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DEVELOPMENT OF "A CHOICE ARCHITECTURE PROTOTYPE" FOR ON CAMPUS TRAFFIC MANAGEMENT: A CASE STUDY OF CAPITAL UNIVERSITY OF SCIENCE AND TECHNOLOGY, ISLAMABAD

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Development of "Choice Architecture Prototype" For On Traffic Management: A Case Study of Capital University of Science and Technology Islamabad

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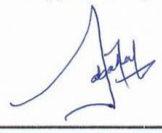

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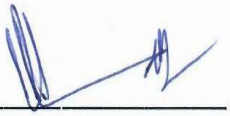

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DEDICATED TO

To My Parents

Your enduring love and sacrifices are the essence of this accomplishment; this work stands as a tribute to your profound influence. Thank you for being the driving force behind my success.

My Mentor

With heartfelt gratitude, I dedicate this thesis to my exceptional supervisor,

Dr. Sabahat Haqqani.

DECLARATION

It is declared that this is my original piece of work, except where otherwise acknowledged in text and references. This work has not been submitted in any form for another degree at any University and shall not be submitted by me in the future for obtaining any degree from this or any other University

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Abstract

Traffic congestion poses a significant challenge on university campuses, leading to delays, frustration, and environmental concerns. This study proposes a novel approach to address this issue through a choice architecture prototype based on principles of behavioral economics. By recommending nudges, subtle interventions will encourage more efficient driving behavior, ultimately reducing congestion and improving overall traffic management. The study aims to observe existing driving behaviors, assess the impact of interventions on traffic flow, time management, and driving behavior, and evaluate the overall effectiveness of the choice architecture program.

The research utilized a field experiment design, focusing on the university community as the target population. Convenience sampling and observational methods was employed throughout three phases: (1) Initial observations and analysis of current driving behaviors; (2) Design and implementation of the choice architecture prototype for campus traffic; and (3) Evaluation and monitoring of the effectiveness of the nudge interventions. Ethical considerations were paramount, and the study acknowledged limitations such as individual variability and sample size constraints.

This program has the potential to not only alleviate traffic congestion but also to enhance efficiency, sustainability, and safety in campus transportation. By promoting a more responsible and streamlined driving experience, the choice architecture prototype aligns with the broader goals of creating a conducive and environmentally conscious university transportation system.

Keywords *Traffic congestion, Choice architecture, Nudges Behavioral economics, Driving behavior, Campus traffic management.*

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Chapter 1

Introduction

University campuses, similar to busy metropolises, offer a spectrum of amenities classrooms, offices, dormitories, libraries, and sports facilities. Amid this vibrant setting, parking congestion emerges as a pressing challenge plaguing most educational institutions (Johnson, 2019; Smith et al., 2020). The scarcity of parking spaces, particularly during peak weekday hours, gives rise to a cascade of issues. The repercussions extend beyond mere inconvenience, impacting punctuality for students, employees, and teachers, while also contributing to a surge in parking penalties (Brown, 2018). The overflow of parking spills into neighboring areas, provoking grievances from local businesses, property owners, and residents. This thesis delves into the multifaceted problem of parking and congestion on university campuses, unraveling its effects and exploring viable solutions to enhance the overall campus experience.

Traffic congestion is a significant issue on university campuses, particularly during peak hours. It leads to traffic jams and gridlock from parking areas to the main road, causing delays, frustration, and a wastage of time. Heightening the stress level promotes much false driving behavior such as risk-taking, aggressive driving behavior, impatience driving, and reckless driving (Qian & Li, 2019). Universities, being hubs of activity, have a high concentration of individuals, vehicles, and goods, making traffic management a critical concern. Traffic congestion on campuses has both economic and social costs, with effects ranging from reduced productivity to environmental pollution. As such, addressing traffic congestion is crucial in enhancing the efficiency and sustainability of universities (Thaler & Sunstein, 2008).

Nudges are defined as subtle changes in the choice environment that influence individuals' behavior without restricting their choices or imposing penalties. In recent years, behavioral insights and the application of nudges have gained significant attention in various fields, including public policy, economics, and healthcare. Nudges prove themselves to be effective in influencing human behavior without resorting to mandates or strict regulations. Instead, they rely on subtle cues, prompts, and incentives to guide individuals towards making desired choices (Litman, T. 2021).

Economic, demographic, and geographic considerations all have an impact on parking demand, claims Litman. Students, employees, professors, and visitors are the four main user groups on university campuses, and each has distinct spatial and temporal usage patterns. The amount of parking spaces offered by the institution is referred to as the parking supply. The infrastructure for campus parking often consists of a number of (open surface) lots and (multistorey covered) garages, each with a small number of spaces to several thousands. A zone may consist of a number of nearby garages and properties. Zoning is a useful policy that limits access to particular user types. By paying fixed fees for permissions, users can enter certain zones (Litman, T. 2021).

The Choice Architecture prototype program applies to traffic management to address the challenges of congestion and inefficiency on university campuses. By understanding the cognitive biases and decision-making processes that influence drivers' behavior, it becomes possible to design interventions that lead them towards more efficient and responsible actions (Benjamin et al., 2020).

One key aspect of the proposed *Choice Architecture* program is the identification of specific behavioral bottlenecks and decision points that contribute to

traffic congestion on the university campus. These bottlenecks could include areas where drivers tend to exhibit inefficient behaviors, such as long wait times at stop signs, improper lane usage, or excessive speeding in high-traffic zones (Sussman et al., 2020)

To develop effective interventions, it is crucial to gather data about the driving patterns and behaviors of individuals on campus. This can be obtained through observational studies of existing traffic. By understanding the underlying factors that contribute to congestion, such as peak hours, parking availability, and common routes, targeted nudges can be designed to address these specific challenges. For instance, signage and visual cues can be strategically placed to provide information and guide drivers towards available parking spaces, alternate routes, or specific entry points. Additionally, implementing speed reduction measures, such as speed bumps or road markings indicating reduced speed limits, can help manage traffic flow and encourage drivers to adopt safer driving speeds. These subtle cues can create an environment that promotes responsible driving behavior and reduces the likelihood of congestion and accidents. Moreover, leveraging technology can enhance the effectiveness of the *Choice Architecture* program. For example, a mobile application (portals) could provide real-time updates on traffic conditions, parking availability, and optimal routes within the campus. Such an app could incorporate nudges, such as notifications reminding drivers of congestion during peak hours (Benjamin et al., 2020).

Feasibility testing is a critical component of the proposed program. It allows the assessment of the effectiveness and acceptance of the nudges among the university community. The development and feasibility testing of an Observational Study of Choice Architecture Prototype for traffic management on a university campus hold great potential for alleviating congestion, enhancing accessibility, and promoting safety.

Ultimately, the successful implementation of this program can contribute to a more efficient and sustainable transportation system on university campuses, benefiting both individuals and the environment (Forberger, S. 2019).

Pakistan grapples with pervasive traffic congestion and recurrent traffic jams, presenting a significant challenge in urban centers and around educational institutions like Capital University of Science and Technology, Islamabad. This prevalent issue not only impacts individuals' daily routines but also engenders frustration, safety hazards, and economic losses due to time wastage and reduced productivity (Malik & Butt, 2018).

At CUST, the traffic congestion further compounds during peak times 3:20pm and 5:10pm, causing notable delays for students, faculty, and staff. The overflow of vehicles onto main roads from the campus exacerbates the problem, leading to gridlocks and amplified frustration among commuters. Addressing these challenges through Choice Architecture and targeted interventions holds promise in managing congestion and cultivating safer driving behaviors within the university campus.

The university faces traffic congestion due to commuting patterns, overflow onto main roads, and parking issues. Lack of awareness and non-compliance with traffic rules worsen the situation. Solutions involve promoting alternative transportation, encouraging parking rule adherence, and raising awareness for responsible driving. These behavioral interventions aim to ease congestion and ensure a safer campus commute.

There was an *Observational Study of Choice Architecture Prototype* conducted to propose the *Choice Architecture* program for traffic management problems.

Literature review

The increasing challenges of traffic congestion within university campuses during peak hours present a compelling backdrop for exploring innovative solutions rooted in behavioral economics, particularly the concepts of "nudge" and "choice architecture." As institutions of higher learning grapple with the complexities of urban mobility, understanding how subtle modifications in the presentation of choices can influence individuals' decisions becomes paramount. This literature review embarks on a journey through the intersection of behavioral economics, choice architecture, and traffic management, aiming to unravel the potential of nudges in mitigating congestion issues. By delving into studies that explore the application of choice architecture to shape commuting behaviors, this review seeks to illuminate the nuanced ways in which nudge strategies can be strategically deployed within the university campus setting. From personalized travel plans to social comparison feedback, this examination encompasses a spectrum of interventions designed to guide individuals toward more sustainable transportation choices. Through this exploration, the review endeavors to contribute insights that go beyond conventional traffic management approaches, offering a fresh perspective grounded in the principles of behavioral economics. In doing so, it aspires to provide a foundation for developing context-specific strategies that alleviate congestion, enhance transportation efficiency, and cultivate a more sustainable and user-centric campus mobility experience.

Exploring the Effectiveness of Parking Cash-Out Programs:

Shoup's (2014) seminal study, "Behavioural Economics and Travel Demand Management: The Case of Parking Cash-Out," delves into the impact of parking cash-out programs on traffic congestion. It emphasizes the effectiveness of providing

employees with cash incentives to alleviate congestion and promote sustainable commuting habits. The study highlights the role of behavioral economics in reshaping travel demand.

Gurbuz et al. (2019) contribute significantly with their work on "Modeling Student Parking Demand on University Campuses." This study focuses on the unique characteristics of student parking preferences, enriching our understanding of parking demand on university campuses. The nuanced insights aid in tailoring parking management strategies to address the specific needs of students, the largest user group.

Huang and Yang's (2016) examination of the relationship between parking pricing and travel behavior complements the discussion on parking cash-out programs. Their study provides insights into how pricing strategies can dynamically influence parking demand, contributing to the broader goal of reducing traffic congestion through behavioral interventions.

Behavioral Economics Unveiled in Mumbai's Traffic Management:

McKenzie-Mohr's (2018) study on Mumbai's traffic congestion explores the practical applications of behavioral economics principles. It delves into the effectiveness of interventions like pricing policies, incentives, and information provision. The research sheds light on how these strategies can be adapted to diverse urban contexts, showcasing the versatility of behavioral economics in addressing traffic challenges.

Cherchi and Cirillo's (2019) research on "The Power of Nudges to Encourage Sustainable Transportation Choices" aligns seamlessly with the behavioral economics perspective. Their exploration of nudging interventions offers crucial insights into

promoting sustainable transportation choices, adding valuable dimensions to the discourse on behavioral interventions in complex urban settings.

Shang's (2018) comprehensive review on "Traffic Congestion and Behavioral Responses" synthesizes theoretical and empirical literature. It emphasizes the pivotal role of behavioral interventions, such as incentives, social norms, and information provision, providing a holistic view of strategies to effectively tackle traffic congestion in urban areas.

Behavioral Interventions Championing Safety and DUI Reduction:

Delhomme et al.'s (2017) exhaustive review on "Behavioral Interventions for Reducing Driving under the Influence (DUI)" explores diverse intervention avenues, including education campaigns and sobriety checkpoints. The study aims to foster responsible driving behaviors and reduce accident risks, highlighting the significance of behavioral approaches in enhancing road safety through targeted interventions.

Benjamin et al. (2020) significantly contributes to this realm with an overview of "Behavioral Interventions for Traffic Safety." Their exploration of feedback, incentives, and social norms in the context of traffic safety delivers valuable insights that can inform policies and strategies for creating safer road environments through the lens of behavioral economics.

Delhomme et al.'s (2019) meta-analysis on "Behavioral Economics and Traffic Safety" serves as a comprehensive examination of studies applying behavioral economics to enhance traffic safety. The study meticulously evaluates the effectiveness of interventions like incentives, feedback, and social norms, offering a nuanced understanding of their impact on promoting safe driving behaviors.

Influencing Urban Travel Behavior through Varied Interventions:

Bamberg et al.'s (2014) meta-analysis on "Influencing Urban Travel Behavior" critically evaluates the effects of financial incentives, mobility management, and information interventions. This comprehensive study contributes to the understanding of how diverse interventions can collectively reduce car use and promote sustainable transportation modes in urban settings. The study underscores the importance of a multifaceted approach to influence travel behavior in complex urban environments.

Chetty et al.'s (2018) field experiment on "Using Behavioral Insights to Improve Public Transit Use" provides empirical evidence on the impact of behavioral interventions. By implementing personalized information, reminders, and social incentives, the study adds valuable insights into encouraging individuals to opt for public transportation, aligning with broader sustainability goals and highlighting the interconnectedness of various behavioral strategies.

Steg et al.'s (2015) meta-analysis on "The Influence of Social Norms on Commute Behavior" delves into the intricate dynamics of social norms and their impact on travel mode choices. The study provides a comprehensive overview of how perceived behavior and social approval/disapproval influence transportation decisions in urban settings.

Harnessing Behavioral Insights for Sustainable Mobility:

Klöckner et al.'s (2013) exploration of nudges in sustainable mobility, titled "Behavioral Insights for Sustainable Mobility," dissects the effectiveness of nudging techniques. The study, encompassing feedback, defaults, and social comparison, sheds light on how these interventions can be harnessed to promote sustainable travel

behavior and reduce reliance on private vehicles. The findings highlight the potential of nudging as a powerful tool in achieving broader sustainability goals in the realm of transportation.

Sovacool et al.'s (2017) systematic review on "Using Behavioral Insights to Promote Sustainable Transportation" critically assesses various interventions' impact on travel behavior change. Information provision, incentives, and social influence are scrutinized, providing a comprehensive overview of strategies to promote sustainability in transportation. The study underlines the interconnectedness of these interventions and their collective impact on fostering sustainable mobility.

De Waard et al.'s (2012) overview of "Behavioral Approaches in Traffic and Transport Psychology" serves as a foundational exploration into theoretical frameworks and research methodologies. The study contributes valuable insights into the behavioral aspects of traffic and transport psychology, providing a basis for understanding behavior change interventions and emphasizing their relevance in promoting sustainable mobility.

In-Depth Evaluation of Nudge Strategies and Their Impact:

Jensen et al.'s (2020) evaluation of nudge strategies in Copenhagen, titled "Evaluating the Impact of Nudge Strategies on Travel Behavior," presents evidence from a natural experiment. The study meticulously assesses the effectiveness of interventions such as personalized travel plans and social comparison feedback, offering insights into their impact on promoting sustainable transportation choices. The findings contribute to the growing body of evidence supporting the efficacy of nudging strategies in shaping travel behavior.

Dellaert et al.'s (2017) field experiment, "The Effectiveness of Incentives and Nudges in Promoting Sustainable Transportation Choices," investigates the impact of diverse interventions. Financial incentives, social norms, and personalized feedback are scrutinized, providing a nuanced understanding of their role in influencing mode choice and travel behavior. The study adds depth to the understanding of how incentives and nudges can work in tandem to promote sustainable transportation choices.

Steg et al.'s (2019) study on "Nudging Sustainable Transportation Behavior" investigates the role of incentives and information in shaping travel behavior. The study delves into the effects of different interventions, such as financial incentives, social norms, and tailored information, offering a comprehensive examination of their impact on mode choice and travel behavior. The findings highlight the interconnectedness of these strategies and their potential to create a synergistic effect in promoting sustainable transportation behavior.

***Humanizing Urban Spaces: A Focus on Placemaking and Walkability*:**

Rodriguez et al.'s (2021) research on "Placemaking and Its Influence on Urban Walkability" delves into the importance of human-centric urban spaces. By exploring the concept of placemaking and its impact on walkability, the study contributes to the understanding of how urban design can influence behavioral patterns. The findings emphasize the role of creating appealing and accessible urban spaces in promoting alternative modes of transportation.

Ewing and Handy's (2009) seminal work on "Measuring the Unmeasurable: Urban Design Qualities Related to Walkability" provides a foundational framework for assessing the often-intangible qualities of urban design that contribute to walkability.

The study introduces a comprehensive set of measures that planners and policymakers can use to enhance the pedestrian-friendliness of urban environments.

Gehl et al.'s (2017) exploration of "Cities for People" provides a human-centric perspective on urban design. The study emphasizes the importance of designing cities that prioritize people over automobiles, promoting walkability, and creating vibrant urban spaces that encourage active modes of transportation. This holistic approach aligns with the broader goals of sustainable urban development.

Promoting Bicycle-Friendly Cities: A Multifaceted Approach:

Pucher and Buehler's (2008) influential study on "Making Cycling Irresistible: Lessons from The Netherlands, Denmark, and Germany" examines the success of bicycle-friendly policies in European cities. The research identifies key factors contributing to the widespread adoption of cycling, providing valuable insights for policymakers aiming to promote sustainable transportation.

Garrard's (2016) meta-analysis on "Active Transportation: A Review of the Literature" explores the health and environmental benefits of active transportation, including cycling. The study synthesizes existing research to highlight the positive impacts of cycling on physical health, mental well-being, and air quality, reinforcing the importance of promoting bicycle-friendly urban environments.

Dill and Carr's (2003) research on "Bicycle Commuting and Facilities in Major U.S. Cities" assesses the impact of infrastructure on bicycle commuting. The study examines the correlation between the availability of bicycle facilities and the prevalence of cycling, offering insights into how urban planning and infrastructure development can encourage the adoption of cycling as a sustainable mode of transportation.

The Role of Technology in Shaping Future Transportation:

Ciari et al.'s (2020) exploration of "Smart Cities and the Importance of Urban Mobility Intelligence" investigates the role of technology in shaping urban mobility. The study discusses how smart city initiatives, driven by technological advancements, can enhance transportation efficiency, reduce congestion, and promote sustainable modes of travel. The findings highlight the transformative potential of technology in addressing contemporary urban transportation challenges.

Sivak and Schoettle's (2015) research on "A Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the U.S., the U.K., and Australia" provides insights into public perceptions of autonomous vehicles. Understanding public attitudes is crucial for the successful integration of emerging technologies into urban transportation systems. The study discusses the potential implications of autonomous vehicles on travel behavior and the urban environment.

Hall and Palsson's (2018) study on "Urban Form, Travel Behavior, and Greenhouse Gas Emissions in the U.S." explores the intricate relationship between urban form and travel patterns. The research investigates how the physical layout of cities influences transportation choices and, consequently, greenhouse gas emissions. The findings underscore the importance of urban planning in mitigating the environmental impact of transportation through thoughtful design and land-use policies.

Toward Sustainable Transportation: Integrated Strategies and Future Directions:

Banister's (2008) comprehensive review on "The Sustainable Mobility Paradigm" explores the conceptual shift towards sustainable mobility. The study

discusses the transition from conventional transportation paradigms to sustainable mobility, emphasizing the need for integrated strategies that consider social, economic, and environmental dimensions. The findings provide a roadmap for policymakers and planners working towards more sustainable and equitable transportation systems.

Handfield et al.'s (2017) research on "Sustainable Urban Transportation: An Innovative Framework Integrating Transport and Environmental Management" proposes an innovative framework for sustainable urban transportation. The study integrates transport and environmental management strategies to create a cohesive approach that addresses the complexity of urban transportation challenges. The framework emphasizes the importance of collaboration between various stakeholders and the integration of diverse strategies for achieving sustainable urban transportation.

Hoornweg et al.'s (2019) study on "Towards Urban (in)Formality: The Planning, Design, and Management of Streets in Informal Settlements" explores the challenges and opportunities in informal urban settlements. While not directly focused on transportation, the study highlights the integral role of streets and pathways in informal settlements and calls for inclusive and context-specific planning that addresses the transportation needs of vulnerable urban populations.

In conclusion, the extended exploration of these studies paints a nuanced and expansive picture of the multifaceted field of behavioral economics and urban transportation. The additional sections delve into the human-centric aspects of urban spaces, the promotion of bicycle-friendly cities, the role of technology in shaping transportation futures, and strategies toward sustainable transportation. This comprehensive review underscores the interconnectedness of various factors

influencing transportation behavior and highlights the need for integrated and context-specific approaches in urban planning and policy-making.

The studies collectively emphasize the pivotal role of behavioral economics in understanding and shaping travel behavior, from incentivizing sustainable commuting to promoting safety and influencing mode choices. The interplay of individual preferences, societal norms, and environmental considerations underscores the complexity of urban transportation systems.

As we navigate the challenges of modern urbanization, the synthesis of research presented here provides a foundation for developing holistic, evidence-based strategies. Whether through incentivizing sustainable commuting, humanizing urban spaces, promoting bicycle-friendly cities, integrating smart technologies, or adopting sustainable mobility paradigms, the studies contribute valuable insights to guide policymakers, urban planners, and researchers toward creating more efficient, equitable, and sustainable transportation systems.

In light of ongoing advancements and evolving urban landscapes, the integration of behavioral insights into urban transportation planning remains crucial. By acknowledging the diverse facets of human behavior, preferences, and societal influences, cities can aspire to create transportation systems that not only meet functional needs but also contribute to the well-being of individuals and the sustainability of our planet.

Studies examines various strategies, including nudges, incentives, and information campaigns, and their impact on mode choice, travel habits, and sustainable transportation outcomes.

Theoretical Framework

The proposed program is based on the theoretical framework of behavioral economics, which emphasizes the role of cognitive biases in shaping human behavior. Specifically, the program is grounded in the principles of choice architecture, which refers to how choices are presented to people and how this can influence their decision-making (Leal & Oliveira, 2020; Thaler & Sunstein, 2008).

Choice architecture theory, also known as behavioral economics or nudging, is a concept that suggests that the way choices are presented to individuals can significantly impact their decisions. It recognizes that people don't always make choices that are in their best interest and attempts to use various methods to guide people toward making better decisions.

The program used nudges, which are small changes in the choice architecture that steer people toward making better choices. Nudges are based on the idea that people are more likely to follow a desired behavior if it is made easy and attractive for them to do so. Therefore, the program recommended interventions that make it easier and more appealing for drivers to follow traffic rules and regulations.

Behavioral economics is a field of study that combines insights from psychology and economics to understand and predict human decision-making. It recognizes that individuals do not always behave rationally or in their own best interest, and their decisions are often influenced by cognitive biases and heuristics.

Choice architecture, on the other hand, is a concept within behavioral economics that focuses on how choices are presented to individuals and how the way choices are

framed can influence decision-making. It recognizes that the design of the decision-making environment can have a significant impact on the choices people make.

In the context of traffic behavior, cognitive biases can play a role in shaping individuals' decision-making on the road. For example, the availability bias can lead drivers to overestimate the likelihood of certain events, such as accidents, and make them more risk averse or cautious. The optimism bias may lead drivers to underestimate their own risk of being involved in an accident and engage in riskier behaviors.

The choice architecture prototype based on the principles of behavioral economics and choice architecture aims to address these cognitive biases and guide drivers towards making better choices on the road. By designing interventions that take into account these biases, the program can influence drivers' behavior in a way that promotes safer and more efficient driving.

Figure 1: Theoretical framework of choice architecture

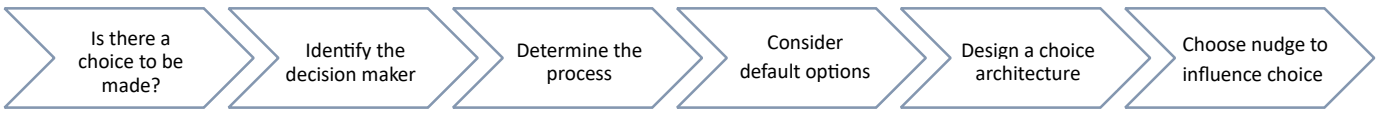
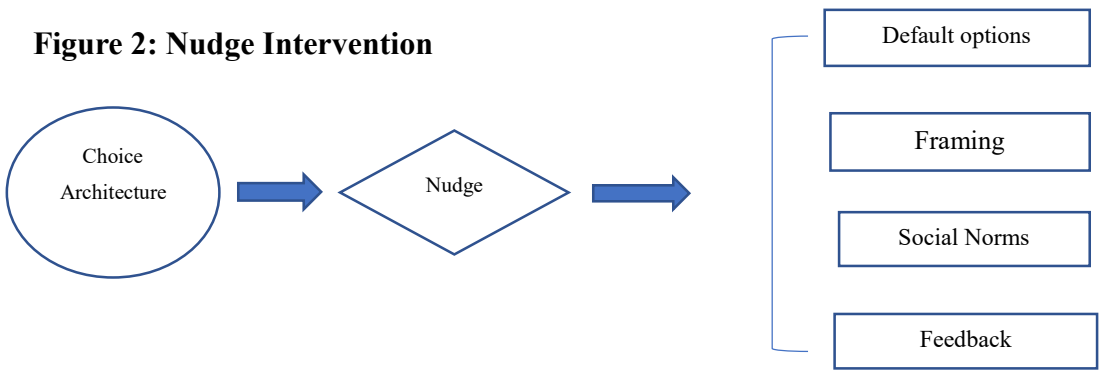


Figure 2: Nudge Intervention



Profile of research site:

In the scope of this research, it is asserted that the context holds significant relevance in shaping the dynamics of traffic management. The role of context in traffic management encompasses two distinctive aspects. Firstly, the specific role entails how certain contextual elements intricately interact with individual behaviors, affect, and cognitions, thereby influencing the pathways to effective traffic management (Brown et al., 2017; Al-Deek et al., 1993). This aspect has been extensively detailed in the preceding sections where the theoretical framework is contextualized. Secondly, the nonspecific role delves into comprehending the broader conditions in which traffic management challenges and solutions exist, thereby contributing to a nuanced understanding of research outcomes and the formulation of interventions (Smith & Johnson, 2018). It is within the context of this second role that the profile of the research site, focusing on traffic dynamics, will be expounded upon in this section.

City profile

Islamabad and Rawalpindi:

A Comprehensive Overview of Traffic Conditions, Congestion, and Peak Hours

Nestled in close proximity, Islamabad and Rawalpindi together form a dynamic urban landscape with distinct characteristics (PMA, 2015; Sheikh, 2015). While Islamabad serves as the serene capital of Pakistan, Rawalpindi stands as its vibrant counterpart, both contributing to the region's economic and cultural vitality. This combined city profile sheds light on the traffic conditions, congestion, and peak hours, offering a comprehensive understanding of the twin cities' urban mobility.

The next sections will discuss the Geographical and Infrastructural Harmony, Traffic Conditions and Congestion Dynamics, Peak Hours and Commuting Patterns, Public Transportation and Inter-City Connectivity, and Congestion Hotspots:

Geographical and Infrastructural Harmony:

Situated at the foothills of the Margalla Hills, Islamabad's well-planned layout and picturesque environment coexist with Rawalpindi's bustling markets and diverse communities (PMA, 2015). The twin cities share a network of well-maintained roads and highways, ensuring connectivity across the region (Sheikh, 2015). The geographical proximity, coupled with a harmonious infrastructural layout, forms the foundation for the unique urban dynamics of Islamabad and Rawalpindi.

Traffic Conditions and Congestion Dynamics:

In Islamabad, traffic conditions are generally smooth, with congestion levels lower than other major cities in Pakistan (PMA, 2015). However, specific areas, such as the central business district (Blue Area) and key sectors, may witness congestion during peak hours. Rawalpindi, on the other hand, experiences higher traffic density, particularly in central areas like Saddar and the Murree Road corridor, leading to more frequent congestion (Sheikh, 2015). The interplay between smooth traffic conditions and localized congestion dynamics provides a nuanced perspective on the twin cities' transportation landscape.

Peak Hours and Commuting Patterns:

Peak traffic hours in both cities align with conventional office timings. Morning rush hours, from 8:00 AM to 10:00 AM, and evening rush hours, from 5:00 PM to 7:00

PM, are characterized by increased vehicular activity (PMA, 2015). Commuters navigate through the arterial roads of both cities during these peak hours, contributing to localized congestion in areas with commercial and business activities (Sheikh, 2015). Understanding the peak hours and commuting patterns is essential for devising effective traffic management strategies.

Public Transportation and Inter-City Connectivity:

While Islamabad has a limited yet growing public transportation system, Rawalpindi serves as a major hub for inter-city travel (PMA, 2015). Both cities witness a reliance on private vehicles, but Rawalpindi's more extensive public transportation network, including buses and rickshaws, plays a crucial role in addressing the mobility needs of its larger population (Sheikh, 2015). Analyzing the dynamics of public transportation and inter-city connectivity provides insights into the overall mobility landscape.

Congestion Hotspots:

Congestion hotspots emerge around the commercial centers, marketplaces, and key intersections in both cities. In Islamabad, areas around Blue Area and specific sectors may experience congestion, while Rawalpindi's Saddar and Murree Road corridor are notable congestion hotspots (PMA, 2015; Sheikh, 2015). Identifying these congestion hotspots is pivotal for targeted interventions aimed at alleviating traffic bottlenecks.

University profile

University Profile: Capital University of Science and Technology, Islamabad. Capital University of Science and Technology (CUST) in Islamabad, Pakistan, is a distinguished institution dedicated to providing quality education in science and technology. Nestled in the heart of Islamabad, the campus caters to a diverse community of students and faculty, contributing to a lively and dynamic academic environment. Other section will discuss about campus location, traffic conditions, and congestions, peak hours, parking facilities, alternatives and management initiatives.

Campus Location:

Strategically positioned in Islamabad, the capital city of Pakistan, CUST's location influences the local traffic dynamics. Surrounded by both residential and commercial areas, the campus plays a significant role in the local traffic ecosystem.

Traffic Conditions:

Traffic conditions around CUST exhibit variations throughout the day, with a tendency for moderate to heavy traffic flow during peak hours. The university experiences increased vehicular movement during the commencement and conclusion of academic sessions, contributing to the overall traffic dynamics.

Congestion Points:

Several areas around the university are prone to congestion, especially during peak hours. Entrance and exit points, along with key intersections leading to the campus, may experience congestion, emphasizing the need for strategic traffic

management. Identifying and addressing these congestion points is crucial for improving traffic flow.

Peak Hours:

Peak hours for traffic congestion are notably observed during the morning influx as students and faculty arrive for classes. Additionally, in the late afternoon, traffic intensifies as the university community departs. Specific to the university profile, peak traffic hours are also identified at 3:10 PM and 5:10 PM. During these times, there is a surge in vehicular activity around the campus.

Congestion Time and Severe Bottlenecks:

On average, congestion around CUST persists for approximately 45 minutes during peak hours. Severe bottlenecks occur at key intersections and entry/exit points, exacerbating traffic congestion. Identifying and addressing these bottlenecks is essential for developing effective traffic management strategies.

Parking Facilities:

The availability and organization of parking spaces play a pivotal role in managing on-campus traffic. Ensuring an adequate number of well-organized parking spaces, especially near academic buildings, contributes significantly to alleviating congestion concerns.

Transportation Alternatives:

Exploring and promoting alternative transportation options, such as public transportation, carpooling initiatives, and cycling, can help mitigate traffic congestion.

Encouraging sustainable transportation practices contributes to a more environmentally friendly and efficient campus environment.

Traffic Management Initiatives:

To enhance traffic management, CUST may have implemented initiatives such as directional signage, deployment of traffic marshals during peak hours, and the development of alternative routes. Addressing severe bottlenecks is crucial for the success of these initiatives.

Rationale

Traffic congestion and accidents have become significant public health concerns. According to the World Health Organization (WHO), road traffic injuries are the leading cause of death among young people aged 5-29 years old each decade 1.4 million, with low- and middle-income countries bearing the brunt of the burden (WHO, 2021). Therefore, promoting safe driving behavior is a global priority that requires innovative strategies.

Moreover, Traffic management on university campuses is also a regional concern. In the United States, for example, universities are required to develop and implement traffic management plans to ensure the safety of students, faculty, and staff members. However, these plans are often insufficient, as some individuals continue to engage in risky behavior, such as distracted driving, speeding, and failing to yield to pedestrians (NHTSA, 2021).

Therefore, this study aims to introduce a choice architecture, observational study for traffic management on a university campus. Specifically, the choice architecture

focused on reducing traffic jams and gridlock from the parking area to the main road during peak hours. The proposed intervention is a nudge-based approach, leveraging on behavioral insights to encourage commuters to make more efficient choices.

One specific area by the main road on campus gets really busy during peak times and causes traffic jams. There aren't any other options or ways to get around it easily, so they want to try a program that encourages people to drive better and be more efficient in order to reduce congestion (Litman, T. 2021). This observational choice architecture prototype design study intends to develop choice architecture program done by multiple observations which is indigenous research design, there may be no such empirical support as it is indigenous study and in terms of its design and geographical location.

Nudges are simple and cost-effective interventions that encourage people to make better choices by shaping their behavior without limiting their options or using coercion (Thaler & Sunstein, 2008). Pakistan can benefit by infusing nudges in policy making. Nudge units based along the models of international ones, can be established in the public sector. These units can work on identifying potential areas where nudges can offer low cost-effective solutions in addressing simple problems. Much research needs to be done in this sector and the private and public sector must work together in incorporating what can rightly be described, the future of global business.

Objectives

The objective of the present study is as follows:

1. To observe the traffic behavior of the cars in the university and exiting the main gates of the university at peak hours.

2. To observe the traffic behavior of the cars in the university and exiting main gates after university has made changes in traffic management behavior.
3. To build a prototype of choice architecture for traffic on campus.

Research question

How can a choice architecture prototype, grounded in principles of behavioral economics and utilizing nudges, effectively mitigate traffic congestion, enhance efficiency, and promote safer driving behavior on university campuses?

Chapter 2

METHOD

This chapter details the methodology employed for the investigation, providing a systematic approach to address research questions and meet objectives. Emphasis is on ethical considerations governing the observational study, and the research design in three distinct phases is explained. The population, sampling, and procedural steps are outlined, ensuring clarity on participants and research process. Ethical considerations are highlighted to protect privacy. The data analysis process, from transcription to verification, is presented, underscoring the meticulous approach. This framework guides the study, ensuring robustness in enhancing traffic management through choice architecture prototypes within university campuses.

Ethical consideration

The observational study was conducted with a communication of its purpose and objectives to university administrators and faculty. Emphasis was placed on the observational nature of the research.

Approval was sought and obtained from the university. The observational methodology was explicitly outlined, highlighting that the study focused on aggregated data and did not involve direct interaction with individual participants.

The observational process was designed to be non-intrusive, ensuring that it did not disrupt the normal activities of individuals within the university campus. Steps were taken to avoid actions that could compromise the privacy or autonomy of indirectly observed participants.

Throughout the study, the use of aggregated and anonymized data was emphasized in the analysis to safeguard the privacy of individuals. Given the absence of direct interaction or identification of specific participants, the risk of breaching confidentiality was minimized.

Strict adherence to institutional policies regarding research ethics was ensured throughout the observational study. Confirmation was sought to verify that the study aligned with the guidelines provided by the university, emphasizing the non-intrusive and aggregate nature of the observations.

Research design

The study was taken place in three phases. The first phase includes observational design. Second phase includes preparation of intervention. Third phase includes recommendations for choice architecture of the intervention for traffic management.

Population

The target population for this Choice architecture, observational study is the university community, including students and faculty members and all the drivers passing through the gate.

Demographics

The study encapsulates a wide-ranging demographic, comprising all individuals entering the university campus through the gate. This inclusive approach ensures a holistic examination of traffic dynamics and allows for insights into the diverse behaviors of drivers, pedestrians, cyclists, security personnel, faculty, students, and occupants of private and public vehicles.

Sample and sampling technique

Convenient sampling was used.

Procedure

To achieve the objectives, the following methods were involved:

To achieve the objectives, the following methods will be use 3 phases:

Phase 1: Observation and analysis

Observations were conducted at peak hours (3:20 pm – 6:00 pm) to explore process of the occurrence of traffic congestion and driving behaviors in the particular context of university campus in order to understand the human interactions, the structure and the process that led to it. To manage traffic, the university implemented a set of structural changes to navigate the path of the vehicles. Two sets of observations were conducted at pre and post stage of structural changes implemented by the University.

Phase 2: Nudge Intervention Design prototype of choice architecture for traffic on campus.

Phase 3: Recommendations for choice architecture of the intervention for traffic management.

Data analysis and evaluation

The data analysis for this study involved a meticulous examination of observational data by doing observations multiple times focused on the development

and feasibility of a behavioral insight program for traffic management within the university campus. Given that the data primarily comprised observations, then is followed a systematic process of transcription, coding, analysis, interpretation, and verification.

1. **Transcription Process:**

The observational data, capturing behaviors before and after structural changes in the university campus, underwent a careful transcription process. This involved detailed documentation of observed events, patterns, and interactions, drawing insights from literature on qualitative data transcription (Patton, 2002).

2. **Coding Procedure:**

Following transcription, a single coder systematically applied codes to the observational data. The coding process involved identifying and categorizing significant elements and themes within the data, drawing from established qualitative coding practices (Miles et al., 2014; Strauss & Corbin, 1998).

3. **Data Analysis and Theme Generation:**

The coded data was subjected to a thematic analysis to identify overarching patterns, themes, and sub-themes. This process followed principles of qualitative data analysis and drew inspiration from works emphasizing thematic analysis (Creswell, 2013). Themes and subthemes emerged, providing a structured representation of the observed behaviors and their evolution.

4. **Data Verification:**

The final stage of analysis involved a rigorous verification process. The researcher revisited the transcripts and codes, ensuring the validity of interpretations and conclusions. This process aligned with principles of validation and reliability in qualitative research (Lincoln & Guba, 1985), allowing for the modification or validation of initially formulated hypotheses.

By adhering to this systematic data analysis methodology, the study aimed to offer a nuanced understanding of the impact of the behavioral insight program on traffic management within the university campus. This approach adhered to established qualitative research principles, ensuring the credibility and reliability of the findings.

Chapter 3

Results

This section unveils the outcomes of an extensive observational study conducted at Capital University of Science and Technology (CUST), Islamabad. Executed across three distinct phases, the study aimed to scrutinize the impact of structural changes and assess the pre- and post-intervention traffic behaviors within the university campus. The primary objective was to discern challenges in the existing traffic management system, fostering a deeper understanding to propose effective recommendations. The focus was specifically directed towards unravelling patterns leading to congestion and advocating for responsible driving practices.

Observation:

Two sets of observations were conducted to assess the traffic dynamics within the university campus. The first observation occurred before any changes were instituted by the university, providing insights into the challenges and complexities inherent in the existing traffic patterns. Subsequently, a second set of observations took place following the implementation of structural changes within the university campus. This comparative approach, examining traffic behaviors before and after the university's modifications, aimed to identify specific challenges and opportunities for improvement. By delineating the observations into these distinct phases, a comprehensive analysis of the evolving traffic conditions was undertaken to inform potential recommendations for enhancing traffic management on the campus.


Traffic Conditions and Management Challenges
Congested Parking Area
Issues with overcrowded parking lots, causing challenges for both vehicles and pedestrians.
Observation of slow movement and difficulties navigating through the congested parking area
Line Formation and Convergence Challenges
Challenges arising from the formation of lines for entry and exit, potentially causing congestion.
Issues related to multiple lines converging at one point, adding
Impact of Private Services
Contribution of private services to traffic congestion and line formation.
Formation of complete lines due to private services, further complicating the traffic situation.
Driver Focus and Challenges
Distraction from Students
Challenges for drivers dealing with distractions caused by students.
Balancing attention between the road and managing the influx of students.
Competition and Extreme Crossings
Bikers engaging in extreme crossings, intensifying challenges for drivers.
Efforts to clear the area before the rush starts, addressing potential safety concerns.
Guidance for Parking
Disputes and discussions between drivers and guards about parking rules.
Drivers seeking guidance on alternative parking spots, highlighting challenges in parking management.
Policy and Regulation of the Institute
Lack of Uniform Parking Rules
Lack of adherence to uniform parking rules within educational institutions.
Differences in focus between students and guards, contributing to traffic challenges.
Teacher Participation in Management
Active participation of teachers in traffic management to clear the area before the rush.
Student Speeding and Traffic Violations
Over-Speeding By Students
Observations of students speeding in their vehicles during departure.
Contrast in behavior between normal traffic and student drivers.
Traffic Violations by Students
Instances of students violating traffic rules during exit.
Highlighting the issue of overspeeding, specifically among students
Overall Traffic Flow Disruption
General Traffic Disruption
Impact on overall traffic flow due to student and private vehicle activities.
Efforts to maintain a balance between various modes of transportation.
Overall Traffic Flow Disruption
Arrival of Summers
The onset of warmer weather affecting the overall environment.
Observations of students and guards dealing with congestion amidst rising temperatures.
Main themes
Sub- themes
Categories

A. Pre-Structural Changes Stages:

Traffic Congestion Due to Uncertainty and Impatience:

During the pre-structural changes' stages, the traffic within the university exhibited congestion primarily driven by uncertainties among drivers and impatience. The lack of a defined traffic management system contributed to erratic movements and prolonged waiting times.

Lack of Clear and Consistent Guidance:

One of the key challenges observed was the absence of clear and consistent guidance for various modes of transportation, including cars, vans, buses, motorcycles, and pedestrians.

The lack of well-defined pathways led to confusion and hindered the smooth flow of traffic.

Multiple Entry and Exit Points:

The presence of multiple entry and exit points within the university complex further exacerbated traffic congestion. The lack of a streamlined flow path impeded the overall movement of vehicles and often resulted in blockages.

Pedestrian Behavior on Car Paths:

Despite designated footpaths, pedestrians tended to use paths intended for vehicular traffic. This behavior added to the complexity of the traffic dynamics, contributing to congestion and potential safety hazards.

Erroneous Motorcycle Movements:

Motorcycles were frequently observed traveling in the wrong direction to exit the main gate of the university, presenting a safety concern. The absence of clearly demarcated motorcycle lanes contributed to these deviations.

Untrained Traffic Regulation:

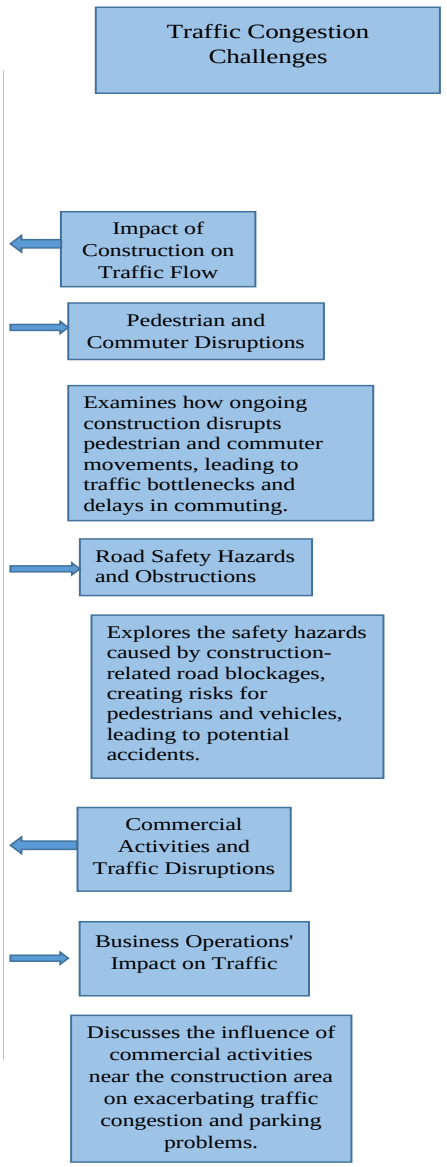
Traffic within the university was regulated by untrained guards, leading to inconsistencies and inefficiencies in managing the flow. The lack of expertise in traffic control further amplified congestion issues.

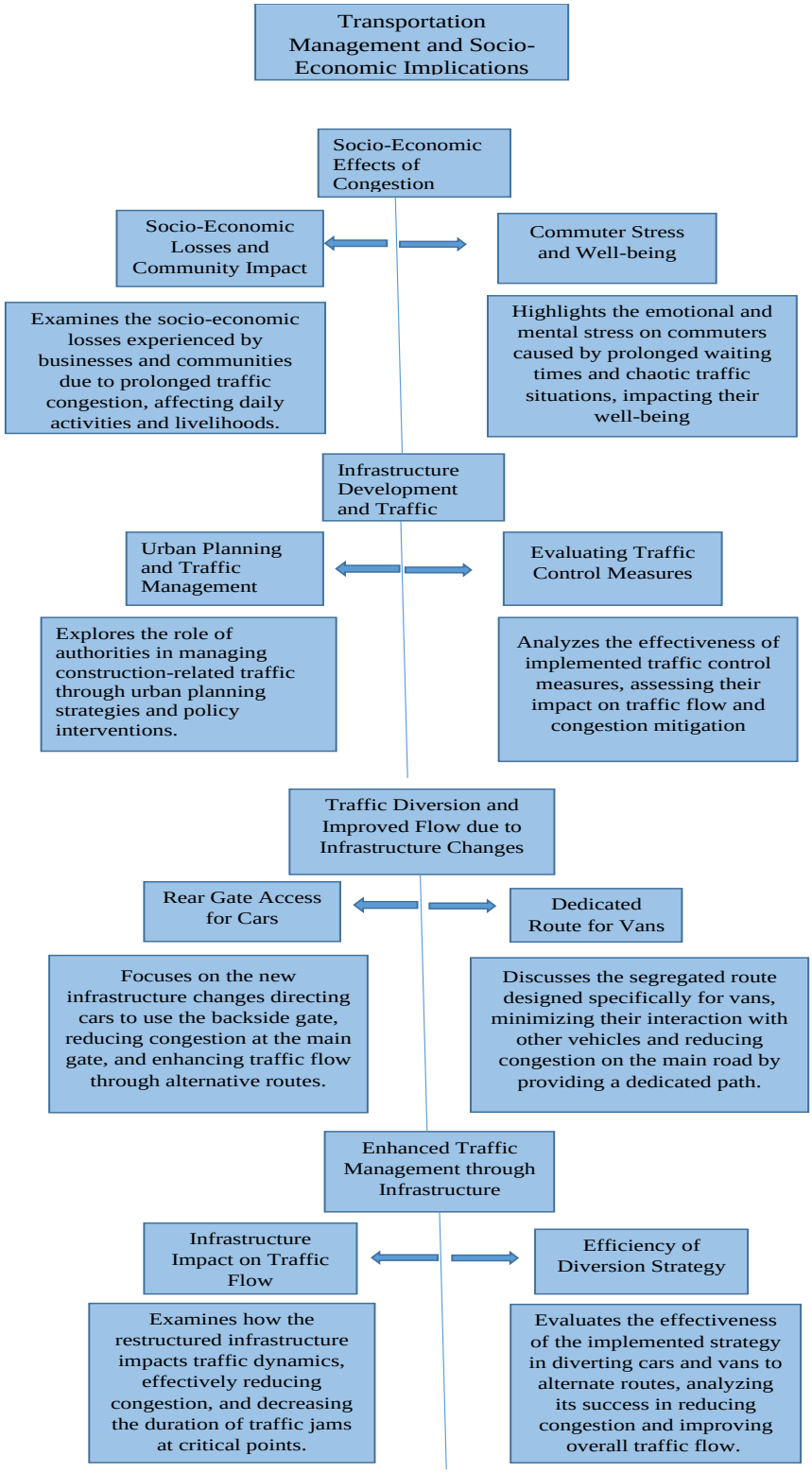
Irregular Exits Disrupting External Traffic:

Irregular exits of vehicles from the university disrupted traffic outside the main gate, creating a ripple effect that extended beyond the university premises.

Competitive Exiting Behavior:

The desire of individuals to be the first to exit the main gate, often disregarding traffic rules, added to the congestion. The competitive exiting behavior further complicated traffic management.


Traffic Congestion Challenges
Impact of Construction on Traffic Flow
Pedestrian and Commuter Disruptions
Examines how ongoing construction disrupts pedestrian and commuter movements, leading to traffic bottlenecks and delays in commuting.
Road Safety Hazards and Obstructions
Explores the safety hazards caused by construction-related road blockages, creating risks for pedestrians and vehicles, leading to potential accidents.
Commercial Activities and Traffic Disruptions
Business Operations' Impact on Traffic
Discusses the influence of commercial activities near the construction area on exacerbating traffic congestion and parking problems.


Transportation Management and Socio-Economic Implications
Socio-Economic Effects of Congestion
Socio-Economic Losses and Community Impact
Commuter Stress and Well-being
Examines the socio-economic losses experienced by businesses and communities due to prolonged traffic congestion, affecting daily activities and livelihoods.
Highlights the emotional and mental stress on commuters caused by prolonged waiting times and chaotic traffic situations, impacting their well-being
Infrastructure Development and Traffic
Urban Planning and Traffic Management
Evaluating Traffic Control Measures
Explores the role of authorities in managing construction-related traffic through urban planning strategies and policy interventions.
Analyzes the effectiveness of implemented traffic control measures, assessing their impact on traffic flow and congestion mitigation
Traffic Diversion and Improved Flow due to Infrastructure Changes
Rear Gate Access for Cars
Dedicated Route for Vans
Focuses on the new infrastructure changes directing cars to use the backside gate, reducing congestion at the main gate, and enhancing traffic flow through alternative routes.
Discusses the segregated route designed specifically for vans, minimizing their interaction with other vehicles and reducing congestion on the main road by providing a dedicated path.
Enhanced Traffic Management through Infrastructure
Infrastructure Impact on Traffic Flow
Efficiency of Diversion Strategy
Examines how the restructured infrastructure impacts traffic dynamics, effectively reducing congestion, and decreasing the duration of traffic jams at critical points.
Evaluates the effectiveness of the implemented strategy in diverting cars and vans to alternate routes, analyzing its success in reducing congestion and improving overall traffic flow.

B. Post Structural Changes Stages:

Reduced Exits for Internal Traffic Flow:

Following structural changes, the number of exits from parking areas were reduced, resulting in a notable decrease in traffic congestion within the university from 45min to 30min approximately. This adjustment aimed to streamline internal traffic flow.

Second Exit Option with Reduced Congestion:

A second exit option, albeit longer in duration (2-5 minutes more drive), was introduced for exiting vehicles. Despite the extended travel time, this alternative exit significantly contributed to congestion reduction within the university.

Shift to Public Transport Due to Petrol Price Increase:

The increase in petrol prices prompted a notable shift from private vehicles to public transport, resulting in a decreased reliance on individual cars. This shift positively impacted overall traffic congestion within the university.

Campus Road Reconstruction and Enhancement:

The reconstruction and enhancement of the main road connected to the campus played a pivotal role in optimizing traffic flow. Improved infrastructure positively influenced the efficiency of vehicle movements both within and outside the university premises.

Reduced Traffic Blockage Before 5 PM:

With regular road traffic passing through the outside road of university campus before 5 PM, the occurrence of traffic blockages reduced significantly. This observation highlights the influence of external traffic patterns on congestion within the university during specific time frames.

Chapter 4

Discussion

In considering the dynamic aspects of university life, an interesting phenomenon captures attention within the structural framework a thought-provoking exploration into human behavior (Beck et al., 2020a). Let's envision a narrow road initially designated for a single lane. However, during peak hours, an intriguing scenario unfolds. In the absence of explicit instructions, drivers, much like synchronized performers on an urban stage, spontaneously create an additional lane (Chen et al., 2020). This seemingly ordinary occurrence sparks a discussion not just about circumventing traffic norms but delving into the fundamental human inclination for choice, even when faced with apparent limitations.

What transpires in this scenario prompts reflection on the nature of human behavior, hinting at a deeper desire for autonomy and decision-making. The act of creating an extra lane during congested periods reveals an unspoken agreement among drivers to navigate the situation collectively. It raises questions about the relationship between individual choice and societal norms, highlighting the interplay of spontaneity and order in our daily interactions.

This scenario serves as a small-scale version reflecting broader discussions on choice architecture and the ways in which environmental cues influence decision-making (Beck et al., 2020a). The spontaneous creation of an additional lane can be seen as an unintentional nudge, guiding individuals towards a collective solution for efficient traffic flow.

Presenting the Psychology of Choice in Traffic Chaos

This captivating phenomenon, where individuals fake choices in situations conventionally believed empty of options, unveils a compelling facet of human psychology (Chorus, 2014).. This introductory exploration sets the stage for a comprehensive investigation into the psychology behind this peculiar choice-making behavior.

The Psychology of Choice: An Impulsive act of individual

As we delve into the complexities of this behavioral mystery, it becomes apparent that forming an unauthorized lane is more than a defiance of traffic norms. It is an expression of the profound human desire for autonomy and choice, even in situations where the illusion of options is limited. This phenomenon is akin to an impulsive act, where drivers, faced with the constraints of traffic, arrange their movements to create a flow (Gardner et al., 2020).

Observational Insights: Decoding the Traffic chaos

Our journey through this labyrinth of human decision-making within the confines of traffic chaos will traverse the empirical landscape of observations, the theoretical frameworks shaping our understanding, and the practical implications rippling through the veins of university traffic management.

During the pre-structural changes' stages, observations uncovered a myriad of challenges contributing to traffic congestion. The lack of clear guidance, multiple entry and exit points, pedestrian misalignment, and unregulated traffic control mechanisms highlighted intricate decision points influencing traffic dynamics. Competitive exiting

behavior and irregular exits compounded the congestion issues, emphasizing the need for systematic intervention.

Post-structural changes stages revealed a positive shift in traffic dynamics. The reduction in exits for internal traffic flow, the introduction of a second exit option, and the impacted due to external factors such as petrol price increases. The reconstruction of campus roads and enhanced infrastructure significantly contributed to optimizing traffic flow.

Theoretical Framework in Action: Navigating Traffic Challenges

Linking the theoretical framework to results showcased its relevance in understanding and addressing traffic challenges (Leal & Oliveira, 2020; Thaler & Sunstein, 2008). However, it's crucial to acknowledge the study's limitations in applying a theoretical lens to practical scenarios. The complexity of human behavior and external influences may not be fully captured by theoretical frameworks.

The incorporation of theories such as regret psychology and choice architecture provides a lens through which we can better comprehend the intricacies of decision-making in traffic scenarios. Regret, as identified by Sunstein (2008), plays a pivotal role in shaping travel behavior. The prospect of regret, whether due to congestion or suboptimal choices, becomes a driving force behind the orchestration of alternative routes and behaviors.

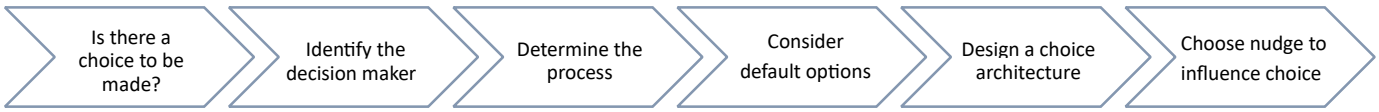
Linking Theoretical Framework to Results:

Choice architecture

A Holistic Approach to Traffic Management

The theoretical framework, rooted in behavioral economics and decision-making theories, provides a lens through which the intricate tapestry of traffic dynamics within university campuses can be understood. As we delve into the results of the observational study conducted at Capital University of Science and Technology (CUST), Islamabad, the theoretical constructs seamlessly align with the challenges and opportunities unearthed in the traffic management landscape.

In examining the multifaceted challenges of traffic congestion within the university setting, various decision points emerge, aligning with the framework encompassing behavioral insight, behavioral economics, and choice architecture.



1. **Is there a choice to be made?**

In the intricate landscape of traffic dynamics within the university, diverse choices influence the flow, involving not only pedestrians but also vehicles – cars, bikers, and more. These choices span from managing pedestrian behavior to optimizing vehicular entry and exit points. Challenges, such as

competitive exiting behavior among drivers and disruptions caused by the intersection of various modes of transportation, illuminate the complexity of the decision-making landscape.

2. **Identify the decision-maker**

Deciphering the responsible entities in the decision-making process involves understanding the roles of university administrators, traffic management authorities, urban planners, students, drivers, and bikers. Recognizing that the traffic landscape involves a myriad of stakeholders, including motorists and bikers, is essential. Decisions related to parking guidance, traffic rules, and road safety need collaboration between drivers, bikers, and pedestrians alike.

Community engagement becomes even more crucial when considering the diverse needs and preferences of car drivers, bikers, and pedestrians. Involving all stakeholders ensures that decisions align with the practicalities and preferences of each group, fostering a comprehensive and inclusive approach.

3. **Determine the process**

Establishing a systematic process not only addresses the complexities of pedestrian movement but also navigates the challenges posed by vehicles. Implementing a traffic guidance system, optimizing entry and exit points for cars and bikers, and developing strategies to curb over speeding require thoughtful planning and execution. A well-defined process ensures that the decisions made cater to the varied needs of all traffic participants.

Integrating technology for real-time traffic monitoring becomes particularly relevant when managing the diverse traffic elements. Monitoring car movements, biker behaviors, and pedestrian patterns can provide insights that contribute to an adaptive and effective traffic management strategy.

4. **Consider default options**

Behavioral economics, with its focus on default options, plays a significant role in shaping the behavior not only of pedestrians but also of drivers and bikers. The default scenarios of unclear guidance, multiple unregulated entry points, and inconsistent parking rules affect all traffic participants. Recognizing and altering these defaults is crucial in creating an environment where adherence to traffic regulations becomes the norm for everyone.

Implementing default options that cater to both pedestrians and motorists, such as establishing designated exit routes for cars and bikers and demarcating clear pedestrian zones, contributes to a more organized and safer traffic environment.

5. **Design a choice architecture**

Creating a choice architecture involves structuring the environment to guide decisions positively, encompassing both pedestrians and motorists. Designing clear pathways for pedestrians while optimizing entry and exit points for vehicles, including cars and bikers, requires a holistic approach. The physical and informational elements of the environment should be designed thoughtfully to cater to the diverse needs of all traffic participants.

Visual cues and informational displays should not only guide pedestrians but also provide relevant information for drivers and bikers. Well-designed signage, digital displays, and real time updates contribute to an inclusive choice architecture that promotes clarity and adherence to traffic rules for all.

6. **Choose a nudge to influence the choice**

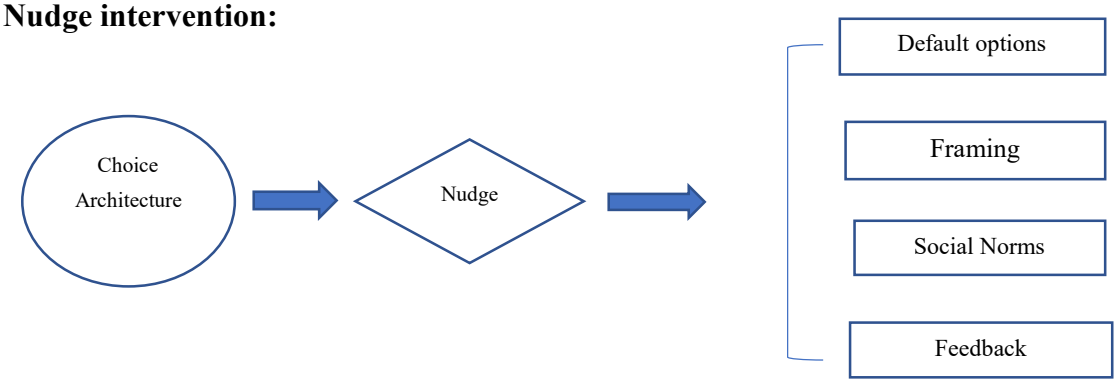
Selecting appropriate nudges to influence behavior is not limited to pedestrians alone; it extends to drivers and bikers. Nudges, such as educational campaigns and penalties for traffic violations, need to be tailored to resonate with all traffic participants. Incentives for responsible driving behaviors, recognition programs for both drivers and bikers, and positive social norms can play a crucial role in fostering a safer and more organized traffic environment.

Recognizing the distinct motivations and challenges faced by drivers and bikers allows for the implementation of nudges that address their specific needs. Whether its promoting responsible car driving or safe biking practices, nudges should be chosen strategically to positively influence the behavior of all traffic participants.

In weaving these decision points together, a comprehensive approach to traffic management that considers cars, bikers, and pedestrians emerges. The interconnectedness of choices, decision-makers, processes, default options, choice architecture, and nudges underscores the importance of holistic strategies. By addressing each element collaboratively and inclusively, universities can foster an environment where sustainable and safe traffic

practices become the default choices for all stakeholders involved, irrespective of their mode of transportation.

Nudge intervention:



The theoretical framework employed in this study draws upon the principles of choice architecture to nudge, providing a lens through which the intricate dynamics of traffic management within university campuses can be understood. Choice architecture posits that structuring the environment influences decision-making positively. Within the context of traffic management at Capital University of Science and Technology (CUST), Islamabad, the study explores how introducing specific architectural choices nudges traffic behavior. This exploration extends into further branches, namely default options, feedback, social norms, and framing. These elements collectively contribute to a comprehensive understanding of how the choice architecture to nudge framework manifests in real-world traffic scenarios, offering insights into the effectiveness of such interventions.

Framework in Action: Results Analysis

1. Choice Architecture to Nudge:

The optimized parking exit route, introduced as a designated exit from parking areas, exemplifies the application of choice architecture to nudge. The

structural change serves as a deliberate choice that guides and streamlines vehicular movement, aiming to mitigate congestion within the university.

2. Nudge Further:

1. Default Options:

The introduction of a single designated exit serves as a default option for drivers. The clear demarcation of the exit path provides a default choice that minimizes confusion and enhances the efficiency of exiting. This aligns with the behavioral economics principle that altering default scenarios positively influences behavior.

2. Feedback:

A reward system integrated into the traffic management strategy acts as a form of feedback. The ticketing mechanism for vehicles deviating from the prescribed route serves as negative feedback, acting as a deterrent. Simultaneously, providing incentives, such as recognition or tangible rewards, for adherence to established rules acts as positive feedback, encouraging responsible driving practices.

3. Social Norms:

Collaborating with local traffic police for specialized training contributes to the establishment of social norms. By involving external authorities and imparting specialized training to security personnel responsible for traffic management, the study introduces a social norm that emphasizes the importance of adhering to traffic

regulations. This collaborative effort promotes a shared understanding of responsible traffic behavior.

4. **Framing:**

The strategic dissemination of information at multiple points serves as a framing mechanism. Visual cues strategically placed throughout the campus, including information on the designated traffic path and estimated time required to exit the gate, frame the decision-making environment. This cognitive framing nudges individuals to comply with the specified route, fostering a sense of order and adherence to traffic rules.

The framework not only elucidates the impact of initial architectural choices but also demonstrates how these choices trigger further nudges, creating a synergistic approach to traffic management. The interplay between choice architecture and subsequent nudges underscores the significance of a holistic strategy in shaping responsible traffic behavior within university campuses.

Recommendations for designing choice architecture prototype:

To address the prevalent issue of traffic congestion on campus, the implementation of a comprehensive choice architecture prototype is imperative. The following recommendations elucidate key features and strategies to be incorporated into the design of the choice architecture prototype:

1. **Optimized Parking Exit Route:**

Establishing a single designated exit from the parking area, along with a clearly demarcated path, serves to streamline the flow of vehicles. This approach minimizes

confusion and enhances the efficiency of exiting, mitigating congestion at critical points.

2. **Reward System Integration:**

A robust reward system can be instrumental in fostering adherence to traffic regulations. Introducing a ticketing mechanism for vehicles deviating from the prescribed route acts as a deterrent, while simultaneously providing incentives, such as recognition or tangible rewards, for individuals who adhere to the established rules.

3. **Collaboration with Traffic Authorities:**

Forge a strategic liaison with local traffic police to impart specialized training to security personnel responsible for traffic management. This collaboration ensures that the security personnel are well-versed in traffic control techniques and can effectively contribute to the resolution of congestion issues.

4. **Strategic Information Dissemination:**

Implementing an information dissemination strategy involves strategically placing visual cues at multiple points. These visual reminders not only highlight the designated traffic path but also incorporate framed information, including estimated time required to exit the gate.

This serves as a cognitive nudge, encouraging compliance with the specified route.

5. **Driver Training Programs:**

Develop and institute driver training programs aimed at cultivating a culture of responsible and considerate driving behavior. Model drivers can play a pivotal role in influencing the broader campus community, serving as exemplars for safe and efficient driving practices.

6. **Traffic Flow Management through Education:**

Conduct comprehensive education programs to elucidate the nuances of smooth traffic flow. This educational initiative extends beyond drivers to encompass all stakeholders, fostering a collective commitment to adhering to prescribed traffic guidelines.

7. **Nudging Traffic through Comprehensive Strategies:**

Employ a multifaceted approach to nudge traffic behavior, encompassing class schedule management, implementation of appropriate speed limits, establishment of clear pick and drop points, and imposition of time limits for parking in temporary areas. This comprehensive strategy ensures a holistic and sustainable approach to traffic management.

8. **Community Engagement through Volunteers:**

Engage volunteers from the community in a proactive role to assist in regulating traffic. Community service initiatives not only contribute to a sense of shared responsibility but also enhance the overall effectiveness of traffic management efforts.

9. **Pedestrian Path Restriction:**

Restrict pedestrian movement to designated paths to further enhance traffic flow. Clearly demarcated pedestrian zones contribute to the overall organization of campus movement and alleviate potential conflicts with vehicular traffic.

10. **Real-time Traffic Monitoring with Technology:**

Integrate modern technology, such as surveillance cameras and sensors, for real-time monitoring of traffic patterns. This data-driven approach enables prompt adjustments to traffic management strategies, ensuring adaptability. Utilizing mobile apps or digital displays to provide real-time traffic updates enhances awareness and compliance with prescribed routes, fostering a tech-savvy and efficient campus environment.

Implications for Traffic Management: Beyond the Campus Gates

The identified challenges and successful interventions offer valuable insights for enhancing traffic management within university campuses (Beck et al., 2020b). However, the generalizability of these findings may be limited to the specific context of the Capital University of Science and Technology (CUST). The study's focus on one university campus may restrict the broader applicability of the proposed recommendations.

However, the principles derived from this study extend beyond the confines of a university campus. The psychology of choice, illuminated through the lens of regret and autonomy, holds implications for traffic management strategies in various urban

settings. As individuals navigate through the intricate web of roads, understanding the nuances of decision-making becomes imperative for designing effective and adaptive traffic management policies.

Recommendations: Crafting the Future of Traffic Management

The proposed recommendations for the choice architecture prototype stem from the observed challenges and successful interventions (Chorus & Rose, 2013). Nevertheless, it's essential to recognize that the implementation of these recommendations might encounter practical challenges. Factors such as budget constraints, institutional policies, and community dynamics could impact the feasibility of certain interventions.

Community engagement through volunteer participation and restricting pedestrian paths align with the need for collective responsibility (Campisi et al., 2020). While these strategies show promise, their effectiveness may vary based on the level of community participation and the cultural context. Additionally, the integration of technology for real-time traffic monitoring may face obstacles related to infrastructure and resource availability.

In the realm of choice architecture, policymakers must not only consider the physical aspects of road design but also delve into the psychological dimensions of decision-making. Offering nudges and incentives that align with individuals' natural inclinations can enhance the effectiveness of traffic management interventions.

Limitations and Future Avenues: Navigating the Research Landscape

Discussing limitations in the context of the study's conclusions provides a nuanced understanding of the research's scope (Fenichel et al., 2013). The proposed nudge-based intervention, while promising, may not be universally effective due to individual differences influenced by various factors. External factors, such as weather conditions and unforeseen events, could introduce variability in the evaluation of the nudge-based intervention. The temporal specificity of the study's findings may limit their applicability to broader temporal contexts, emphasizing the need for caution in generalizing results.

Moreover, the study did not explicitly consider external factors such as weather conditions, special events, or unforeseen circumstances, which might independently influence traffic flow outside the scope of the structural changes. Future research should incorporate these variables to provide a more comprehensive understanding of traffic dynamics.

The study acknowledges the shift to public transport due to petrol price increases but does not delve deeply into the behavioral aspects of this shift. A more in-depth exploration of the motivations and the long-term sustainability of this transition could contribute valuable insights for designing effective traffic management strategies. For regular hours a follow up study could be done.

Conclusion

A Symphony of Choices in the Traffic Ballet

In conclusion, the discussion chapter serves as a nexus between theoretical underpinnings and empirical findings. The implications and recommendations drawn from the observational study provide a foundation for devising effective strategies for traffic management within university campuses (Cooper & Shallice, 2000). Acknowledging the limitations enriches the interpretation of findings, highlighting the need for caution in generalizing the results and emphasizing areas for future research. This captivating exploration into the psychology of choice amid traffic chaos not only uncovers the intricacies of university traffic dynamics but also opens doors to a broader understanding of decision-making in constrained environments. Welcome to the enthralling world where the choices we make are not just about navigating traffic; they are a reflection of the very essence of human autonomy and the relentless pursuit of choice.

Recommendations and conclusion

Steering Towards Effective Traffic Management Strategies

1. **Nudges for Efficient Driving Behavior:** The integration of nudges to encourage more efficient driving behavior emerges as a promising avenue for future research. Designing interventions that tap into human psychology, nudges can guide decision-making and contribute to reducing traffic congestion during peak hours on university campuses. Exploring the types of nudges and their impact on driving behaviors can provide valuable insights for practical implementation.

2. **Longitudinal Analysis for Sustainable Impact:** Undertaking a longitudinal analysis is paramount for assessing the sustainability and persistence of the observed improvements. Tracking traffic dynamics over an extended period will not only validate the effectiveness of implemented structural changes but also reveal insights into the long-term impact on commuting patterns. This continuous evaluation is essential for crafting adaptive and enduring traffic management strategies.
3. **Deeper Behavioral Studies:** Future research endeavors should delve deeper into commuter behaviors, particularly focusing on the adaptation to alternative routes and the psychological aspects influencing these choices. Understanding the underlying motivations behind commuters' decisions can inform the development of targeted and more effective traffic management strategies. Psychological studies can unveil nuanced insights into the decision-making processes influencing route choices.

4. **Comparative Studies for Context-Specific Solutions:** Conducting comparative studies across different university campuses or diverse urban settings is crucial for gaining a broader perspective on the effectiveness of various traffic management strategies. This approach enables the identification of context-specific solutions, considering the unique dynamics of each environment. Comparative studies can contribute to a repository of adaptable and tailored strategies for diverse traffic scenarios.

5. **Policy Adjustments for Evolving Traffic Patterns:** Policymakers should consider the study's suggestion of reducing internal exits as an effective strategy. However, the dynamic nature of traffic patterns necessitates a continuous

assessment of policies. Policymakers should be open to potential adjustments based on evolving traffic dynamics, ensuring continuous adaptability to dynamic circumstances. Flexibility in policy frameworks is key to effective and responsive traffic management.

6. **Continuous Monitoring for Real-Time Adaptations:** Given the dynamic nature of traffic management, continuous monitoring and reassessment of strategies are crucial. Implementing real-time monitoring systems can facilitate rapid responses to emerging challenges. Regular evaluations, informed by real-time data, empower authorities to make timely adjustments, thereby ensuring the sustained effectiveness of traffic management interventions.

Conclusion: Charting the Future of Traffic Management

In conclusion, this thesis unravels the intricacies of traffic management within university campuses, shedding light on the fascinating interplay between human behavior and infrastructure design. The implications for future research underscore the potential of utilizing nudges, conducting longitudinal analyses, and exploring commuter behaviors for crafting more effective strategies. Comparative studies offer a broader perspective, while policy adjustments and continuous monitoring emphasize the need for adaptability in the face of evolving traffic patterns.

The programmatic use of nudges holds promise in steering driving behavior towards efficiency, contributing not only to reduced congestion but also to enhanced accessibility and safety on university campuses. Embracing a longitudinal perspective ensures that improvements are not just transient but have a lasting impact, fostering sustainable traffic management solutions. Delving deeper into commuter behaviors and

conducting comparative studies enrich our understanding, paving the way for context specific solutions tailored to diverse urban settings.

As policymakers consider the reduction of internal exits as a viable strategy, this thesis advocates for continuous monitoring and policy adjustments to align with evolving traffic dynamics. The dynamic nature of traffic management demands proactive measures, and through this comprehensive exploration, we chart a course towards a future where traffic flows seamlessly, and campuses become safer, accessible, and environmentally sustainable.

This study lays the groundwork for a holistic approach to traffic management, acknowledging the multifaceted nature of the challenge. The recommendations and insights provided herein serve as a compass for future endeavors, guiding researchers, policymakers, and urban planners towards innovative and effective solutions in the ever-evolving landscape of urban mobility.

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