending support to his proposal that we evolved from a common ancestor. Like Plato, Darwin regarded emotion as a vestige of our animal past and as such lacking any functional value because it has been surpassed by human reason.

Independently of William James' (1884) work on emotion, the Danish physician Carl Lange had reached similar conclusions resulting in the popular James-Lange theory of emotion. This account states that, if for example, we find ourselves being chased by a wolf, we interpret our physical state—say, trembling, running and crying "wolf!"—as evidence that we are afraid. This theory was challenged in the 1920s by Cannon on the grounds that animals that had their viscera surgically separated from their brains appeared to have unimpaired emotional behaviour (this claim was itself challenged a little later). The resulting rival Cannon-Bard theory of emotion was to place a greater emphasis on the role of the brain, claiming, for example, that the hypothalamus has a significant role in our emotional responses (Cannon 1927; Bard and Rioch 1937). Papez (1937) expanded on this when he proposed what was to become known as, the *Papez Circuit*. This "circuit" comprises the neural structures of the hippocampus, the fornix, and the mammillary bodies which includes many of the constituents of the limbic system. More recently, these bodies have been collectively described as the "visceral brain" by MacLean (1949, 1990).

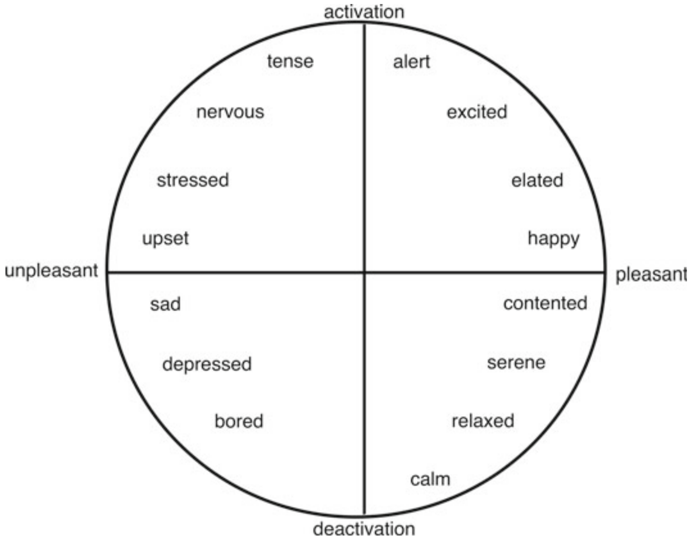

Fig. 5.2 The emotion wheel

Since then, research has led to a good understanding of the neural bases of a number of specific emotions—fear, for some reason, proving to be the most popular emotion among psychologists. Having set the scene, we now move into consider the current thinking on emotions.

Figure 5.2 is a fairly typical form of presentation of the emotions we experience. In this figure, the different forms of emotion have been divided among the active and the passive and the pleasant and unpleasant. This is a little misleading as the number of negative emotions tend to outweigh the pleasant varieties (see the discussion below on positive and negative emotions).

5.6.1 Emotions Are the Result of Appraisals

Reisenzein tells us that appraisal theory has its roots in the work of Arnold (1960) when she wrote of the direct, intuitive evaluations we employ to distinguish among the emotions. Her work has been seen as the first appearance of the post-behaviourist, cognitive accounts of affect which are the current vogue (Reisenzein 2006).

Despite emotional states appearing to be phylogenetically older, they had been nonetheless seen as "inferior" to cognition. This has changed and now they are regarded to be a form of cognition. Oatley and Johnson-Laird (1987), for example, regard emotion to be a form of communication, in that they guide our actions in situations of bounded rationality, that is, in situations of imperfect knowledge and multiple conflicting goals. Our emotions offer this guidance by making available a repertoire of actions which have been previously useful in similar situations, thus emotions effectively guide our actions and decision making (consciously and unconsciously).

Ratcliffe (2008) also writes that in "*describing emotions as cognitive, philosophers tend to mean at least that they are intentional states of some kind. They either are or at least (essentially) involve evaluations, appraisals or judgements*" (p. 20). Treating affect (as a whole) as a form of cognition is seen as attractive because it satisfies "*a deep intuition that emotions are meaningful. They … inform us about our relationship to the world, they embody our convictions, and they factor intelligibly into our decisions in life*" (Prinz 2004, p. 16).

Pessoa (2008) has also shown that those regions of the brain which had been previously viewed as "affective" are also involved in cognition; and conversely, brain regions previously viewed as "cognitive" are also involved in emotion; and, the neural processes which support emotion and cognition are integrated and cannot be treated as though they can be neatly assigned to separate modules. From this perceptive, "*complex cognitive-emotional behaviours have their basis in dynamic coalitions of networks of brain areas, none of which should be conceptualized as specifically affective or cognitive*" (Pessoa 2008, p. 148).

Finally, advocates of the cognitive approach to emotion also claim that, "*cognitive approaches based on the mind's organisation of conscious and unconscious knowledge, offer a clarifying perspective because they focus on the fundamental issue of how emotions are caused and what their effects are*" (Oatley and Johnson-Laird 2014, p. 134). We now consider three quite different accounts of emotion which have been variously adopted by HCI researchers.

5.6.2 The Nature of an Appraisal

Ortony et al.'s (1988) *The Cognitive Structure of Emotions* has proved to be popular with UX/design researchers. For example, Desmet (2002) adopted it as part of his design research; and, Bartneck (2002) put it to use in the design of embodied agents as did Bartneck and Forlizzi (2004) in the design of social robots. More generally Norman and Ortony (2003) sought to adopt it as part of an interaction design methodology—cf. Norman's *Emotional Design.*

Ortony and his colleagues differentiate emotions according to the character of their source, for example, events are judged by their consequences, agents by their actions, and objects by their intrinsic properties. These aspects are not exclusive, for example, people can be judged as agents or as objects. This, in turn, leads to three major classes of emotions: those arising from appraisals of objects correspond to likes and dislikes; those from appraisals of agents to pleasure and displeasure; and, finally, those from appraisals of events to approval and disapproval. There are further subdivisions, and in all twenty-eight emotions are distinguished. So, to use their example, we might focus on an event such as a sports match for its consequences—like our team winning; or we might focus on agents and its actions, for example, whether the neighbour's dog is going to bite you; or we might focus on an object, such as your new smartphone and how much you have to pay the telecoms provider every month for the next two years. Taking another approach, Schachter and Singer (2001) have described an appraisal as "*an evaluation of what one's relationship to the environment implies for personal well-being*." Frijda (1986, 2007) agrees and describes an appraisal as the process involving the detection and assessment of the significance of the environment for well-being. Concerns include the individual's needs, attachments, values, current goals, and beliefs (Frijda 2007; Lazarus 1991; Scherer 2004). In short, an appraisal includes everything that an individual might care about, showing how emotions bind us to the world.

5.6.3 Emotions Are for Action

A further account of emotion which has attracted the attention of design researchers is Frijda's *action-readiness* account which argues that emotions are built from elements which are not emotions but are what they describe as "ur-emotions". Ur-emotions are simple stimulus–response states of readiness, which carry with them a sense of whether we wish to maintain or end our relationship with the cause of the emotion (Frijda 2007). So, for example, we consider the emotion of joy, which is associated with the motivation to maintain or possibly enhance our relationship with the source of it. With fear, in contrast, the aim is to reduce or remove the source of danger. For Frijda, emotion is a process, with cognition regulating it.

Oatley and Johnson-Laird (1987) have created their own computational (rather than psychological) model of affect arguing that emotions guide our actions in situations of bounded rationality and make available actions which have been previously been useful in similar situations. Their theory argues that emotions are cognitively based states which coordinate processes in the nervous system.

Emotions have also been seen by many as providing solutions to problems arising from moving between plans. This theme of the relationship between emotion and the execution of plans has been considered by Oatley (1992) who also tells us, "*Each goal and plan have a monitoring mechanism that evaluates events relevant to it. When a substantial change of probability occurs of achieving an important goal or subgoal, the monitoring mechanism broadcasts to the whole cognitive system a signal that can set it into readiness to respond to this change. Humans experience these signals and the states of readiness they induce as emotions*" (p. 50). These emotions signal success, failure, frustration, and disgust. Oatley and Johnson-Laird equate achieving a sub-goal with happiness; the failure of a major plan with sadness; and the frustration of an active plan with anger.

Finally, Prinz writes that emotions must "*detect something more than the vicissitudes of vasculature* [changes in the state of our guts]. *Otherwise, they would confer no survival advantage*" (2004, p. 60). It is by having intentional directedness that aims at things external to the organism that emotions can play their distinctive roles in guiding our activity. Thus "*Emotions promote behavioural responses. We (are meant to) run when we are afraid of something external. If emotions represented bodily* *changes this would be unintelligible. We should flee when our hearts race*" (Prinz 2004, p. 59). Nevertheless, Prinz holds that emotions do not have ordinary intentional objects, such as particular objects or people, as their proper targets—except incidentally. This does not mean that emotions lack intentionality, rather, as Prinz stresses, emotions are intentional in their own right (2004, p. 62). This emotional guidance may also serve to signal our involvement with the situation.

Russell (1980, 1989, 1996, 2009), in contrast, has proposed that underlying any emotion is core affect—an idea which might be traced back to the thinking of Wundt. For Russell, core affect has two dimensions: namely the level of physiological arousal (from calm to excited) and the emotion's valence (the dimension of pleasure–displeasure). Core affect, then, is a continuous assessment of one's current affective state, and as this is a continuous process of change, the locus of our affect moves in response to impact of internal and external factors.

For the design researchers Desmet and Hekkert (2007) this account "*offers a simple, yet powerful, way to organize product experience, because all possible experiences involved in the user-product interaction can be described in terms of core affect*".

5.6.4 Positive (and Negative) Emotions

What has emerged from our discussion so far is that emotions have a broadly cognitive element (an appraisal) and have a corporeal aspect (a physiological change) resulting in an experience, and perhaps an action or are regarded as purely cognitive.

A key question which remains unanswered is how many are there? Ortony and Turner (1990) observe that there are a variety of answers to the apparently simple question, particularly when we modify it with the word "basic". So, how many basic emotions are there? Theorists and researchers have argued for a small number of basic emotions and while there are many who would agree, they do not agree on that number, or which emotions are basic, and why they should be regarded as basic. This has been a hotly debated topic for many years, and one of the oldest lists is Plutchik's (1980) influential classification which identified eight primary emotions, namely anger, fear, sadness, disgust, surprise, anticipation, trust, and joy. There followed quite a large number of alternative lists including Panksepp (1982) who has proposed the basic emotions of expectancy, fear, rage, and panic; Kemper (1987) has proposed a different four, namely fear, anger, depression, and satisfaction; and Oatley and Johnson-Laird (1987) base their work on the emotions of sadness, anxiety, anger, and disgust. At the other end of the scale, Frijda (1986) has identified 18 basic emotions, including arrogance, humility, and indifference, as well as the more commonplace anger, fear, and sorrow. However, Frijda (1987) also seemed to be happy with only two, arguing that we only have pleasant or unpleasant experiences. Friesen (1972) proposed six basic emotions (anger, disgust, fear, joy, sadness, and surprise), and Ekman et al. (1972) have reported that in reviewing a large body of published work that they found that every investigator had obtained evidence for six emotions (happiness, surprise, fear, sadness, anger, and disgust combined with contempt).

This universality of emotion has been challenged by a number of researchers. Prinz (2004), for example, writes that emotions vary across borders, and quoting other authors he notes that in Inuit culture, for example, signs of anger are rarely seen and that the Malay language has no exact synonym for "anger." He also asks us to consider the Japanese term amae, which is an indulgent feeling of dependency, akin to what a child feels towards a mother. Westerners may recognise something like *amae* in children but they rarely attribute anything of that kind to adults. Japanese also has a term *oime* for a feeling of indebtedness and fureai, which refers to a feeling of connectedness. For Prinz, emotions appear to be less like biological universals and more like "enculturated scripts". A further example comes from Lutz (1998) *In her Unnatural Emotions*, in which she claims that for groups in the South Pacific, emotional experience is not "*pre-cultural, but pre-eminently cultural.*" She continues, "*the concepts of emotion can more profitably be viewed as serving complex communicative, moral, and cultural purposes rather than simply as labels for internal states whose nature or essence is presumed to be universal. … The complex meaning of each emotion word is the result of the important role those words play in articulating the full range of a people's cultural values, social relations, and economic circumstances. Talk about emotions is simultaneously talk about society— about power and politics, about kinship and marriage, about normality and deviance …*" (pp. 5–6).

5.7 Mood

Finally, arguably the most mysterious (or least researched) of aspect of affect is mood which according to Russell (2003) is simply "*prolonged core affect without an object*". However, Richard Coyne's recent *Mood and Mobility* (2016) helps us to see that they are a means by which we make sense of the world and, unlike our emotions, we can never escape them. And, moods which are generally agreed to be longer lasting examples of affect (as opposed to emotions such as a flash of anger, which might be over and done in an instant) can be produced by using technology, to put us in a good mood ("good, I love using a tablet") or a bad mood ("I hate writing C++") or induce anxiety or excitement.

5.7.1 In a Mood

Coyne (2016) in his *Mood and Mobility* writes that emotion is too ephemeral but moods last. Mood is clearly an affective state but quite distinctly from the others (the exception, perhaps being temperament). Dreyfus (1991) observed that we can be in a mood but it is meaningless to write that there is a mood in us and another Heidegger scholar Bollnow (2011) writes that moods are neither inside the individual nor outside in the environment but lie in the individual in "*his still undivided unity with his surroundings*". We can also suffer from disorders of mood (e.g., Russo and Nestler 2013) but fortunately, moods can be stabilised pharmaceutically (e.g., Sanacora et al. 2017). Moods are also found explicitly in grammar, for example, the imperative (commanding) mood, or the subjunctive (possible or imaginative) moods. Coyne makes the important distinction between emotion (which he describes as personal and private) and mood which is often public. The public mood, for example, is a frequently encountered expression to which the media—social media in particular, politicians, and commentators often seek attune themselves. Such moods might include being interested, "ugly", enthusiastic, inspired, scared, hostile, ashamed, or melancholy—but this list, of course, is not complete.

Although moods are persistent, we abhor stasis—we like a change of mood and Coyne writes that digital products are "*complicit … as instruments to influence, transmit and transform mood states*" (p. 260). He also observes that digital products can also serve to highlight the "*mood of the times*". Moods can be transmitted and modified by and through pervasive digital media, particularly mobile devices and he gives the example of a Facebook emoji accompanying a status update (whether the emoji is a matter of mood or feelings or emotions is, of course, moot). He writes that melancholy could be considered as the quintessential mood. Melancholy is self-reflexive and thus can be considered as a meta-mood. A meta-mood allows us to be aware of the fact, in this case, that we are melancholy and this in turn allows us to discriminate between this and other moods and may contribute to their regulation. Coyne suggests that Turkle's description of our dependency on technology for social interaction could be characterised as melancholy and further that ubiquitous digital media seems to promote a state of melancholy.

Dick's (1968) celebrated *Do Androids Dream of Electric Sheep?* (which is quite unlike the movie realisation) the "Penfield mood organ", is introduced and is described as a device which can induce any desired mood in people. While moods such as "an optimistic business-like attitude" and "the desire to watch television, no matter what is on", are available, the protagonist's wife selects hours of "existential despair" to match her loneliness.

Coyne also notes that well-designed digital products can create a positive, "can-do" mood while Apple's products, for example, historically may have created a sense (mood) of playfulness—witness their colourful iMacs G3 of the late 1990s.

Similarly, online pornography can create a mood of arousal or disgust. This introduces the issue of the influence of media content and here music and mood are the best-known examples of this. Coyne argues that such relationships are probably not causal as other external factors have a role. However, social media content can trigger, sustain, and fuel collective mood changes (cf. the role of social media in the so-called *Arab Spring*[4]).

[4] The Arab Spring was a series of anti-government protests, and armed rebellions that spread across much of the Arab world in the early 2010s.

They are interactive digital media and environments designed to alter the interactor's psychological state. Freeman et al. (2004) have reported the development of Relaxation Island, which was developed as a "Mood Device".

Relaxation Island was designed to support established relaxation techniques, as part of interventions to assist individuals cope with specific anxieties such as examination stress, and also simply as a virtual place where anyone can go to relax. Attendees of this interactive experience will have the opportunity to relax on the island, navigating around the virtual space using a novel wireless "seashell" device.

5.7.2 Befindlichkeit and Stimmung

Heidegger does not have a great deal to say about affect but does discuss mood in some detail for which he uses a pair of terms, namely Befindlichkeit and Stimmung. These might be translated as *attunement* and *mood*, respectively.

Befindlichkeit has been variously translated as "how one finds oneself", or "state-of-mind". It is what we are enquiring about when we ask someone, "how are you?" in everyday speech.

In contrast, Stimmung—or "mood"—refers to an enduring disposition rather than the shorter-lived "being in a mood". Together they allow us to make sense of the world without, of course, ever escaping our moods. Not being in any particular mood or not being concerned is a mood. These are not the emotional expressions of Dewey which colour experience but are fundamental, as it is not possible for us not be in a mood. Downing (2000, p. 245) also helps here when tells us that mood is the ground against which things (figures) are disclosed, he writes "Moods are Heidegger's favourite example of a response to what matters in a situation, at least in part because they are so pervasive, intrusive, and uninvited. A mood makes manifest not only how things are going (here and now); but also, the way in which this matters, and the extent to which it just has to be accepted. Although it seems quite simple to categorise mood as just "persistent emotion", mood and emotion are different. Writing this sentence finds me in my usual mood (I would characterise it as calm and measured, while my wife would call it capricious) but I am not experiencing emotion. My mood points me at being accurate and clear in my writing but I feel a flicker of pleasure when I see that this chapter is nearly complete. Three affective states in a moment.

5.8 UX and Affect

We have identified a number of typical studies of user experience from the perspective of affect. These, it is hoped will underline some of the challenges encountered mating affect to experiment. They do not fit well and often require the use of additional perspectives.

5.8.1 I Love My Phone

Bowlby (1969, p. 242) proposed "attachment theory" to describe the affective relationship between parent (subsequently revised to "primary caregiver") and child. Bowlby tells us that: "*Each party manifests intense pleasure in the other's company and especially in the expression of the other's expression of affection … proximity and affectionate interchange are appraised and felt as pleasurable by both, whereas distance and expressions of rejection are appraised as disagreeable or painful by both*". It is interesting that Bowlby emphasises the reciprocal nature of attachment. Nonetheless, the subsequent use of the term by researchers has slowly become one-sided.

Schultz et al. (1989) have reported that when they asked people about their feelings about those possessions for which they felt attachment, love was the second most frequently cited (of the 83 emotions (sic) elicited). That our relationship with technology in general goes beyond mere functionality is also reflected in Verbeek's distinction regarding our attachment to the thing itself and to what the thing provides (Verbeek 2005). Though, by its very nature, emotional attachment to artefacts is to some extent capricious it is reasonable to assume that it is based on a repeated exposure or familiarity.

While proposing that emotional attachments can be observed between people and their pets (Thomson et al. 2005), it becomes a little more of a stretch to include other objects of our affection such as brands (Fournier 1998; Thomson et al. 2005), or places (Altman and Low 1992), or experiences (Arnould and Price 1993; Kleine and Baker 2004).

Kleine and Baker (2004) in their excellent review paper are able to refine this further by recognising different forms of attachment, for example, place attachment ("Paris in the Spring"); brand attachment (e.g., Apple™) and experience attachment (e.g., sky diving). They go on to offer the following definition of material attachment as, "*material attachment is a multi-faceted property of the relationship between an individual or group of individuals and a specific material object that has been psychologically appropriated, de-commodified, and singularized through person-object interaction*".

Konok et al. (2016) have also suggested that we have predispositions to form attachments to social partners, which we generalise to the non-human (e.g., pets) and the inanimate objects (e.g., personal jewellery or digital artefacts). They found evidence that found young people readily develop attachment towards their phone, keep it physically close and experience distress on separation from it. Their study concludes that attachment to such artefacts may be the result of what they describe as the "cultural cooption" of the attachment system. In a further study, Konok et al. (2017) note that while there are general perceptions of increasing levels of ownership of and engagement to, smartphones, whether this is actually attachment per se is yet to be demonstrated directly. However, in a series of studies, they did find evidence of separation-related anxiety (when people were deprived of their phones), which does tend to suggest that people do form attachment towards their phones which is analogous to social attachment.

The popular press often run features on the theme that we care more for our phones than our spouses, boyfriends, girlfriends, or indeed almost anyone else. Magazine and newspaper even run challenges in which their ace reporters try to manage a day or even as much as a week without their mobile phones. The participants often described themselves as bravely enduring “digital detox” pausing to reflect how much simpler life would be without a phone. Whether or not these journalists are “addicted” to their phones is moot but the use of the term attachment is more charitable and does serve to avoid any discussion of pathology (e.g., Billieux et al. 2015).

Meschtscherjakov (2009) has argued that the basis of any emotional attachment to technology lies with it being an expression or an extension of its user or owner, for example, of mobile phones he writes, “*Mobile devices enable us to stay in contact with our friends, to access information from everywhere, to be productive and efficient, to capture memories, and to be entertained. They make us independent, increase our mobility, and give us a freedom we do not want to miss anymore. Since mobile devices are also an expression of our personality and a symbol for our peer group membership, they have become an extension of our self*.” Meschtscherjakov et al. (2014) add to this in their investigation of the apparent growing attachment to mobile phones, a phenomenon which they describe as “mobile attachment”. They argue that rather than a simple emotional bond, mobile attachment emerges when the mobile phone becomes part of the user’s self-concept. This link or bond develops as it empowers, enriches, or gratifies the user’s self. They write that people have a need to behave consistently with the view of one’s self and extending this “self-consistency” motive, they have concluded that consumers prefer products that are congruent to their self-concept (e.g., Malhotra 1988; Sirgy 1982, 1985). It has been observed that people make a comparison between their self-concept and the product’s image and prefer products with a congruent image. Possessing congruent products is also valuable to express one’s self-concept to others, because it is common to make personality inferences about a person from the possessions they own (Burroughs et al. 1991; Gosling et al. 2002). The ideas of “brand” and even “product” attachment have also been proposed (e.g., Aaker 1997; Govers and Schoormans 2005; Jordan 1997; Lee and Cho 2017). Govers (2004) has defined product personality as “*the role of personality characteristics that people use to describe a specific product variant and to discriminate it* from others” (p. 15). For example, a Volkswagen Beetle has a happy and friendly personality.

Our final perspective on attachment is from McCarthy and his colleagues, following the original usage by Bennett (2001) who have proposed that we might become enchanted with technology. They write, “*An object or interactive system that is likely to evoke enchantment should offer the potential for the unexpected, given the chance of new discoveries, and provide a range of possibilities. The greater the opportunity it offers for finding new aspects or qualities, the longer the enchantment may last*”. From this perspective enchantment appears to complement attachment by introducing a “mindful” dimension. McCarthy et al. (2005) continue that, “*Enchantment does not necessarily imply that the object of enchantment must be* *novel or extraordinary, rather that the person sees how rich and extraordinary the everyday and familiar can be*".

In this section, we move from emotions about technology to those emotions we experience with technology. This might be seen as a nice point but it allows us to separate two quite distinct sets of emotional experiences, namely those experiences which arise from owning, using, or loathing the technology at work or owning the latest excellent phone from Japan and those which arise from playing digital (video) games. So, the key digital product we will consider in this section are digital games which have been specifically designed for emotion including competition, pleasure, adventure, fun, danger, and excitement and all from the comfort and safety of an armchair.

There has been, and there continues to be, a sustained but very diverse effort to design games which deliver distinct emotional experiences. Choosing three (more or less at random) we find Sylvester (2013) who advocates an "engineering" approach while reminding use for an (onscreen) event to be meaningful in "must provoke emotion" (p. 8). Isbister (2016) argue that games can play a "powerful role in creating empathy and other strong emotional experiences" and that "games reveal these emotionally positive qualities over time". Finally, Ge and Ifenthaler (2017) are interested in how we construct "serious games" in an educational context with an emphasis on engagement and assessment. In short, the sheer breadth of designing games for … is quite breathtaking. However, our interest is not in the design of what might be described as "games technology" but in the emotions they engender.

5.8.2 Playing Games for Pleasure

McGonigal tells us unequivocally that playing games makes us happy and that playing games will make the world a better place. In her *Reality is Broken* (2011), she provides us with an impressive array of statistics including that about 50% of the population play games and that the average player will have spent 10,000 gaming by the age of 21. She continues that 69% of all heads of household play games and large numbers of CEOs and CFOs take games breaks at work; 97% of all youth and 40% of women play (that figure is now nearer 50% according to Statistica). A game player has an average age of 35 and has played for 12 years and most expect to continue to do so for the rest of their lives.

Deterding et al. (2011) tell us that "gamification" originated in the digital media industry with a first usage dating from 2008. Gamification is a poorly defined term but among its many usages, it refers to using game-like features in non-gaming digital environment for the purposes of *motivation.*

So, for example, the language learning platform—Duolingo (https://www.duolingo.com/)—has a gamified user interface. Duolingo employs daily email reminders, a within-learning environment "currency" which can be earned and then used to buy access to extra features. It has challenges and a learner can "gamble" with their currency. Gamification is proving popular in the design of educational software and has been proposed, like so many ideas before it, as a potential solution to the perennial problems of getting young people to engage with boring education. It is not clear whether gamification offers emotional experiences or is a smart reinvention of "token economies".

So, while gaming might not be a usual topic in a discussion of UX, on the basis of the sheer weight of numbers, it demands our attention. So, why are games so popular? McGonigal's answer is that, "*Today, many of us are suffering from a vast and primal hunger. But it is not a hunger for food—it is a hunger for more and better engagement*." Games, she believes, have far more to offer than solipsistic retreat but her point is not so much technological as psychological. "No object, no event, no outcomes, or life circumstances can deliver real happiness to us. We have to make our own happiness—by working hard at activities that provide their own reward."

From this perspective, digital games are engines for creating and enhancing emotional experience and for making our lives "better". She claims that we crave, "satisfying work" because it allows us to be "optimistic about our own chances for success"; playing games involves "social connection", and they allow us to feel "curiosity, awe, and wonder". So, we can see a little of why she asserts that playing games make us happy.

When all of the technological frippery is stripped away (here we are thinking of things like screen resolution, refresh rates and the quality of the sound), she argues that there are four key defining characteristics for digital games: goals, rules, feedback, and voluntary participation. The goal is the specific outcome that players will work to achieve. It focuses their attention and continually orients their participation throughout the games. The goal provides players with a sense of purpose. The rules place limitations on how players can achieve the goal. By removing or limiting the obvious ways of getting to the goal, the rules push players to explore previously uncharted possibility spaces. She tells us that this helps unleash creativity and strategic thinking. The feedback system provides the players with information as to how close they are to achieving their goal. In its most basic form, the feedback system can be as simple as the players' knowledge of an objective outcome: "*The game is over when* …" Real-time feedback serves as a promise to the players that the goal is definitely achievable, and it provide motivation to keep playing. Finally, voluntary participation requires that everyone who is playing the game knowingly and willingly accepts the goal, the rules and the feedback (which is very reminiscent of GOMS).

Not everyone agrees with this somewhat messianic position, Suits (2014), for example, prefers to define a game in terms of embracing unnecessary obstacles. He writes, "*To play a game is to engage in activity directed towards bringing about a specific state of affairs, using only means permitted by rules, where the rules prohibit more efficient in favour of less efficient means, and where such rules are accepted just because they make possible such activity … playing a game [which he describes as lusory interaction] is the voluntary attempt to overcome unnecessary obstacles*." But McGonigal is undaunted, as her *SuperBetter* (2016) she reminds us that "*a gameful life can make you stronger, happier, braver and more resilient*".

A study reported by the polling company Bowen Research (Bowen n.d.) indicates that games are beginning to catch up with other media such as books, movies, and music with respect to their emotional impact on their users. In their survey of 535 gamers, over two-thirds said that games were either the best medium at eliciting emotion or would soon equal the other media. What is even more revealing is the list of "emotions" that gamers claim to have experienced.

Although this list is neither accompanied by a set of definitions nor has it been examined with controlled, empirical studies, whatever else, games are clearly a fertile source of emotion and/or quasi-emotional states. The report continues that after role-playing games, the most emotional genres (of games) were first-person shooters and action games. They also reported that scripted events in the former are becoming increasingly adept at telling an emotional story, but the most common feeling elicited by the games was competitiveness, followed by honour/loyalty. However, lowest on the scale, and notably lacking in those areas as well as "awe and wonder" or "delight," were flight simulators. The authors note that, "It is striking that young people today look at games as an entertainment medium that surpasses or will equal the more traditional things that touch us deeply, like books, movies, and music," and "*Half of all gamers think conveying emotion is extremely or pretty important which suggests that games which can achieve more of this will be extremely popular*." In the same vein, McGonigal has her own list of emotions which are said to be experienced while playing games. These are accomplishment amusement, curiosity, excitement, awe, beauty, bliss, compassion (for others), competitiveness, excitement, contentment, danger, delight, fiero,[5] frustration (and wanting to overcome), hate, honour, loyalty, integrity, love, naches,[6] relief, sadness, sexuality, spirituality, surprise, violence, wonderment.

Of interest here, is the appearance of "new" emotions indicating that games are a potentially rich and under-researched source of affect. However, aside from making us happy, some believe that they make (particularly young men) behave violently.

5.8.3 Playing Violent Games …

It is widely known that playing violent video games causes the player to become more violent. However, this is untrue. Not least because there are a number of non-sequiturs in such a statement. I have a couple of "violent video games" which I occasionally play, but never violently. I play them sitting down at my desk using a games controller which limits interaction to pressing the X key, or a square and a circle and a triangle and wiggling a couple of joysticks with a thumb. No sharp edges anywhere, yes I have a PS 4.

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[5] The feeling of triumph over adversity.

[6] Naches (pride in the accomplishments of one's children).

Elson and Ferguson (2013) in their comprehensive review of violence in digital games and consequent harm conclude that there are simply too many shortcomings in the reported work. We will follow the structure of their work quite closely. They begin by outlining the debate from social, political, and legal perspectives before moving to proposed psychological bases. The first psychological account is Anderson and Bushman's (2002) General Aggression Model (GAM) which relies on social learning. They describe it as the default model for many digital game researchers, particularly those who endorse the harm view of games. GAM is based on social-cognitive theories and has its roots in social learning theory, like Bandura and Walter's (1963) account. Its basic assumptions, as Elson and Ferguson tell us, are that behaviour is directed by schematic knowledge structures which themselves are acquired from being in the world and doing generally stuff. GAM, in common with many cognitive models, has no place for affect, personality, "the world", individual differences or biology. The other account is the Catalyst Model (Ferguson et al. 2008) which is based on the interaction between biological determinants and social context. Interestingly, this model does not propose a causal link between, exposure to violent scenes does and violence. Instead, exposure is said to shapes acts of violence which would have happened anyway, so playing a digital game with violent contents may serve to provide an expression for it. The reviewers note that this model had not yet been subject to detailed empirical scrutiny at the time of their writing.

Turning to the empirical evidence, they describe the many studies as largely sharing a common design in that a group of psychology students were recruited to play a game (violent or otherwise), while typically having their physiological arousal measured (often by way of a GSR measure) and then they are asked to complete a questionnaire to measure their affective state. The review then considers the evidence for three kinds of "harm", namely the evidence for aggressive cognition, aggressive affect, and violent behaviour. Considering these in turn, they note that measurements of aggressive cognition often take the form of a word completion task, an example of which is, supply the missing letter in the following, "explo_e". Here the missing letter might be "r" for explore or "d" for explode. If aggressive thinking has been activated, we might expect more explosions than explorations. Aggression scores for participants can then be calculated for participants who have played violent or non-violent games. Many studies have been able to show the presence of aggressive-related associations in players of violent games. Although the US courts appear to like these "common-sense" measures, they rejected them as evidence of such cognitions leading to violent intent. The reviewers then turn to the large number of studies of aggressive affect (anger or hostility) which rely on participant self-reports. These studies have reported a mixture of clear confirmatory evidence of people reporting anger after playing games, mixed results, or no evidence. However, a number of compounding factors in these studies have been identified, for example, Eastin (2007) has reported that group size and game mode (competitive vs. cooperative) have an effect on the reported feelings of anger. Overall, results linking violent digital games to aggressive affect showed smaller effects than other potential sources.

Finally, the evidence for playing violent games giving rise to aggressive behaviour was considered. As the reviewers note, inducing aggressive behaviour in the laboratory is fraught with ethical (and probably legal) problems, so experimenters are left to “approximate” it. One laboratory measure being the “Hot Sauce Paradigm” which involves measuring the quality of hot sauce a participant would use to prepare a cup of chilli for another (fictional) person. Again, the evidence is uncertain or missing or weak.

Overall, the Elson and Ferguson are vocal in their criticism of the design of many of these studies and conclude that there is no good evidence that playing digital games leads to aggressive cognition or aggressive affect or aggressive behaviour in the real world.

5.8.4 Using Social Media Can Make Us Anxious

The symptoms of social media depression include **feeling** left out, feelings of inadequacy and inferiority. This can be prompted by scrolling through pages of Instagram images or Facebook posts from friends, acquaintances, or even strangers—which often seem to embody their seemingly “perfect” lives.

Hartanto and colleagues (2021) have reported evidence of an inverse causal relationship between the use of social media and the experience of depression. The authors of the research note that according to the World Health Organization there are 264 million people worldwide suffer from depression. Depression is characterised by feelings of low self-esteem, impaired concentration, and disturbed sleep. Those suffering from this aged between 13 and 18 years of age are perhaps the most vulnerable. Worryingly, depression is also associated with serious problems including failure to complete education, higher unplanned parenthood rates, poorer interpersonal relations, and increased risk of illegal substance abuse and suicide.

While Lopes et al. (2022) have reported a review the appearance of mental health issues and social media and Internet use. They note that it has been long suspected that the use of social media made be associated with the occurrence of depression and/or anxiety but the evidence has tended to be only circumstantial or anecdotal. This detailed review of nearly 2000 publication revealed a strong and often bi-directional relationship between social media use and these conditions.

They found this relationship to be frequently related to problematic social media use, as they did not find a definite linear relationship between time spent using social media and mental health symptoms, except to say that, the longer the time engaged in social interaction, the poorer the outcomes.

5.8.5 *The Presence of a Cell Phone Can Calm Us*

Diefenbach and Borrmann (2019) report an investigation of the role of the smartphone being adopted by young adults as a source of emotional comfort. They argue that, given the central role of the device in the life of young adults who spend an average of four hours using it, there is reason enough to suppose that it may be associated with emotional support or comfort.

Diefenbach and Borrmann report a substantial study focusing on what they call "alone time" which they characterise as (the phone owner waiting) in the subway, or alone in bed. They were also particularly interested in how they managed their negative emotions with respect to this proposed "attachment object". Their results, firstly underlined the calming role of smartphone usage during the "alone time"; but they also highlighted the interaction between this and the personality dispositions of the owners. They found that those with a high need to belong, or a high propensity to boredom were associated with more extensive self-reported smartphone usage.

5.8.6 *Uncontrolled Use (Addiction)*

There is a growing body of literature reporting the overuse or misuse of smart/cell phones and a variety of associated social, developmental, and psychological problems. However, reducing these many studies to a meaningful sentence of two is challenging. Firstly, there is a matter of the sheer number of studies, consulting Google Scholar, for example, reports that there were more than 17,000 papers answering to the query "mobile phone addiction" in the last 5 years. From an academic perspective, this is recognised as being "quite a lot".

Reading (skimming) across these scholarly publications, they appear to fall into two or three major categories: some are primarily clinical, others which are social scientific and there are still others which are paediatric. The clinical studies are ultimately concerned with the diagnosis and treatment of people who are have become distressed as a result of this habit. In contrast, the social scientific studies are more concerned understanding the patterns of human cognition and behaviour. There may be a third category which is beginning to emerge which is concerned with the health of small children. My simple classification aside, we are left with a field which is large, complex, contradictory, and ill-defined. So, by way of example, we will compare two studies papers reported by De-Sola Gutiérrez et al. and Elhai et al., respectively.

From a clinical perspective, De-Sola Gutiérrez et al. (2016) after reviewing a substantial body of published work conclude that there is a consensus on mobile phone addiction, it is real but not well defined (it can, for example, be distinguished from "*Internet addiction*"). They found evidence for the greatest abuse to be among young people, primarily young women but they were unable to comment on cultural or socioeconomic factors which might have been at play because of the variations across studies. Mobile phone addiction was, however, found to be associated with extraversion, neuroticism, self-esteem, impulsivity, self-identity, and self-image (taken to be aspects of personality). Interestingly, other disorders, including sleep disturbance, anxiety, stress, and, to a lesser extent, depression, were also found to be associated with problematic phone use. The authors concluded by noting the coexistent relationship between problematic cell phone use and substance use (e.g., tobacco and alcohol).

However, from a non-clinical perspective, Elhai et al. (2017) reviewed the research literature on problematic mobile phone use but were unable to relate these findings with existing categories of psycho-pathology. They did find that most research examined problematic use phone use *and* disorders including depression, anxiety, chronic stress and/or low self-esteem. Across this literature, depression severity was consistently related to problematic mobile phone use; they found similar but less pronounced evidence for anxiety and stress. The authors of this study proposed that that phone "addiction" is better characterised as a struggle to maintain effective self-regulation, with "phone addiction" more accurately described as *overuse* due to loss of self-control. So, there we have it—clear evidence for the existence and non-existence of phone addiction. There is both convincing evidence that it will not cause problems and equally convincing evidence that it will. Let's begin with the good news. Orben and Przybylski (2019) published a review of the evidence examining the association between adolescent well-being and digital technology use, finding little or no effect. In contrast, Lin et al. (2012) tell us that Internet addiction is characterised by an individual's inability to control they use of the Internet (to which we add) *excessive screen time*. Brain scans have also revealed structural and functional changes in brain regions involving emotional processing, executive attention, decision making, and cognitive control. Further evidence has been presented suggesting that both grey matter and white matter may have become compromised (e.g., Zhou et al. 2011, Weng et al. 2013). The debate continues.

We conclude this discussion of affect with the words of the late great, James Brown tells us in no uncertain terms that, "Whoa! I feel good/I knew that I would/I feel good, I knew that I would, now/So good, so good, I got you" (I got you 1965). Good for him.

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Chapter 6
Killing Time

We're busy doin' nothin
Workin' the while day through
Tryin' to find lots of things not to do
Crosby, Bendix, and Hardwicke (1949)

This book has presented a psychology of user experience into which we have adopted a philosophical perspective to frame at least some of the ways in which we use digital products. Central to this is the premise that it is not just this ubiquitous presence of technology which provides the context for UX, but our routine use of it.

6.1 Introduction

Schaeffer (2019), at the Pew Research Center, tells us that "*Most U.S. teens who use cellphones do it to pass time, connect with others, learn new things*". This is quite revealing as it both highlights and elevates the importance of *time wasting*.

Teen boys and girls are about equally likely to say they often or sometimes use their devices to connect with other people (85% versus 83%, respectively), or just pass the time (both 90%) or learn new things (79% versus 87%). Teen girls are more likely than boys to use their cell phone to avoid social interaction. For many teens, phones have become a vital part of their daily routine, and their relationship with their device can be complicated.

This same survey found that around seven-in-ten teens (72%) say they often or sometimes check for messages or notifications as soon as they wake up. More than half of teens (56%) associate the absence of their phone with at least one of three emotions: loneliness, being upset, or feeling anxious. Girls are more likely than boys to feel anxious or lonely without their phone.

Teens have mixed views about whether they are on their phones too much. Some 54% of teens worry they spend too much time on their phone, and of those who say they spend too much time on the phone, roughly half (53%) say they have ever cut back on the time they spend on their cell phone.

P. Turner, *A Psychology of User Experience*, Human–Computer Interaction Series,
https://doi.org/10.1007/978-3-031-32454-3_6

6.2 Two Modes of Experience

Returning to our main discussion, we would argue that our trio of involvement, affect, and aesthetics are all cognitive faculties. This is not the small "c" version of cognition involving rule-driven symbol manipulation but the newer treatments of cognition which recognise the importance of our embodiment, and the role of the external world in how we think. Further, this is not cognition as information processing which for many is seen as a largely an outmoded legacy from the computer metaphor for the brain.

As we have seen, involvement is very inclusive. It encompasses the means by which we engage with and make sense of the world (which necessarily includes digital technology). In addition to making our stance concernful towards technology, it provides us with the means to use, and even form relationships with digital products.

Affect is cognitive because it is how we make sense of the world. Affect tells us about good and bad and much of affect, as emotion, relies on appraisals such as these. An appraisal is not based on carefully weighing options one by one but may take the form of "thoughtless thoughts" or feelings which have been described as "embodied appraisals".

Finally, aesthetics is cognitive, as in addition to being a source of pleasure, as it serves to guide our decision making. Aesthetics prompt us to be oriented towards the attractive form because, as we have learned, "*attractive things are easier to use*".

All three place the experiencer at the centre of the world of his or her making. All three are the result of the interaction between (among) the brain, the body of the organism, and its environment (or digital product). All three could, very naturally, be described from an enactive perspective (*vide* Valera et al. 1991). UX is unmistakably cognitive.

6.2.1 Two Ways of Thinking

Having recognised UX as cognitive, we should also see that cognition is modal, manifesting in at least two different forms. Kahneman, for example, in his *Fast Thinking, Slow Thinking* (2011) distinguishes between System 1 and System 2 thinking. While this is fairly traditional cognitive psychology in its origins, it is not limited to the laboratory.

Kahneman describes System 1 thinking as occurring "*automatically and quickly, with little or no effort and no sense of voluntary control*" (*ibid*, p. 20) and he contrasts this with System 2 thinking which involves the "*allocation of attention to the effortful mental activities that demand it, including complex computations. The operations of System 2 are also associated with the subjective experience of agency, choice, and concentration*" (p. 21). System 2 may also be described, in more familiar terms, as reasoning or deliberation while System 1 is more perception-like, that is, seamless, immediate and unmediated. UX relies on both systems.

6.3 A Third Form of Experience: Killing Time

We use digital products to get practical stuff done but, for some of the time, or perhaps even most of the time, we just idle with them. Here we do not mean playing a digital game which requires some effort to set up, but that often we simply use digital products to pass the time. This is not well understood, but all we need do to find evidence of it is to travel on any public transport system. There, many of us can be seen distracting ourselves with our mobile digital products. People are flicking between screens on their devices, not reading or searching, just letting images pass before their eyes and waiting for time to pass. We can even see people out on dates ("romantic liaisons"), filling in the awkward silences and pauses in the conversation with "fiddling with their phones" or at the cinema, during the dull scenes in the second act checking for messages, even though they know that the notification system is more than capable of handling this for them or rather ineptly in the back row of a lecture theatre while attending class. We are inveterate fiddlers and there is a restless energy about us (which may have a little to do with the caffeine content of soft drinks). While this fiddling does not appear to be purposive, as we will see, it may not be entirely useless or pointless.

It is a fact of everyday life, even before we invented the mobile phone, that we all day-dreamed and idle. We spend inordinate amounts of time thinking of others, or the movie we watched last night or how the cat is feeling, or where to take a holiday next year—none of which could be described as being particularly purposive much less problem solving, yet the study of cognition (including the modern varieties) seems to be almost exclusively concerned with the serious use of our wits. And if our formal study of psychological processes does not appear to match how we spend our time, this is made doubly more mysterious when we realise that there is substantial neurological evidence that there is a "default circuit" in the brain devoted to just these kinds of apparently pointless activities. In the literature, these pointless activities are usually described as "mind wandering", and we should note that this is not usually associated with digital technology. However, we might describe web surfing (as opposed to web browsing which may be unplanned but purposive) as killing time with a browser. Various technology surveys tell us that browsing has gone mobile (that is, the web is more usually accessed from a phone rather than a personal computer) and that teenagers, in particular, much to our surprise spend an alarming amount of time web surfing.

Digital products mediate idling. It is evident that some of the current generation of digital products in addition to offering all manner of user experiences also actively promote killing time. If this seems to be something of an exaggeration, at least it is fair to say that they certainly support and scaffold time wasting. Books are still read, of course, but more and more people prefer to spend their quiet time (commuting to work or college; lounging on the holiday beach and, increasingly, while out with friends —even while sitting with them at the same table) killing time with their smartphones rather than reading from paper. This clearly cannot be regarded as purposive in the usual sense (in that there are no goals or targets) and it does not appear to be a source of enjoyment in the same way playing a digital game is fun, but there is something compelling about it as lots of people spend lots of time killing time.

6.3.1 The Neural Basis of Killing Time?

Before an fMRI[1] can be used, the rest state of the person being examined needs to be established and Ingvar (1974, 1979, 1985) was the first to note the presence and importance of consistent and specific pattern of activity in the resting brain. To explain this, he proposed that the "hyper-frontal" pattern of activity corresponded "*to undirected, spontaneous, conscious mentation, the 'brain work' which we carry out when left alone undisturbed*". Thus, what came to be known as the *default network* was identified. It is a network of highly correlated, interacting regions of the brain. The default network is most commonly shown to be active when a person is not focused on the outside world and the brain is at wakeful rest, such as during daydreaming but it is also active when the individual is thinking about others, thinking about themselves (e.g., retrieving autobiographical memories), remembering the past, and planning for the future (e.g., Buckner et al. 2008; Raichle et al. 2001; Buckner and DiNicola 2019). Since its identification, this default circuit has been of interest to those who were concerned to know why the brain was consuming more oxygen and glucose when it was at rest than when it was apparently busy (e.g., Raichle et al. 2001; Buckner et al. 2008).

The default network is a distinct neural system that is active when we are not focused on a particular task and on the basis of this evidence, Buckner and colleagues (2008) have proposed that it may be the source of internally directed cognition. It is implicated in the production of internal mentation, which itself is grounded in autobiographical memories, speculations about the future, but separate from the real world. Pace-Schott (2013, p. 1), writes that "*dreams create new stories out of nothing. Although dreams contain themes, concerns, dream figures, objects, etc., that correspond closely to waking life, these are only story elements.*" Pace-Schott suggests that a credible source for these (night time) dreams is the default network. He then goes on to argue that this story-like structure found in dreams may have become integrated into existing belief systems, or even to create new beliefs and legends.

Social cognition also seems involve the default network (Spunt et al. 2015; Meyer et al. 2019).

As the mental state resulting from the operation of this default network is by definition is our default condition, it follows that it must have a role in the everyday things we do including planning and prospective thought and our social relationships with others, and possibly creativity including storytelling (e.g., Bar 2007; Buckner

[1] Functional magnetic resonance imaging (fMRI) measures the changes in blood flow that occur during brain activity.

et al. 2008; McVay and Kane 2010; Mooneyham and Schooler 2013). The role in planning, for example, may prepare an individual for expected or forthcoming events, and visualising potential outcomes serves to improve our readiness in otherwise unpredictable situations.

This also suggests that the default network may be active when we are idling with our mobile phones and the like. And Binky adds an empirical dimension to this argument.

6.3.2 Binky

Binky is a social network app that is available for Apple and Android mobile phones and offers "an infinite feed of random things to look at". These images are binks and all the user needs do is pay attention. It is a content-free services with no network or socialising but Binky may more satisfying than real social media services.[2] Its posts are innocuous and comprise images of a variety of fairly ordinary things which have been quite nicely photographed. Users are free to comment on the images without consequence and the likes or "re-binks" are not tallied.

The creator of Binky claims that the idea for it came to him while waiting for a train, telling us that he did not want to engage cognitively with anything but felt that he should be looking at his phone, which he describes as his "default state of being". His aim was to provide a service which allowed people to interact with it but without consequences. To this end he has created something with affords the repetitive actions of touching and tapping a glass rectangle with purpose and seeing it "nod in response". It may be that Binky offers something for our "default network" to do after all.

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[2] The following section has been adapted from an interview in the Atlantic magazine. https://www.theatlantic.com/technology/archive/2017/06/the-app-that-does-nothing/529764/.

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