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Nudges at The Forefront of Sustainable Urban Mobility?

By
Soroor Mansouyar
Mindaugas Bruzas

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Supervisors
Thomas Kalling

Abstract

The main aim of this article is to investigate the application of the Nudge theory within the field of sustainable mobility as a strategy to encourage more use of sustainable modes of transport. This line of research is of particular importance due to the high share of emissions in the transportation sector, which has been increasing over the years. Although there have been pro-environment policies in place together with the implementation of sustainable city infrastructure, the extent to which people have changed their choice of travel to more sustainable modes has not been sufficient to address climate change. Therefore, understanding ways in which governments and decision-makers can influence citizens' mobility choices, as a complementary strategy, gains value. For this purpose, by following a single case study design, the research used interviews to gather perspectives from decision-makers within the field of sustainable mobility to assess if nudge strategies are an effective way to change the behavior of the citizens.

The findings of the paper indicated the Nudge theory's ineffectiveness in reshaping habits, of which mobility behavior is one example. Moreover, the theory lacks critical aspects necessary to address unsustainable mobility behavior such as the effect of one's attitude toward pro-environmental measures and sustainability in addition to the effect of proper city infrastructure. Hence, decision-makers or so-called choice architects, in order to design effective nudge strategies are require to understand the kind of behavior they are aiming to address and the kind of target group they are facing. This could potentially assist the choice architects to design nudge strategies that align with the environment and attitude of the target group, in conjunction with other more effective interventions, such as financial incentives and charges.

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Table of Content

1. Introduction	7
1.1 Problem Statement	8
1.2 Purpose Statement and Research Question	9
1.3 Outline of the Paper	10
2. Literature Review	10
2.1 Sustainable Mobility Behavior	11
2.2 Behavioral Economics and Psychology of Choice	12
2.3 What is the Nudge Theory?	13
2.3.1 Nudge Categories	14
2.3.2 Are Nudges Ethical?	17
2.3.3 Nudging in Mobility	18
2.4 Research Question vs. The Established Literature	20
2.5 Theoretical Framework	21
3. Methodology	24
3.1 Methodological Choices	24
3.2 Research Design	25
3.2.1 The Case	26
3.2.2 Data Collection	28
3.2.2.1 Sample Description	29
3.2.2.2 Interviews	30
3.3 Data Analysis	32
3.3.1 Primary Data	32
3.3.2 Secondary Data	33
3.4 Research Quality	33

3.4.1	Validity and Reliability	33
3.4.2	Ethical Considerations	35
4.	Empirical Data	36
4.1	Interview findings	36
4.1.1	Respondents	37
4.1.2	Determinants of Successful Sustainable Mobility	38
4.1.2.1	City Planning	39
4.1.2.2	Citizen Attitudes	40
4.1.2.3	Sustainable Mobility Package	41
4.1.3	Private vehicle use	43
4.1.4	Main Findings	44
4.1.4.1	Disclosure	44
4.1.4.2	Frictionless	45
4.1.4.3	Default Option	47
4.1.4.4	Social Norms	48
4.1.4.6	Nudge Success Factors	49
4.1.5	Hard Measures	50
5.	Analysis	51
5.1	Nudging in Mobility	51
5.2	Key Finding For Nudge Categories in Mobility	54
5.3	Contributions	55
6.	Conclusion	56
6.1	Limitations	57
6.2	Future Research	58
	References	60
	Appendices	66

List of Figures

Figure 1 - Theoretical Framework	23
Figure 2 - Theoretical Framework - Nudge Categories	24

List of Tables

Table 1 - List of Participants	39
Table 2 - Five D's	41

Definition of Terms

Soft measures: any intervention that is considered to be a nudge, as defined in the theoretical framework.

Hard measures: any intervention that includes financial incentives, charges, and changes in the infrastructure.

Sustainable Modes of Transport: use of public transport, cycling, walking, and carpooling.

1. Introduction

Travel behavior has been a research focus since a few decades ago and has taken a pro-environmental turn (Punzo, Panarello & Castellano, 2021) given the individuals' and households' negative environmental impact as a result of unsustainable mobility behavior (Thøgersen, 2014). This line of study gains further importance as a result of increasing CO2 emissions for which transportation takes a great share (UNCC, 2018). Governments, in order to minimize the negative environmental impacts of human activities and potentially eliminate their effects, have set climate goals, with the Paris Agreement serving as a good example of such government collaboration. In order to reverse this negative trend of emissions, encouraging more sustainable modes of transport are of critical importance to meet our climate goals (Chng, 2021), especially given their share of CO2 emissions. In this regard, hard interventions such as regulations, economic incentives, and urban development projects have been implemented to address climate change. On the other hand, there was less research found on soft behavioral interventions reshaping behavior despite individuals' and households' share of emissions, as mentioned earlier (Thøgersen, 2014). Therefore, this paper aims to develop our understanding of nudges, one form of soft behavioral intervention, within the field of mobility, and their effectiveness in transforming citizens' behavior toward more sustainable modes of transport.

Nudges have gained increasing popularity across different sectors, particularly health, and mobility, since their introduction by the Nobel-winning scholar in economics, Thaler, and Holberg-winning scholar Sunstein in 2008. The Nudge theory has built on human inefficiencies in decision-making (Selinger & Whyte, 2012; Gigerenzer, 2015), concepts introduced earlier in bounded rationality by Simon in addition to Kahneman and Tversky's three lines of research in human psychology of decision-making. The Nudge theory revolves around the concept of choice architecture that aims, together with soft interventions, to alter people's behavior in certain directions that decision-makers, or so-called 'choice architects' intend (Thaler & Sunstein, 2008). The theory has received criticisms from various scholars from ethical standpoints as to how it preserves one's freedom of choice (Goodwin 2012; Hausam & Welch, 2010; Legget, 2014; Pykett, Jones, Whitehead, Huxley, Strauss, Gill, McGeevor, Thompson & Newman, 2011;

Schnellenbach, 2012; John, Smith & Stoker, 2009; Jones, Pykett & Whitehead, 2013). On the other hand, scholars such as Schmidt and Engelen (2020) alongside the original authors argue that nudge strategies do not take any options away from individuals but rather ensure informed decision-making by disclosing all the necessary information.

Furthermore, nudging has mostly been utilized in the health and food sector; however, its use within mobility is found to be limited. Due to the novel nature of the Nudge Theory, as well as the various forms and characteristics that nudges can hold, knowledge surrounding the effective implementation of nudges in real-life cases and their associated outcomes is yet unclear.

1.1 Problem Statement

Human activities have caused an average temperature increase of 1°C, for which transportation contributed to approximately one-quarter of energy-related global greenhouse gas emissions in 2009 (UNCC, 2018). The transport sector was responsible for about one-fifth of energy use worldwide (UITP, 2014). By 2030, GHG emissions from transport are expected to increase by nearly 50% when compared to 2009 figures (UITP, 2014). Furthermore, private individuals and households are significantly contributing to the overall negative environmental impact, both directly and indirectly in a manner that is found to be unsustainable (Thøgersen, 2014). This raises the importance of strategies targeting individuals' behavior to encourage them for more sustainable choices, especially within the highly-polluting urban transport activities (EPA, 2022).

Measures through which decision-makers could influence the unsustainable behavior of consumers are gaining importance (EPA, 2022); therefore, this paper aims to study the behavioral change strategy, the nudges, to examine effective nudge tactics by which citizens are encouraged toward more use of sustainable modes of mobility. Previous research on behavioral measures has focused on several main topics such as behavioral change studies analyzing the bounded rationality of humans (Simon, 1981; Selten, 1990; Bendor, 2001; Bendor, 2015), human psychology of choice, and studies that revolve around human biases and their effects on decision-making (Kahneman, 2003). However, there is not enough empirical data and evidence

examining how nudge interventions have been employed and what has been their outcomes. This raises the question of whether implementing nudge tactics could be in any way influential and effective in changing citizens' mobility choices for more sustainable, and less emitting transportation alternatives.

1.2 Purpose Statement and Research Question

Mobility other than city infrastructure is affected by factors such as gender, class, age, and ethnicity (Sheller, 2018 cited in Bohman, Ryan, Stjernborg, & Nilsson, 2021). In order to assess the effectiveness of the nudge strategies in encouraging sustainable mobility choices, the paper employed the Nudge theory by Thaler and Sunstein (2008; 2021). Since the introduction of the theory, governments have started implementing units utilizing this approach, such as the Behavioral Insight Team or so-called Nudge Unit in the UK (Brown, 2012; Kusters & Van der Heijden, 2015; Goodwin, 2012). The Nudge strategies are often implemented and found effective within the health and food sectors (Yoong, Hall, Stacey, Grady, Sutherland, Wyse, Anderson, Nathan & Wolfenden, 2020; Arno & Thomas, 2016; Broers, Van den Broucke, Taverne & Luminet, 2019). However, there has been minimal research found directed toward the nudges that are implemented to change mobility behavior. Although authorities and researchers have been emphasizing various mechanisms to ensure the anticipated behavior of citizens (White, Habib, & Hardisty, 2019), ways to achieve behavioral change through seemingly “invisible” measures lack examination when it comes to sustainable choices of daily transport. Therefore, this study aims to assess the effectiveness of the Nudge theory within the transport sector by using qualitative inquiry to understand the decision-makers' perspectives when implementing nudges to encourage more sustainable modes of mobility. For this purpose, the research question below has been the focus of the paper:

To what extent have mobility actors successfully influenced citizens' mobility choices using the nudge theory to promote and encourage the adoption of sustainable modes of transport?

1.3 Outline of the Paper

The following chapter, “Literature Review”, will address existing literature in the field of behavioral economics, the psychology of choices, and nudges. The third chapter, “Methodology”, described the research methods employed to conduct this study. Components regarding research design, data collection, data analysis, research quality, and ethical considerations are presented. The fourth section lists the “Empirical Data” by presenting field evidence with an interpretation of the researchers’ point of view in the analysis. Following the result section, the fifth chapter, “Analysis”, analyzes the empirical findings in relevance to the hypothesis raised in addition to addressing the practical implications. The final chapter, the “Conclusion”, concludes and summarizes the findings of the study while drawing some light on the limitations of the study. A direction for future research in the intersection of nudges and their use within mobility and travel choices will also be presented.

2. Literature Review

This chapter includes an overview of the literature established on the selected theoretical framework that will, later on, be utilized to create a foundation for the analysis. The subsections start with a brief description of ‘sustainable urban mobility’ as the key focus behind this paper. In addition, the established literature, the Nudge theory, and its background will be explained starting from a holistic view, and later on, a more narrowed version of the theory will be presented. The main scholars of the theory will be introduced, accompanied by additional scholars and researchers who have examined the theory in addition to their contributions and criticisms. The chapter will also include a motivation for the research question in relation to the established literature together with the application of the theory in practice up to this point and will end with the theoretical framework.

2.1 Sustainable Mobility Behavior

Travel behavior has been one of the research focus areas since 1970, especially explored by Torsten Hägerstrand, a Swedish geographer in 1974 (Punzo, Panarello & Castellano, 2021). The focus has taken a pro-environmental turn at both individual but also societal levels since 1990, initiated by scholars such as Garvill in 1999, and Van Lange, Vugt, Meertens, and Ruiter in 1996 (Punzo, Panarello & Castellano, 2021). According to Chng (2021), understanding and changing travel behavior are important factors in order to meet climate goals. In this study, the climate goals mainly refer to the Paris Agreement to limit the average temperature increase to 1.5°C above the pre-industrial level (United Nations Climate Change, n.d.). In addition to that, urban travel behavior is found to be determined by a set of aspects including socio-demographic, economic, and environmental, as Punzo, Panarello, and Castellano (2021) explained in their study of three developed European countries - Germany, Italy, and the Netherlands. This line of studies gains more importance with the growing population, given the individual's share of emissions (Thøgersen, 2014).

According to Ellegård and Svedin (2012), the activities in people's everyday lives related to work, service, and family projects, cause a need for transport. The environmental damage related to transport, especially private cars, has raised concerns in most advanced countries (Punzo, Panarello & Castellano, 2021). Although the use of private cars has its own benefits such as flexible timing and convenience, its harmful consequences are threatening the countries when it comes to increasing air pollution, accidents, and mobility disadvantages (Punzo, Panarello & Castellano, 2021). This has resulted in policies aiming to encourage citizens toward more sustainable modes of transport such as using public transport, cycling, and walking (Punzo, Panarello & Castellano, 2021). In the following sections, the terminology of "sustainable modes of transport" is regarded as a modal shift from cars to more use of public transport, more use of cycling, more walking, and more carpooling, which stands for sharing a car with some other passenger or more to similar destinations (Shaheen, Cohen & Bayen, 2018).

2.2 Behavioral Economics and Psychology of Choice

Behavioral economics, as the general area under scrutiny in this study, aims to understand inefficiencies in human behavior (Camerer, 2006). In addition, the extent of individuals' rationality by applying different models has been explored in this area of study in order to design organizations, policies, and markets that best suit human psychology (Camerer, 2006). The inefficiencies, or so-called cognitive constraints, are found to impose limitations on individuals' rationality, self-interest, and willpower (Mullainathan & Thaler, 2000; Rabin, 1998). Of the models and theories that have been the center of study by various researchers, with a focus on humans' decision-making and factors affecting them, Bounded Rationality by Herbert Simon in 1955 and 1979 and psychology of choice by Kahneman and Tversky, between the years 1937 and 1996 (Kahneman, 2003) are outlined in this study. Understanding bounded rationality and the psychology of decision-making is important for comprehending the Nudge theory, as they explain inefficiencies in human decision-making, which nudges are built upon.

The theory of Bounded Rationality developed by Simon, in general terms, proposes that humans are cognitively constrained (Selten, 1990; Bendor, 2015). Simon suggested that such constraints, such as selective attention and limited memory, are reflected in human decision-making (Selten, 1990; Bendor, 2001; Bendor, 2015), which replaced utility maximization as the center of decision-making at the time of its introduction (Selten, 1990). Simon further added that an individual's state of mind affects their behavior which consequently is reflected in their decision-making (Bendor, 2015). In this regard, Bendor (2015) in his paper on 'Bounded Rationality' explained that there is a relationship between an individual's mental capabilities and how complicated problems might be perceived by them. However, he further explains that this does not mean that humans are typically intellectually impaired, but rather that their performances are also dependent on the demand placed on them together with their cognitive capabilities. Simon (1981) also clarified this phenomenon in his work by explaining that one's cognitive constraints, or as he called it 'inner environment', will only be reflected in their decision-making only if the task is challenging enough.

In his paper, Kahneman (2003) elaborates on his and Tversky's line of work in relation to human decision-making and playing factors related to it. According to him, they initially aspired to create a coherent set of theories and concepts concerning intuitive judgments. Their contributions to the field of behavioral economics compiled three lines of studies - heuristics, and biases under uncertainty when making decisions, prospect theory explaining decision-making under risk, and framing effect as Kahneman (2003) established in his paper 'Psychology for Behavioral Economics'. Among all, the framing effect is of more relevance for this study. That is due to the fact that the framing effect, in general terms, evolves by capitalizing on human inefficiencies in decision-making (Kahneman, 2003) which is how nudges function.

The framing effect refers to when the choices vary depending on how and from what perspective a problem is presented (Kahneman, 2003; Thaler & Sunstein, 2021). Decision-making processes are often violated by human rationality impairment (Thaler & Sunstein, 2021), followed by variance violation in the framing effect resulting in different choices (Kahneman, 2003). Furthermore, the basic principle of the framing effect, as Kahneman (2003, p.1459) explained, is "the passive acceptance of the formulation given". Due to this aspect, people often fail to create a standard version of a given problem irrespective of how it is presented (Kahneman, 2003).

2.3 What is the Nudge Theory?

The theory was first introduced by Richard H. Thaler and Cass R. Sunstein in 2008, which they later modified in 2021. Since then, other scholars have elaborated on the theory (e.g., Gigerenzer, 2015; Kusters & Van der Heijden, 2015). Thaler and Sunstein (2008, p.6) defined nudge as:

"...any aspect of the choice architecture that alters people's behavior in a predictable way, without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid."

Furthermore, one of the key aspects to nudge strategies that are often mistakenly overlooked is that the nudges, opposite to the economic theory, are supposed to influence people without using any economic incentives, coercion, or education (Selinger & Whyte, 2012; Gigerenzer, 2015).

In addition to that, Thaler and Sunstein (2008; 2021) further elaborated on their theory by introducing ‘libertarian paternalism’ and ‘the choice architecture’. These are two concepts that are integrated into the theory (Thaler & Sunstein, 2008; Brown, 2012; Kusters & Heijden, 2015; Mols, Haslam, Jetten, & Steffens, 2014). Choice architects or policy-makers, as Gigerenzer (2015) calls them, are the ones that decide what is best for their target group. The decisions are taken place without asking the target group's point of view on the matter, which Gigerenzer (2015) believed is due to the fact that people are often rationally bound. Lastly, libertarian paternalism refers to interventions targeting people’s decisions to direct them toward the decision they would have made if they were rational (Gigerenzer, 2015).

As Thaler and Sunstein explained, nudges, while preserving the freedom of choice, in a way take advantage of people’s inefficiencies in decision-making (Thaler & Sunstein, 2008; Hausam & Welch, 2010; Mols, Haslam, Jetten, et al., 2014). Thaler and Sunstein clarify that “*nudges are not mandates*” (2008, p.5-6). That means the strategists or so-called ‘choice architects’, are only aiming to influence the target groups’ decisions for the groups’ best interests and in the right direction. They explain that this phenomenon does not take away individuals’ freedom not to pursue what they are encouraged to do (Thaler & Sunstein, 2008). In addition, as Yoong, Hall, and Stacy et al., (2020) explained, nudges are a way to modify the environment to best utilize one’s capacity to encourage people toward behaviors that are also in line with their intrinsic values without necessarily actively taking away any other alternatives. However, nudges as a form of a “low-cost strategy” (Sunstein, 2019; Kusters & Van der Heijden, 2015) make other [less environmental-friendly or unhealthy] alternatives seem more costly in terms of time and trouble by intervening in people’s decision-making process (Hausam & Welch, 2010).

2.3.1 Nudge Categories

Sunstein (2014), in a guide to nudging, has categorized the ten most important nudges as the following:

1. *Default rules*: these concern the programs that people are automatically enrolled in (Sunstein, 2014). However, users are still free to opt out of the program if they wish to do so (Sunstein, 2014). For instance, the U.S. government implemented the so-called default rules by introducing a meal plan which aimed to provide necessary nutrition for less privileged students (Fusaro & Sperling-Magro, 2021). In the program, the students that are not in need of government subsidy are free to opt-out. The design of these kinds of programs, making the meal plan a default option, is found to have a higher participation rate compared with the ones where the target group should register rather than opt-out (Fusaro & Sperling-Magro, 2021).
2. *Simplifications*: these types of nudges center around simplicity for increased participation rate (Sunstein, 2014). The functionality of this type of nudge is irrespective of whether the country or society of implication is rich or poor. For example, in cases where the target group needs to fill out application forms, the responsible authorities refraining from complexity could potentially increase the participation rate of the program in question (Sunstein, 2014).
3. *Reminders*: these types of nudges take into account inertia and procrastination as factors why one might not implement an activity (Sunstein, 2014). Deals in which the individuals are only to confirm the pre-selected options instead of choosing them are examples of how to nudge people in certain situations where people might have only forgotten to take part in an event/deal (Sunstein, 2014).
4. *Implementation intentions*: asking for someone's intentions as a way of nudging them in certain directions goes under this category (Sunstein, 2014). This type of nudging revolves around following up on an expected future event and potential behavior by

creating a cognitive link between the two (Nickerson & Rogers, 2010). For instance, a voting campaign that called the citizens to ask whether they will participate in the upcoming elections saw a rise of an average of 1% (Green & Gerber, 2008). That is attracting 1 more person out of 100 calls that would otherwise not participate in the elections. It is also worth mentioning that implementation intentions have been proven to be more effective for repetitive activities such as exercising (Milne, Orbell & Sheeran, 2002) but also certain one-time activities like picking up a book at an office to read (Dholakia & Bagozzi, 2003).

5. *Social norms*: this type of nudge is like informing people of their peers' actions, and activities (Sunstein, 2014). This is considered to be one of the most effective ways of encouraging people toward certain activities (Sunstein, 2014). As Nahmias, Perez, Shlomo, and Stemmer (2019) explain, social nudges exploit people's need to fit in their environment. Collecting and processing the personal information of the individuals are the steps of designing this type of nudge (Nahmias, Perez, Shlomo & Stemmer (2019). It is worth mentioning that by making the social norms more salient, their effectiveness could increase (Cialdini, Kallgren & Reno, 1991).
6. *Ease and convenience*: Arranging food in a healthy order in canteens or placing healthier products in the middle and upper shelves at the stores are examples of this kind of nudge (Cheung, Gillebaart, Kroese, Marchiori, Fennis & De Ridder, 2019). The main aspect of this type of nudging is to make choices as easy as possible for people to pursue by reducing barriers (Sunstein, 2014).
7. *Disclosure*: making information available and comprehensible to people (Sunstein, 2014) to nudge them to make more informed decisions by providing them with critical information prior to them making any decision (National Library of Medicine, 2021; Franklin, Folke & Ruggeri, 2019). Chong and Druckman (2007) in their paper 'Framing theory', explained that disclosure nudges in fact make the information more salient by creating an emphasis on framing (cited in Franklin, Folke & Ruggeri, 2019). For

example, using disclosure nudges is found to result in more advantageous financial-related decisions (Franklin, Folke & Ruggeri, 2019) that could concern more sustainable and efficient use of energy only if the institutions and energy companies would inform the customers of the details of their consumption.

8. *Warnings*: The goal of this type of nudging is to attract people's attention to a source of danger using graphics, large fonts, etc. (Sunstein, 2014).
9. *Precommitment*: Gym membership is an example of this kind of nudge. The main assumption behind the precommitment strategy is that people will pursue actions that they have committed to (Sunstein, 2014).
10. *Informing people of the nature and consequences of their own past choices*: This type is called 'smart disclosure' in the U.S. (Sunstein, 2014) and 'midata project' in the U.K. (Sunstein, 2014). This type of nudging is around making past data available to the companies and the users to inform them of the consequences of their actions as a way of encouraging them to pursue, for example, more environmentally-friendly behavior (Sunstein, 2014).

2.3.2 Are Nudges Ethical?

The popularity of the theory and the policymakers' enthusiasm for it has however been followed by critics (Goodwin, 2012; Pinch, 2010; Selinger & Whyte, 2011). They have been challenging the theory, especially from an ethical standpoint in terms of preserving individuals' freedom of choice (Goodwin 2012; Hausam & Welch, 2010; Legget, 2014, Pykett, Jones, Whitehead, Huxley, Strauss, Gill, McGeevor, Thompson & Newman, 2011; Schnellenbach, 2012, John, Smith & Stoker, 2009; Jones, Pykett & Whitehead, 2013). Scholars questioned how nudges and choice architects ensure one's freedom of choice if they are making their decisions for them (Goodwin 2012; Hausam & Welch, 2010; Legget, 2014, Pykett, Jones, Whitehead, Huxley, Strauss, Gill, McGeevor, Thompson & Newman, 2011; Schnellenbach, 2012, John, Smith & Stoker, 2009; Jones, Pykett & Whitehead, 2013). Therefore, paternalism, unintended

consequences, and manipulation have been the central matters concerning the scholars as Tummers (2022) also found after analyzing 443 newspaper articles about nudging.

However, Thaler and Sunstein in their interview with McKinsey elaborated on what are the characteristics of an ethical nudge and that nudges are supposed to be transparent and in line with people's values (Fusaro & Sperling-Magro, 2021). This way the target group will have the chance to only make an informed decision. In this regard, Schmidt and Engelen (2020) also explain that nudges often respect one's freedom of choice as no option is removed or significantly changed in terms of economic value. Hausman and Welch (2010), two of the critics of the theory, also argue that in order for nudge strategies to be ethical, they require full transparency, especially if they are being implemented by the government. In addition to that, many scholars have come to agree that as long as nudges align with people's goals and values, people tend to welcome them more than other kinds of traditional interventions such as fines (Hagman, Andersson, Västfjäll, et al. 2015; Petrescu, Hollands, Couturier, Ng & Marteau, 2016; Reisch & Sunstein, 2016; Reisch, Sunstein & Gwozdz, 2017)

On the other hand, Goodwin (2012) explains that the theory could negatively affect one's freedom of choice in an event where a choice architect designs the alternatives to encourage the target group toward what they consider to be best for the society. However, Schmidt and Engelen (2020) find choice architecture to be inevitable as finding a neutral way to frame alternatives is hard to avoid especially when it comes to default options. That is because even if decision-makers refrain from creating a default option, that is also a choice architecture that in the end affects how people behave (Schmidt & Engelen, 2020). However, the concern that choice architecture could result in manipulative strategists who would only impose their own opinions by exploiting the flaws in the human decision-making process could remain (Hausman & Welch, 2010; Goodwin, 2012).

2.3.3 Nudging in Mobility

Given the environmental impact of motor vehicles (MV) such as carbon monoxide pollution, studies have taken a turn to also examine transportation decisions as they are found to be

responsible for 27% of greenhouse gas emissions in the US annually (Whillans, Sherlock, Roberts, O’Flaherty, Gavin, Dykstra & Daly, 2020). Due to the urgency of the climate crisis, changes in mobility behavior are required in order to slow down the rising global temperatures (Whillans, Sherlock, Roberts, et al., 2020). The highly expensive car ownership for both individuals and municipalities is another reason why a change in transportation behavior is necessary (Whillans, Sherlock, Roberts, et al., 2020). Therefore, strategies through which decision-makers can influence transportation demand under the name of “Transportation Demand Management” got introduced that nudge strategies are part of them (Whillans, Sherlock, Roberts, et al., 2020).

It is worth noting that behavioral interventions were not the only focus of the decision-makers to encourage people toward more sustainable modes of transport, but structural or hard measures that focus on economic incentives and environmental changes such as building bike lanes, have been part of the demand management methods (Whillans, Sherlock, Roberts, et al., 2020). As Tennøy and Øksenholt (2017) explained, that has been one of the main strategies implemented by steering land use to change transport behavior toward less-car use through public transportation infrastructure, parking and congestion pricing, and trip length. However, given the complexity involved in the public transport planning process in addition to the funding and implementation aspects, the process has proved difficult to manage (Tennøy & Øksenholt, 2017). This raises the importance of employing low-cost strategies like nudges.

There have been some cases in which nudging has been employed in order to encourage more sustainable mobility behavior. One of the popular measures has been gamification by implementing measures to change behavior at an individual level by making information available to the target group (Mauro, Shinde, Arnone, Zamith, De Rosa & Pietroni, 2022). Gamification in general terms is “the process of using gaming elements to motivate and engage people” (King, Greaves, Exeter & Darzi, 2016, P.76). The strategy has been employed in mobility-related initiatives such as NuRide, MoveUs, and Bike2Work, to name a few (Mauro, Shinde, Arnone, Zamith, De Rosa, Pietroni, 2022). Decision-makers, in similar initiatives with the above-mentioned ones, through apps such as MUV and A World track one’s carbon footprint

and compare it with the user's previous footprint, and other individuals aim to keep citizens informed and motivated to maintain healthy mobility lifestyles (Mauro, Shinde, Arnone, et al., 2022). These apps, by creating digital incentive nudges, allow the users to exchange the points they earn on the app for a free coffee or other small rewards (Mauro, Shinde, Arnone, et al., 2022).

Another case in which the decision-maker employed nudge strategies was in the county of Fürstentfeldbruck, by providing information regarding the offers available to the citizens in a package called "The mobility wonder bag" (Mauro, Shinde, Arnone, et al., 2022). They, through a survey, found all the information that the citizens need in order to consider using public transport and started providing them with the package (Mauro, Shinde, Arnone, et al., 2022). Therefore, they made public transport alternatives more attractive to their citizens by facilitating communication with the users and providing them with the necessary information that was made in a simple and accessible manner.

Furthermore, in Cantons and Zurich, two regions of Switzerland, a large-scale trial, GoEco!, a smartphone app, was implemented to track citizens' mobility behavior and to provide them with eco-feedback and social comparison (Cellina, Bucher, Mangili, Veiga Simao, Rudel & Raubal, 2019). The selected target group indicated a significant decrease in CO₂ emission and energy consumption per kilometer in car-dense areas in Canton (Cellina, Bucher, Mangili, et al., 2019). The results, however, were insignificant in Zurich where a quality PT system is in place (Cellina, Bucher, Mangili, et al., 2019).

2.4 Research Question vs. The Established Literature

The research question concerns *to what extent have mobility actors successfully influenced citizens' mobility choices using the nudge theory to promote and encourage the adoption of sustainable modes of transport*. In order to encourage or forbid certain activities, authorities have been utilizing different governance mechanisms in order to achieve the outcomes that they find valuable to the societies, especially in situations where they are addressing the climate crisis and health concerns within their societies (Lowndes & Skelcher, 2002; Treib, Bähr & Falkner,

2007). For this purpose, as Mols, Haslam, Jetten, and Steffens (2014) explain, ‘hierarchy’, ‘markets’, ‘networks’, and ‘persuasion’ are the four different governance modes that have been used by policymakers. They, in their paper ‘A Social Identity Critique of Governance,’ explore a potential fifth mode of governance called nudging. The theory of Nudge having roots in behavioral economics and sociological theory is influenced by Tversky’s and Kahneman’s work in cognitive psychology, as Brown (2012) explained in his paper on “A Nudge in the right direction”. Nudging has been receiving much attention and enthusiasm, especially from policymakers since its introduction in 2008 (Brown, 2012, Kusters & Heijden, 2015; Goodwin, 2012). The theory stemming from empirical observations (Kusters & Van der Heijden, 2015) resulted in the foundation of special Nudging units in the governments. For instance, in the U.K., the Behavioral Insights Team or the Nudge Unit was founded in 2010 (Brown, 2012; Kusters & Van der Heijden, 2015; Goodwin, 2012). That was followed by similar units in countries such as the U.S., Canada, Germany, and international institutions, such as UN agencies integrating the theory into their practices (Afif, 2017).

2.5 Theoretical Framework

As presented earlier, the aim of this paper is to examine the effectiveness of nudge strategies targeting citizens’ behavior to encourage them toward more sustainable modes of mobility. In this regard, this theoretical framework is developed based on the Nudge theory to facilitate the further steps of this study, such as data collection and analysis. The established framework aims to shed light on the effectiveness of the Nudge theory within mobility by taking into account the criticisms around the theory regarding its effectiveness to address the world’s biggest problems such as the climate crisis (Goodwin, 2012). Therefore, this paper, by examining real-life cases, aims to test the hypothesis that *‘The Nudge theory can be effectively applied in sustainable mobility by targeting citizen behavior’*. “Effectively”, in this paper, means whether the decision-makers could observe any changes in citizens’ behavior toward more sustainable modes of mobility after they had implemented the strategies.

To recapitulate what the Nudge theory is and to set the foundation for conducting the data collection and analysis, the below definition and elements are outlined, which are primarily

based on Thaler and Sunstein (2008; 2021) and Thaler’s (2019) paper ‘A very short guide to Nudging’ which explains that nudges are environmental features altering behavior. For this purpose and in order to recognize the strategy as a nudge within mobility, four main characteristics are determined based on the original theory that the results will be examined against, as indicated below:

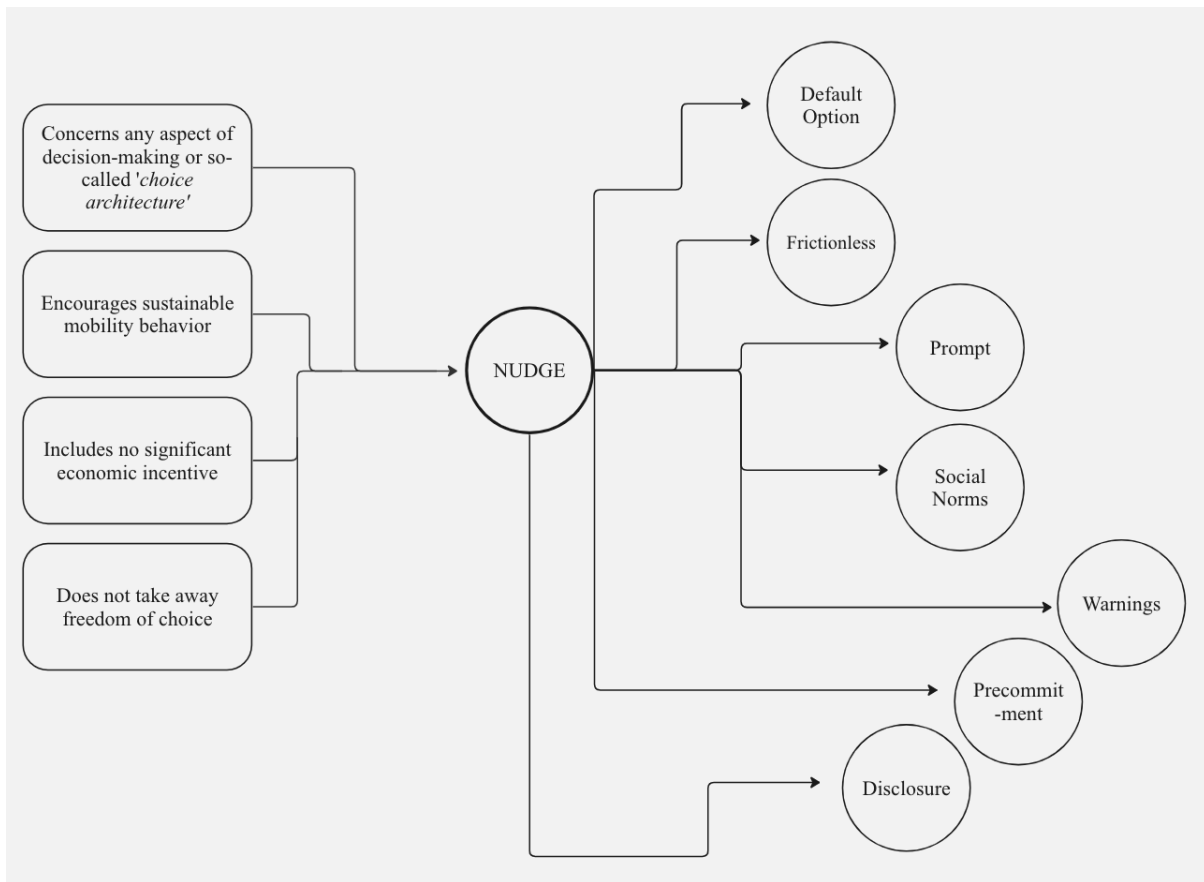


Figure 1. Theoretical Framework.

For the strategy to fit in the description of a nudge strategy within mobility, it should concern any aspect of the choice architecture (Thaler & Sunstein, 2008), which aims to encourage sustainable mobility behavior. The strategy should alter one’s behavior without any significant economic incentive or taking away one’s freedom of choice (Thaler & Sunstein, 2008) to choose any other mode of transport. Once the strategy is recognized as a nudge, the characteristics of the strategy in question will be further examined against the characteristics of the seven categories outlined in

this theoretical framework. It is worth noting that Thaler (2019) proposed ten different nudge categories; however, given the similarity between some of the categories, such as *simplicity* and *ease and convenience*, they are integrated into one category. This is thought to facilitate the assessment process while evaluating the strategies. Another reason why this could specifically be beneficial for this study is that the Nudge theory is not well-established within mobility as it is within the health and food sector. Therefore, the number of cases where the theory has been utilized is limited compared with the other two sectors; thus, by decreasing the sensitivity of categorization, this paper could refrain from unnecessary complexity. Hence, the categories are classified below with definitions specifically targeted toward mobility that is inspired by the original descriptions proposed by Thaler (2019). For a better understanding of the categories, one to two examples are outlined above each category as well:

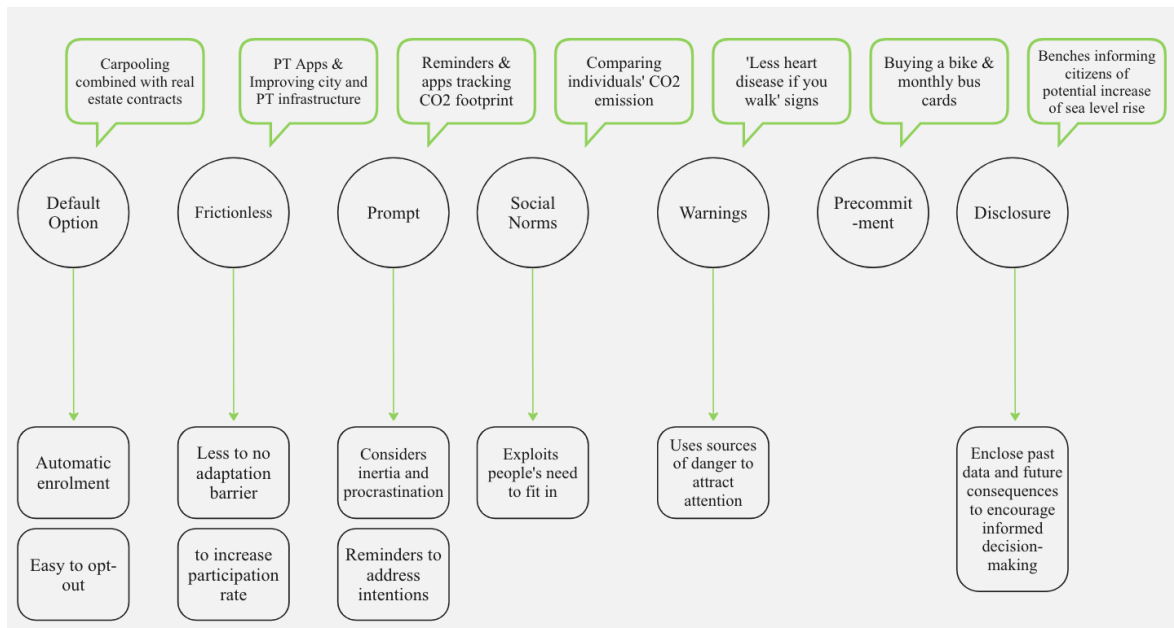


Figure 2. Theoretical Framework - Nudge Categories.

The results are expected to extend the theory and its effective use in sustainable urban mobility by either accepting or rejecting the hypothesis. Furthermore, the characteristics of the effectively implemented nudge strategies are also part of the focus of the study in order to be able to go beyond this specific case. In addition, finding the most common nudge categories are expected to be facilitated through the classification outlined above.

3. Methodology

The chapter will facilitate the general methodology of the study. A walkthrough of methodological choices, research design, data sources, data collection, data analysis, validity and reliability, and ethical considerations will be presented. The findings generated from the selected methodology will be presented in the following section.

3.1 Methodological Choices

As outlined in Chapter 2, “Literature Review”, the theoretical framework selected is the Nudge theory. A hypothesis was raised based on the existing literature and projects where the nudging theory was implemented, that:

Nudge theory can be effectively applied in sustainable mobility by targeting citizen behavior

In the hypothesis, ‘*Effectively*’, refers to whether the decision-makers could observe any changes in citizens' behavior toward more sustainable modes of mobility after they had implemented the nudge strategies. Sustainable modes of mobility include more use of public transport, more walking, more cycling, and other modes that lead to the reduction of private car use. Having this in mind, the study aims to use the hypothesis for validating and extending the application of the Nudge theory within the field of mobility. The framework of this study was applied to the urban mobility sector, primarily looking into nudge strategies used to influence citizens' transportation behavior toward more sustainable choices. With this aim, the study poses this research question:

To what extent have mobility actors successfully influenced citizens' mobility choices using the nudge theory to promote and encourage the adoption of sustainable modes of transport?

The study has built its research question on the following premises (Yin, 2014, Ch. 2):

- As was found in the literature review, nudges do not include financial incentives or taxes;

- The assumption was made that both the citizens and the decision-makers see benefits in becoming more sustainable, thus the motivation for becoming sustainable was not questioned.

3.2 Research Design

The study includes elements of both deductive and inductive reasoning. Deductive reasoning is featured through employing a general theoretical framework - the Nudge theory - to develop the effectivity and potentially, extension, of the theory within the field in question. However, interviews include a semi-structured approach, where alternative explanations are sought too, falling under the category of an inductive approach. Thus, having two types of reasoning combined, the study was designed to proceed abductively while utilizing a qualitative research approach. Abductive reasoning involves generating plausible explanations based on limited information, which can expand the range of potential hypotheses and ultimately lead to more comprehensive conclusions (Charmaz, 2014, Ch. 3). Therefore, this research could benefit from incorporating an abductive type of reasoning in the research design of this study, as it is perceived that a combination of deductive and inductive perspectives can lead to a more nuanced explanation of the phenomena under examination (Charmaz, 2014, Ch. 3).

A number of arguments were developed about why a qualitative inquiry is necessary for this study. When analyzing soft behavioral measures, they can not be easily measured and can involve complicated answers to the research question, which is due to citizen behavior being affected by many intangible factors such as values, norms, and attitudes (Armitage & Conner, 2010). In addition, to understand the behavioral change strategies that target behavior, a detailed understanding of each strategy is required, which, as Creswell (2007, Ch. 3) discussed, is best established by directly talking to participants; therefore, building the case for choosing a qualitative approach for this study. Among these reasons, what also strongly drove the decision to choose this approach was the importance of not underestimating the uniqueness of each decision-makers situation, as tying all individuals to a statistical mean would simply overlook their uniqueness, leading to a lower level of detail in terms of assessing how to use nudges best (Creswell, 2007, Ch. 3).

The research design has followed a sequence of decisions starting with choosing the Nudge theory as the theoretical framework, followed by the outlined hypothesis which will be tested through the data collection and analysis stages.

While the research aims to identify effective uses of nudge strategies in sustainable urban mobility, the level of analysis is mainly regional, since strategies being implemented in the transportation sector normally target areas, or regions, where people reside. For instance, in Sweden, the region of Skåne is an example, having one publicly-funded company, Skånetrafiken, operating the public transport system. The units of analysis will be respondents and their perspectives on the implemented behavioral change strategies, upon which they have been involved in their design and implementation. The motivation behind choosing this analytical unit was the fact that the study is pursuing to gain a comprehensive understanding of individuals who have used the nudging techniques and key lessons and success factors behind them. That is found to be best done by primarily gaining their individual perspectives on it.

3.2.1 The Case

With the level and unit of analysis outlined, the study has followed a design of a single-case study. As Yin (2014, Ch. 1) suggests, a case study should examine a phenomenon within a real-life context. In this study, the phenomenon being investigated is *behavioral measures toward citizens to promote and encourage more sustainable modes of transport*. In the real world, the context of such a phenomenon resides in a *regional context upon which a behavioral measure is implemented*. For example in Sweden, Skåne could be considered as one of those contexts, with public transport innovation taking place on a city- or area-wide level (OECD, 2012). For these reasons, a single case of this study is a decision-maker (local authority, public transport company, researcher) implementing a nudge to encourage citizens toward more use of sustainable modes of transport. Such decision-makers are often involved in public transport companies, local authorities, city planning firms, or researchers within the field of behavioral interventions, acting as a target sample for this study, which will be further explained in the *Sample Description* section.

A single case study approach was picked over others, such as a multiple case study, due to a few reasons supported by the case study guidelines developed by Yin (2014, Ch. 1) and the case survey methodology developed by Larsson (1993). First, the study was framed under a single-case study design due to the fact that the main research questions aim to answer “how” and “why”, being outlined as the most common features of case studies by Yin (2014, Ch. 1). Second, the researchers of the study have no control over the behavior of respondents, which was done in order to receive a comprehensive view of the hypothesis while not closing down on any unpredictable evidence, arguing further why a case study approach is useful in this case. Third, the study focuses on a contemporary phenomenon, which is underexplored in present-day research. As mentioned before, the phenomenon under scrutiny is the implementation of nudges to change citizens’ transportation decisions to more sustainable travel choices. One case with one phenomenon was selected to be able to focus all available resources on understanding one case the best. This builds on top of what Larsson (1993) has argued in regard to case study research. As Larsson (1993) stated, one of the biggest advantages of conducting a case survey, which in this case is a qualitative single case study in combination with interviews, is the aspect of richness when studying one phenomenon. What Larsson (1993) has outlined is that this chosen method capitalizes on the idiographic richness of case studies that derive from their ability to study more complex phenomena than more surface-level standardized surveys can.

Having the positive aspects of a case survey discussed, it is important to outline the drawbacks or limitations of a chosen study design. First, the case study research has an imposed limit of possible cases that can be used for analysis. However, it is not an issue within this study as it has established limitations of time and size of the paper, making it suitable for not reaching that imposed limit (Larsson, 1993). In addition, there is a counterargument toward case surveys stemming from the fact that secondary researchers who could use this study as grounds for their research can not achieve theoretical or statistical generalization. It is not possible because the selection of respondents and cases is out of their control (Larsson, 1993). In the case of this study, it can be seen as one of the drawbacks, but since the uses of the Nudge theory are underexplored in sustainable mobility, any further research in this field is valuable without the

necessary requirements of witnessing generalizations in this field. Last but not least, coding procedures might simplify the complex phenomena under scrutiny (Larsson, 1993). However, to not undermine the complexity, secondary data is employed in combination with an expectation that the findings will validate the hypothesis and expand the theoretical framework. Such an expansion will be done with the help of not only coding information that matches the theoretical framework but also by analyzing respondent answers that were not fully matching the theoretical framework.

The strategy of achieving desired results for this single case study was designed by aiming for a wide range of individual perspectives, which helped create a holistic overview of the case at hand. To optimize the quality of the study, due to imposed limitations, 9 observations were conducted, targeting decision-makers who have implemented a soft behavioral measure. It was assumed that with a wide range of respondent backgrounds, 9 interviews will be sufficient to achieve richness in collecting comprehensive answers to the research questions posed.

3.2.2 Data Collection

In this qualitative study, a cross-sectional data collection design is being used to collect data for the single case, with a focus on key success factors and learnings for testing and developing a more efficient use of the Nudge theory (Bell, Bryman & Harley, 2011, Ch. 2). Both primary and secondary data have been collected in this study.

Primary data has been collected through interviews with local authorities, city planners, company representatives, and sustainability experts that have worked with developing and/or implementing strategies targeting citizen behavior toward more sustainable modes of transportation. Secondary data has been gathered through an examination of previous studies, reports, and statistics related to nudging in sustainable mobility, and decision-making of soft behavioral interventions.

3.2.2.1 Sample Description

According to Creswell and Creswell (2023, Ch. 9), qualitative research generally aims to purposefully sample to select participants or sites that can best help the researcher understand the problem and the research question. Creswell (2007, Ch. 7) also outlines a wide range of over 15 different types of sampling, ranging from maximum-variation to convenience types of sampling, among which a choice was made for this study. To conduct interviews on data-rich cases, this study has employed a criterion sampling strategy, which allows the selection of participants on a number of criteria. In addition, the criterion sampling strategy allows for stronger quality assurance, as participants are picked selectively, standing as another argument for the sampling method chosen. Therefore, a list of criteria was generated to determine which respondents should be selected as units of analysis for the case under scrutiny:

- A choice architect - someone who worked in implementing a nudge or other type of behavioral intervention. Without a specific restriction, this could include a public transport company decision-maker, a researcher, a sustainability expert, an authority, or any other representative who worked in implementing behavioral measures for more sustainable modes of transport. This criterion was formed in high regard to be relevant to the case being studied.
- A diverse set of perspectives - A wide range of perspectives and experiences was sought, aiming to choose respondents from different educational, geographical, and professional backgrounds. A preference for respondents outside of Sweden was outlined. The intention here was to increase the validity and reliability of the results by including a variety of cases where the theory has been implemented.
- Specific involvement in behavioral change and sustainable transport - Only respondents with experience in these fields, which was done in relation to the case, the research question, and the potential of in-depth quality of primary results.

- Positive and negative perspectives towards Nudge theory - Chosen respondents were aimed to be polarized toward Nudge theory, with an expectation that selected participants witnessed either positive or negative outcomes of the framework. The validity and reliability of the study were sought to be increased with this criterion, as this provided a full spectrum of perspectives on the case.

In terms of their area of expertise and competence, respondents were pursued by utilizing contacts recommended by project partners, Fojab, Ericsson, Skånetrafiken, Skanska, Afry, and Region Skåne. The process yielded a pool of 60 potential interviewees from various EU countries outside of Sweden such as the United Kingdom, Netherlands, and Denmark. Email and LinkedIn were the primary tools implemented to reach out to potential candidates. Eventually, a total of 9 interviews were conducted. The reason for choosing this number of final interviews stems from the fact that during the process of conducting interviews, an overlap between respondents' answers was witnessed, leading to a decision to wrap up the interview process with nine respondents.

3.2.2.2 Interviews

Qualitative research involves two primary types of interviews - unstructured and semi-structured (Bell, Bryman & Harley, 2011, Ch. 18). Unstructured interviews are more conversational in nature, with the researcher covering a range of topics and asking one question at a time. The interviewee is free to respond, and the interviewer may follow up on significant topics requiring more detail. In contrast, semi-structured interviews consist of several questions that cover specific topics and follow an interview guide. However, the order of the questions may not be followed, and additional questions may be asked based on the interviewee's response. For this research, a semi-structured interview was used as it allowed for specific subjects to be addressed based on the research questions and for additional information to be requested based on the interviewee's response (Bell, Bryman & Harley, 2011, Ch. 18).

To create the interview guide, a thorough review of relevant literature was conducted together with inputs from Lund University researchers in the field who were also involved in the project.

Questions were designed with several considerations in mind. First, the themes developed in the theoretical framework were used as pointers for developing the questions. Second, the use of technical language was avoided and complex concepts with their convoluted terminology were diminished. Steering away from the “why” type of questions was also implied. These modifications were made to keep the interview format semi-structured and to keep space for interpretation on the interviewees’ behalf. Third, open-ended questions were used, following up with probes such as “Tell us more about x” or “Please explain y”, as suggested by Creswell and Creswell (2023, Ch. 9). Lastly, the interview guide was structured in a coherent demeanor, with more detailed and susceptible inquiries presented as the interview proceeded.

The interview guide (Appendix 1) comprises 3 main parts and an estimated timeframe of 45 minutes. The parts include an introduction, interview questions, and closing remarks. In the introductory section, an elaboration on the research focus takes place accompanied by a short introduction of the hosts, combined with the introduction of types of questions and expected timeframe. The respondent is given a chance to ask any questions before the main part of the interview begins, and a brief explanation of the most important terms used during the interview takes place. It is important to outline that the interview guide was continuously refined as the interviews proceeded, which helped improve the line of questioning, identifying and minimizing bias and improving the output of the results (Creswell, 2007, Ch. 7).

In the second part of the interview, 2 main questions were chosen to best optimize the chances of receiving appropriate answers whilst preserving the necessity to make the interviews as short as possible. As suggested by Creswell and Creswell (2023, Ch. 9), the main questions were split into two parts, the first one acting as a more general background question while the latter - narrowing down to what is expected to provide an answer to the study questions. Therefore, the second question is followed by three subsequent questions.

The concluding section includes the interviewer's closing remarks with an alignment on the confidentiality they would like to retain in regard to their contact details, the company of employment, and the current role to be shared in the study. An additional final question is

utilized to receive any final information respondent would like to share, including a possibility to redirect us to a relevant potential interviewee they might know. Results of a study are not offered to be sent due to potential confidentiality issues, however, per request, the study, its results, and the final presentation made to the final companies were shared with them (Appendix 1).

3.3 Data Analysis

3.3.1 Primary Data

After interview data was collected, an analysis of the case was conducted using the so-called technique of pattern matching, as Yin (2014, Ch. 5) presents. This is one of the most desirable methods when it comes to case study analysis (Yin, 2014, Ch. 5). In this logic, an empirically-based pattern is compared with a predicted one before the data was collected (Trochim, 1989). For this study, among a few different types of pattern-matching techniques, a single case pattern-matching technique was used to analyze the data collected from interviews (Yin, 2014, Ch. 5). This technique focused on the case in question - allowed to zoom in on specific patterns and themes to see how they could fit with the theoretical framework - the Nudge theory.

Once individuals fitting the criterion sampling strategy were identified, the interviews were conducted. In the interviews, each participant's story was closely followed and recorded to ensure the comprehension and level of detail of the results. Once the interviews were compiled together into separate audio files, the data analysis process started.

The interviews were analyzed by listening to the audio files and the data coding process was initiated while listening to the interviews. Coding consisted of writing down all relevant information the interviewee had said and then organizing it into one table (see Appendix 2 for an example). All the information that was written down and information relevant to the research questions of the study received a comment or a "code".

The generated codes were then compared against the categories outlined in the *Theoretical Framework*. The comparison has helped us understand which categories match the theoretical

framework together with the hypothesis, and which do not (Yin, 2014, Ch. 5). If the interviewee has provided at least one successful case of nudges that matches all requirements of the Nudge theory in the theoretical framework, then the respondents' answers were considered as the ones which *validate the hypothesis*. In the opposite case, they were considered to *reject the hypothesis*.

At the end of the data analysis, this method helped us make sense of the rich and in-depth information that was gathered in the interviews. Participants who provided their insights and experiences on the topic have now shed light on the research questions at hand which will be presented in the Analysis and Discussion sections of the study.

3.3.2 Secondary Data

To supplement and enhance the findings, the study also used a pattern-matching method to analyze the secondary data sources chosen. Secondary data sources were drawn from previous studies, reports, and statistics related to nudging, sustainable mobility, and decision-making. With the approach of pattern-matching, the sources were reviewed and common themes relating to the research question and the findings of primary data collection were identified. Those themes will be described and presented in the following sections as a complement to the analysis of primary data. Triangulation of findings from primary and secondary data analysis strengthened the credibility and validity of research outcomes, providing additional context and insight into the topic of nudging and sustainable modes of mobility.

3.4 Research Quality

3.4.1 Validity and Reliability

To begin with, a technique of data triangulation was employed to ensure the accuracy of findings and to build a coherent line of argument within the findings. Data triangulation within this study meant collecting evidence from more than one source, consisting of nine separate interviews, and the usage of primary as well as secondary data to translate the interviews into coherent findings. The approach ensured the results were drawn from different perspectives and types of data, primary and secondary, establishing a higher validity.

Among these strategies employed, the potential bias of the respondents was also taken into account. In the Results section, findings were interpreted while considering respondents' area of competence within urban mobility, depth of knowledge and experience within the field, and education and cultural background of the respondent. Once these elements are well-understood in the data analysis process, emphasis is put on what bias a respondent may have on their answers. However, since diversity and polarization towards the topic of the study are two outlined criteria, it helped ensure that such bias is minimized.

The potential bias of the authors of the study was also reflected. During the steps of data collection and analysis, researcher bias was accounted for by engaging in an ongoing reflection and self-awareness process in order to hold a neutral stand on the results to the largest extent possible. Since the study was conducted by two researchers, it helped ensure that an interpretation does not have any individual bias when aligning an interpretation of results between the two researchers. When data was presented, the authors were aware of their own bias and for this reason, the data from the interviews were presented irrespective of their stance toward the hypothesis and the use of nudges within mobility overall. Although a personal interpretation of results did take place in Empirical Data, this interpretation was carried out in relation to the research question of the study, aiming to eliminate any personal bias. In the Discussion, the demonstration of evidence was provided in relation to the literature of the paper and empirical data, repeatedly aiming to eliminate authors' bias. Among these aspects, the paper was reviewed on multiple instances by multiple researchers in the field, providing a stronger sense of trustworthiness, clarity, and transparency of the study.

Furthermore, evaluating research within international business management involves considering its reliability as well. If results are replicable, it can be claimed that the research is reliable (Creswell and Creswell, 2023, Ch. 9). Nevertheless, due to changing social settings and situations, external reliability may pose a challenge (LeCompte & Goetz, 1982). Therefore, a responsive questionnaire was developed through the use of semi-structured interviews, generating a wide variety of responses from the respondents. Different types of knowledge,

experience, geographical location, professional background, and polarized views on the topic were targeted through our criterion sampling approach, expanding the possibility of stronger reliability of the study.

Emphasis should be placed on the uniqueness of results too. The research is considered to have achieved internal reliability by formulating effective interview questions, with backed-up probes, to make sure that interviewee's experience, knowledge, and insight are comprehensively explored. These insights were also enriched by a literary framework of the Nudge theory, providing a stronger sense of reliability to the analyzed output and its relevance to the research questions posed.

3.4.2 Ethical Considerations

The segment reflects on crucial ethical implications that have been given thought in the design and implementation of this paper.

Prior to each interview, respondents received information about the focus of the study, its purpose, and the types of questions they could expect during the interview process. Interview questions were designed to avoid any potentially harmful or intrusive questions, and participants were ensured of their right to not answer the question by their request. Leading questions were avoided during the interviews and it was ensured that respondents are not interrupted during the interview process so that the answers are kept as unbiased and as elaborate as possible.

Furthermore, upon the authors' request to record the interview for analysis purposes, the respondents were given a chance to deny it, in case they had any objections. To guarantee their anonymity and confidentiality, respondents were assigned pseudonyms in the Empirical Data and Discussion. However, their location, position, and responsibility information was kept as part of the empirical data as it helps display a wide array of perspectives employed in the study, in turn ensuring both higher validity and reliability. All data collected during interviews is stored on personal computers and is only accessible by the research team. Participants' personal data is

retained separately from the interview transcripts and personal details are not included to protect their identities.

Lastly, all data was restored with the utmost care to ensure the necessary security and protection, therefore, only authorized team members are allowed to have access to the data files. When reporting the findings, the research team adheres to relevant ethical guidelines and standards when presenting the results, keeping the option to only mention the names of the respondents in case they would request it. The same applies to the report being shared with the participants of the study - it is only shared upon their request, which helps ensure accuracy and fairness in representing their perspectives.

4. Empirical Data

This chapter will present data gathered during the data collection process, with the aim to build a coherent interpretation of the interviews conducted. The data retrieved from the interviews, depending on their relevance and potential contribution to the study are presented here through different themes. Secondary data analysis will also be taken into account as supporting evidence for the primary data collected. As presented earlier, both primary and secondary data analysis have followed a pattern-matching approach. The approach is visible through the illustration of the main themes identified in the data, which indicates an abductive approach and a fit with the research question raised.

4.1 Interview findings

The section will start with a brief overview of respondents, followed by a display of empirical proof which is split into the following parts - determinants of successful sustainable mobility; private vehicle use; main findings - soft behavioral measures to achieve sustainable mobility; hard behavioral measures and key success factors of nudging. Upon classifying data into the above themes, they were also categorized into sub-themes and interpreted in relevance to the research question (-s) posed.

4.1.1 Respondents

In order to determine interviews best suited for this study, a list of 70 potential candidates was compiled. After sorting them into the most relevant potential interviews, 9 of them were selected for the interview process. Below you can find a table that presents an overview of the respondents. In order to ensure a higher validity of the data collected, decision-makers were selected from different geographical areas. That is due to the fact that participants relatively come from and work in similar fields. Having a group of respondents with different geographical and cultural backgrounds was set up to potentially establish a diverse set of perspectives on the case under investigation:

Respondent	Country	City	Field of Activity	Responsibilities
Respondent 1	Sweden	Stockholm	Architecture & Planning	City Planner
Respondent 2	Sweden	Malmö	Sustainable Transport Systems; Research	Analytic; Ph.D. - Soft Behavioral Measures
Respondent 3	UK	Manchester	Government Administration - Transport	Senior Stakeholder Manager
Respondent 4	Netherlands	Amsterdam	Sustainable Innovation	Board Member; World Economic Forum Council
Respondent 5	Sweden	Lund	Public Services - Sustainability	Behavioral Change Manager
Respondent 6	Sweden	Karlstad	Governmental Services - Municipality Management	Traffic Executive - Region Värmland
Respondent 7	Denmark	Copenhagen	Research	Lead Author of IPCC; Associate Professor in Sustainability Management
Respondent 8	UK	London	National Healthcare Services	Net Zero Travel & Transport Lead
Respondent 9	US/Germany	Harvard/ Konstanz	Harvard University	Associate Professor in Behavioral Economics

Table 1. List of Participants.

4.1.2 Determinants of Successful Sustainable Mobility

The empirical data presentation begins with this section as it will provide a background of factors upon which behavioral measures should be placed. Upon collecting the data, respondents repeatedly mentioned factors that influence effective and sustainable mobility within cities. Thus, it is proclaimed that not only do behavioral measures matter in sustainable urban mobility - *city planning, citizen attitudes*, and a provision of a *sustainable mobility package* - but they play an important role in decreasing the usage of cars and increasing the success of nudging.

4.1.2.1 City Planning

The importance of a city plan and its significance in mobility was pointed out numerous times. In fact, a city plan designs the patterns of movement within it, and if those patterns can be re-designed or optimized, it can save wasteful traveling for citizens, in turn reducing the usage of private vehicles. In relation to the topic of city planning, the concept of a “15-minute city” was brought up by several respondents, who work as city planners or local authorities. Upon this conception, a city where urban services are accessible within a 15-minute walk or a bike received importance, as Respondent 1 has stated: “... *the main thing is how the city is planned and where do you live. A 15-minute city is what sustainable transport is about*”. A paper published by Pozoukidou and Chatziyiannaki (2021) also goes in hand with the idea, arguing that a 15 min city has one significant and distinguishable characteristic which already makes and can continue making urban life more sustainable - proximity from a citizens’ point of residence.

In addition, an extending concept to a “15-minute city” was discussed in the interviews which also states the importance of city planning in mobility - “the five Ds”. The concept refers to five different factors leading to lower usage of cars, as proclaimed by more than one respondent who worked in the field of city planning. The letters stand for Destination Accessibility; Density; Distance to Public Transport; Design and Diversity. To present an overview, Zhang (2014, p. 4912) has developed a definition of the concept, outlining crucial factors in a city planning process, in turn making travel more sustainable:

<i>Five Variables</i>	<i>Meaning</i>	<i>Commonly Used Attributes</i>
Density	The variable of interest per unit of area	Population density, dwelling unit density, employment density
Design	Street network characteristics within an area	Average block size, proportion of four-way intersections, number of intersections per square mile, bike lane density, average building setbacks, average street widths, numbers of pedestrian crossings
Diversity	The number of different land uses in a given area and the degree to which they are represented	Entropy measures of diversity, jobs-to-housing ratios, jobs-to-population ratios
Distance to Transit	The level of transit service at the residences or workplaces	Distance from the residence or workplaces to the nearest rail section or bus stops, number of stations per unit area, bus service coverage rate
Destination Accessibility	Ease of access to trip attractions	Distance to the central business district, number of jobs or other attractions reachable within a given travel time, distance from home to the closest store

Table 2. Five D's (Zhang, 2014, p. 4912).

4.1.2.2 Citizen Attitudes

As it was found in the interviews, the way citizens perceive their surroundings will affect the decisions they make within the cities they reside. The importance of citizens' attitudes toward sustainability and sustainable travel was raised repeatedly: "*People need to be willing to make the change*". The statement points to the fact that only the right groups of consumers can be chosen to target in case of a behavioral measure, meaning that if a citizen has countering

attitudes toward sustainable travel, it will be challenging to effectively affect their behavior. As Respondent 3 has proclaimed: “... *people generally tend to have very polarizing views on the environment. There is a large spread of people who are climate-deniers and a spread of people who are passionate about saving the planet*”. Therefore, such polarization in environmental matters is expressed to have an effect on the potential success of a behavioral measure.

In addition, once car drivers start using public transport, they tend to generalize the experience for the next instances of using it: “... *studies show that car drivers tend to generalize the experience they have. If they have a bad day on the bus, they jump into saying that public transport does not work*”, as stated by Respondent 5. Generally speaking, a few respondents have mentioned that in many countries a bus is still seen as a downgrade in a social status spectrum. It is assumed if a citizen takes the bus, they most likely do not have money to pay for the car.

In addition, the effectiveness of a behavioral measure was discussed to largely depend on the context in which it is utilized. As discussed together with Respondent 9, nudges were often employed for affecting “*one-time behavior in which the individual does not incur the sunk cost*”. That is not necessarily the case in commuting decisions, which sets the use of nudges in mobility apart from other instances such as in the food and health sectors.

In summary, it was noted that nudges can be effectively implemented only if the accurate target market is chosen in terms of their willingness toward change. Nudges can work best for target markets that do not have negative attitudes toward using public transport or toward citizens who are environmentally conscious. Therefore, it is of utmost importance for the decision-makers, before implementing nudges, to first look into changing the attitudes of their target audience in favor of public transport and overall sustainable modes of mobility.

4.1.2.3 Sustainable Mobility Package

“Sustainable Mobility Package” is a set of requirements for a city to initiate more sustainable travel behavior, which is outside the “macro-level” plan of a city, as was outlined in the *City*

Planning section. This concept was developed upon discovering the relevance of results found within this area. To be more specific, it was discovered that when it comes to using modes of transport other than private vehicles, users mostly care about convenience, value for money, and safety.

In terms of convenience, a number of aspects were outlined to make the change from cars to sustainable modes of transport more convenient. As stated by Respondent 2: *“People do not like change, we need to make that change as convenient as possible for them to see results”*. Having convenience in mind, time is one of the most important factors that should be put under scrutiny. The more time-efficient a journey gets when compared with the alternative of a car, the more likely citizens will not take the car. It was mentioned that the share of time urban mobility journeys take should be even less than when taking a car. Also, infrastructure improvements such as wider sidewalks and bike lanes, or trains equipped with all basic amenities such as internet or restrooms can help increase the probability of less car use. Equally, the usage of apps with the aim of integrating different modes of transport and providing personalized timely information on public transport also received a lot of attention, as Respondent 4 has stated: *“..what I think works really well in Holland is the integration of modes of transport. I can use an app to do payments for all modes of transport, I can check in real-time when I need to leave and what connections should I make, and I can plan my travel very precisely which makes it really convenient.”*

Another factor found throughout the interviews, which also supports the provision of a sustainable mobility package, is pricing. As walking or cycling might be cheaper, some modes of travel can in fact not provide good value for money. For example, as Respondent 4 mentioned: *“... if you want to go from south of Sweden to Stockholm, it is many times cheaper to fly than to take the train”*. Another respondent, namely Respondent 3, has also put emphasis on the fact that *“value for money is a thing that influences user choices the most when it comes to public transport”*.

Lastly, besides convenience and value for money as driving factors of a strong sustainable mobility package, safety has been the other key element within the “package”. During the

COVID-19 pandemic, *“people were afraid to take buses”*, as few study participants have emphasized. As a major part of safety, security was indicated as an important aspect too, pointing to the fact that citizens prefer cars more because they are more personalized - as one does not have to travel with strangers and can in fact control the temperature, hence adding to the convenience and flexibility cars provide. In public transport; however, these aspects and functions are not available, which was discussed as one of the reasons why people buy first-class tickets when traveling with public facilities - to *“have more control of people and feel secure and safe that way.”*

Therefore, for nudges to effectively drive sustainable mobility behavior, cities should first consider supplying a sufficient set of convenient, affordable, and safe urban mobility solutions to their citizens.

4.1.3 Private vehicle use

Before describing the main findings of the case, it is important to outline the rationale and costs behind the use of private vehicles in cities, as it will provide an understanding of what the main object from which a behavioral shift should be done entails.

Generally speaking, empirical evidence shows that the main reason why citizens prefer cars over other modes of transport is the factor of convenience. This also goes in line with previously presented pieces of evidence claiming that convenience is a very important determinant of urban mobility. However, a repeated phrase in the interviews was: *“People underestimate the cost of a car”* in other words known as the “sunk-cost fallacy”. As Respondent 2 described: *“Transportation involves big investments, which makes it very hard to change people's behavior. If you own a car, the investment has been made and you need to use it. This situation is also known as a sunk-cost problem”*. Thus, the evidence explains citizen reluctance to use sustainable modes of transport as investing in a car is a one-time cash outflow. Also, a similar problem appears from a government perspective - for years governments have developed city infrastructure around cars - wider streets, more parking lots, and sidewalks with little protection (Martinez, 2015). Within empirical evidence, as Respondent 7 has stated: *“Society has*

encouraged the use of private vehicles and our cities were designed to adapt to cars. This is the reason why it is so hard to move back from it now and diminish the effects they had.”

Despite the fact that such a problem exists, Respondent 8 has provided a solution to this issue - creating programs so that the cash outflow is not a one-time cost. For example, users can either pay for their parking pass for a whole week or daily. Respondents claimed that if citizens paid for parking daily, the chances of them taking a bike are higher, as citizens can customize their week based on when they will need a car.

In summary, when designing and implementing nudges, one major consideration should be toward understanding the cost of private vehicles. Cars are an expensive and convenient mode of transport, which makes it more challenging, but also more important to employ measures of behavioral change to achieve a shift from private vehicles to more sustainable modes of transport. Considering determinants driving sustainable modes of mobility and considerations around private vehicles, the following sections will present the main findings of the case under scrutiny - what measures can be employed to achieve the shift from private vehicles?

4.1.4 Main Findings

This section will mainly focus on soft measures, upon which only nudges that have been employed are included. To understand each measure best, a representation of soft measure practical examples and their possible problems will be equipped, outlining both the positive and negative aspects of each behavioral change initiative.

4.1.4.1 Disclosure

To start with, among the behavioral measures within the empirical evidence collected, the use of disclosure as a method has received significant attention. In essence, disclosure means making information available and comprehensible to people, so they are able to make informed decisions. As it was pronounced during the data collection process: *“Real information on different ways of travel is a good way to make people aware to try things”*. Many different instances where and how this measure can be used were brought up - through media, apps,

informative advertisements, physically and online, as well as simply putting up information displays in train, metro, or bus stops. As Respondent 5 has mentioned: *“It can take place anywhere. The point is effective communication. It can include information on changes in infrastructure, usability, and the effects of your actions. But it has to be personal, it has to be for you”*.

One effective practical example of such a measure took place in the county of Varmland. The rationale behind it was to make people take public transport, walk or cycle to work. Respondent 6, working as a Traffic Executive in Varmland, has mentioned that *“the good thing about disclosure nudging is that people can decide by themselves”*, putting an emphasis on the users’ freedom of choice. The nudge was implemented by putting up simple information cards in easily-visible locations at workplaces. The cards included information on *“how to make their trips more sustainable, listing out sustainable development goals”*. After a period of two weeks, the respondent claimed that there was an increase in people cycling to work, as they realized the benefits of sustainable travel that they have not thought of before.

Despite the positive attributes of disclosure nudging, a few respondents have claimed that *“it is hard to measure attitudes and mindsets”*. Citizen attitudes can be measured with advanced psychological methods, surveys, or interviews; however, these are largely inefficient when it comes to limitations of bias and time. It is both very time-consuming and potentially misleading to measure attitudes, making it a significant consideration when implementing this certain type of nudging. Effects can take place in the short run, but it is important to understand what can be done to ensure the long-term effects of this technique. As Respondent 2 has claimed: *“Projects fail because they are too short. Governments, businesses, and other stakeholders implementing these measures set certain budgets on them and put deadlines in place, restricting the possibility to see if such nudging works in the long run.”*

4.1.4.2 Frictionless

Within the empirical data, another behavioral change mechanism that was emphasized frequently is frictionless nudges. This method means an alleviation or removal of barriers to increasing a

participation rate of a certain solution. In other words, it can also mean a simplification or an increase of convenience within a specific mode of transport.

As it was discovered, the main use of this method can be found in the implementation of transport-related apps. Apps make it easy to know *“If the train will be on time and if your train might have gotten canceled”*, without the need to find a timetable as it was done before the introduction of such digital tools. Apps also can integrate all possible modes of transport, providing the citizens with the most time-efficient type of urban travel: *“It takes all possible combinations, even including taxis and trams, so I can get a personalized recommendation. I think it is really effective in incentivizing me not to take my car, especially as it is not even an option in the app”*. Among these examples, the transportation system of London received a lot of praise in the data collection process. A few respondents have mentioned a frictionless way of moving around London - it has a *“smart ticketing system that works flawlessly”* and *“underground metros are designed to be running way faster than taking a car”*. Among many, these were the main arguments in relation to frictionless nudging, with a focus to make the system more convenient for citizens.

A simple but effective way of frictionless nudging can also be a re-design of sustainable modes of transport. This can both take place in public rail transport and buses, but also on bicycles. The re-design involves an introduction of solutions to make citizens' travel more enjoyable and easier. For example, rail transport can include restrooms, as outlined by one of the respondents. Another solution in this manner is the attachment of grocery bags by the sides of the bicycle, as Respondent 4 has mentioned: *“In Holland, we have bikes made in a way that you can carry your groceries with it. This makes it very convenient and safe. I have seen so many people change from cars because of this.”*

Among the examples of frictionless nudges which were monitored during the process, a behavioral economist from Harvard University has shared an opposing method of such a nudge. With a sample size of 27000 study participants, they have noticed that when a sign-up process is made more difficult within carpooling apps, there is an increase in the user participation rate. As

Respondent 9 has mentioned, *“In a way, it is completely opposite from what nudging is all about, but it works”*. Such findings bring a very diverse perspective to the set of results, as it proves that it might not generate expected results in all cases, raising the importance of examining further determinants that have led to frictionless nudging showing different results.

This type of nudging, similar to disclosure nudging, can also suffer from issues of measurability. With the exclusion of this problem, Respondent 3 has brought up another problem in this manner: *“From my experience, I am a strong believer in hard measures to see any real effects. Although small re-designs or solutions making it more convenient to travel are nice, my experience tells me that punitive measures, like congestion charges, are among the only possible ways to see real changes in people’s travel behavior.”* To add, Respondent 3 has mentioned that *“there is no transport policy focused on simplification or general nudging in the UK. We found that it does not have a big potential to be effective, since such measures are very small scale”*. Consequently, the issue raised here was one of ineffectiveness - frictionless nudges were claimed to be either so hard to measure that their effectiveness is unknown, or are simply ineffective.

4.1.4.3 Default Option

Another form of nudging that received a lot of attention in the interviews is default options. Programs that citizens are automatically enrolled in are what describe a default option best. For instance, in Sweden, a few respondents and a local architectural firm have brought up a carpooling option in their real estate property contracts. With this option, when renting or buying a property, residents can share a ride with someone else to travel wherever they need, as real estate companies had contracts with other “carpoolers”. Such a peer-to-peer solution inevitably contributes to a reduction in private vehicle usage. It creates social pressure for residents to adapt to other residents living at the property, especially considering that the option existed by “default”. In addition, Respondent 2 has brought up that *“when offering to carpool to residents, we realized that communication of information is important. Many people were not aware that this service existed”*. As mentioned, the default option as a soft measure needs to be put in combination with effective communication campaigns, otherwise it might be of no use. This argument provides a variety of default options and disclosure types of nudging. Also, carpooling

in this case is just an example of a default option, respondents have mentioned that this can take place in other forms of incentives, such as providing a free trial on a ridesharing app when you rent a certain property.

As mentioned, appropriate communication for the target market was outlined as a key factor when implementing default options. In addition to this success factor, *“an ongoing plan with a respective mobility coordinator should support such options”*, as Respondent 2 has mentioned, outlining the need for decision-maker consistency and long-term planning when implementing default nudges. The same respondent has pointed out that the long-run requirement is important also due to the fact that *“nudges tend to be quite small and invisible. It is normally hard to see their effects in the beginning”*.

4.1.4.4 Social Norms

The last major type of nudges that was discovered to be significant within the empirical proof was the social norm nudges. This type of behavioral mediation focuses on informing citizens about their peers' actions and activities. For example, Respondent 4 has given an example of “car-free Sundays” taking part in Manilla, Philippines, where she worked with helping governments focus on the reduction of pollution and carbon emissions. Respondent 4 mentioned that *“In Manilla, the government has closed traffic on some less busy streets to incentivize less private vehicle use. In the beginning, people were very hesitant to participate and even protested against it. But after a while, people took out their bikes, they walked past the street with their strollers, and parents even started buying bicycles for their kids as a result”*. Such an example fits best under social norm nudging as it follows a pattern of more and more people joining on after seeing an example of others and realizing the benefits of sustainable travel that way.

Although this type of nudging has received a lot of attention, valid counter argumentation was provided for them too. Respondent 3 has pinpointed one major issue when it comes to social norm nudges: *“Transport has many layers. It is very complex and it includes many determinants. Although this type of nudging can work, it is very hard to know if it is specifically social pressure that made it work”*.

4.1.4.6 Nudge Success Factors

A major part of the evidence revolved not only around the types of soft behavioral tactics but also around what makes nudges successful. Therefore, most of the success factors of nudge strategies were mentioned not in the idea, design, or post-implementation stages, but *during* the implementation of these soft strategies. More specifically, consistent long-term focus, correctly chosen target groups, and strong stakeholder collaboration were named as the most significant factors.

As Respondent 2 has claimed: *“Projects fail because they are too short. Project leaders say we need to have this budget and we need to have this timeline. It harms the potential quality of work”*. In addition, the business owner who was previously. Respondent 5 has mentioned that *“Consistency in nudging is one of the most important factors. It should not work for a month or two, it should still be there after 6 or 12 months while getting improved and maintained”*. Both respondents, among more similar examples within empirical data, have outlined a need and importance of a long-run strategy, consistent focus toward it, and dedicated resources for its maintenance of it.

In addition to these success factors, a lot of attention has been directed toward choosing the right target groups. It was proclaimed that if the target group of a measure is not chosen carefully, the chances of a measure failing are higher. Mainly, it was stated that these target groups should consist of people who are willing to make a change. This characteristic goes in line with the data presented in the *Citizen Attitudes* section, providing a clear hint of a determinant deciding the success of a nudge. To give an empirical example, Respondent 2, among many other respondents, has mentioned that *“Target group is really important. Choose the right target group. People need to be interested in the first place.”*

Lastly, one uniquely significant perspective on the phenomenon in question was brought up by Respondent 8. The importance of collaboration and stakeholder management was outlined, by utilizing the strengths of each partner considerably. For example, as Respondent 8 has mentioned: *“NHS has worked closely with public transport authorities across regions to improve*

physically active modes of travel, and that has worked out really well for us. Public transport companies helped us with setting up the infrastructure we need for cycling and walking, while we helped them with getting to people, providing solutions, and setting up the projects that actually solve a need and can work more effectively if we do it". Thus, a strong collaborative focus of all actors is needed, indicating a potential for higher success if actors collaborate and complement each other.

4.1.5 Hard Measures

Throughout the empirical data collection, considerable counterarguments toward nudges have been raised, specifically presenting hard measures as possible substitutes or supplementary solutions for effective behavioral change. Among those, two precise types of hard measures received the most attention - free trials and financial incentives.

When it comes to free trials, half of the respondents have given relevance to the effectiveness of free trials when it comes to behavioral change. Respondent 2 has actually worked in implementing a field experiment that involved a free trial and has shared their thoughts on it: *"Getting people to test stuff is key. A trial. Really intense marketing can have the same effect as just allowing someone to test through a free trial. People need to experience it to understand it. You also get a foot in the door with an offer. It is a good incentive to start with and make someone join"*. Another study participant, Respondent 8, has added to the effectiveness of free trials: *"After we gave away a free one-week bus pass to employees, we have seen that 66% of those pass holders continued with purchasing public transport passes after that period. We have found out that users saw the benefits of public transit and realized that it's actually more hassle-free than taking a car."*

With the considerable effectiveness that free trials were pronounced to have - *"punitive measures, like congestion charges, and restrictions, are only possible ways to change people's behavior"* - as claimed by Respondent 3. The same study participant has also claimed that if a *"congestion charge was brought into the city of Manchester, making journeys more expensive by 5 pounds weekly or even daily - then the value for money would suddenly drop and fewer people*

would take cars.” As presented, congestion charges are claimed to be the leading types of such hard measures, but in addition to congestion charges, respondents have also mentioned other forms of taxes, or even - discounts, that were used to incentivize sustainable traveling by them in the past. However, one consideration should be kept in mind - as Respondent 8 has claimed, financial incentives are valuable but hard to implement in a governmental context, due to a need to build a strong business case on why the money should be spent. The same study participant stated, *“Financial incentives are valuable, but other forms of softer measures are easier to implement in my area”*. Thus, both free trials and various forms of financial tax or subsidy can help the promotion of sustainable transport very effectively, if it is not placed in the context of a government as noted in the empirical data.

5. Analysis

This chapter will address the research question and the hypothesis in relation to the empirical findings. The research question with a focus on choice architects within the field of sustainable mobility aims to assess *to what extent have mobility actors successfully influenced citizens’ mobility choices using the nudge theory to promote and encourage the adoption of sustainable modes of transport*. In this regard, the following hypothesis will be evaluated, *‘Nudge theory can be effectively applied in sustainable mobility by targeting citizen behavior’*. Also, the contribution of this study and the extension of the theory in terms of its application within mobility is outlined.

5.1 Nudging in Mobility

Whether nudge strategies can be effectively applied within mobility has been the center of focus in this study. Nudges are found to have been part of strategies encouraging people toward sustainable modes of mobility. However, the ways in which nudges have been implemented are considered out of the scope of their original definition, as nudges are generally assumed not to include any economic incentive or other costly measures (Selinger & Whyte, 2012; Gigerenzer, 2015). By costly measures, it is referred to interventions such as regulation, infrastructural

developments, financial incentives, or taxes. Moreover, mobility behavior is complex and affected by factors such as age and social class which is consistent with Cresswell's (2010) and Sheller's (2018) (cited in Bohman, Ryan, Stjernborg, et al. 2021) where they find the factors of age and class to be aspects determining one's mobility choices. Therefore, when it comes to implementing nudge strategies in mobility, it is important to consider differences among different groups within society. As mentioned above, differences in age and class could mean different mobility behavior. Hence, implementing a nudge for a group of society that includes a variety of ages for example, might not prove successful in encouraging every group of society to reshape their mobility behavior.

Therefore, due to this complexity, the use of financial incentives and infrastructural developments are found to be inevitable when implementing the nudges, although by theory they are part of hard interventions. That is also due to the fact that even if choice architects successfully encourage sustainable modes of transport, if the right setup of the environment does not provide suitable infrastructure, such as well-developed bike lanes for example, the nudge could eventually fall short of its goal.

Existing evidence provided by Punza, Panarello, and Castellano (2021), in terms of aspects determining urban travel behavior included the factor of 'environment' being important in determining citizens' mobility choices. Moreover, Yoong, Hall, Stacy, et al, (2020), as mentioned in the literature review, explain that nudges are a way to modify the environment to utilize citizens' capacity to encourage certain behaviors without taking away other alternatives. Given the nature of mobility, the modification of the environment that Yoong, Hall, Stacy, et al, (2020) refer to is the changes in the infrastructure of the city to make it more suitable for sustainable modes of mobility. Therefore, for nudges to be effective in encouraging sustainable modes of mobility, additional considerations may have to be taken into account, of which the infrastructure and the extent to which it is designed to complement nudges are key factors.

Furthermore, nudges, as mentioned in previous chapters, have proven to be effective in sectors such as health and food (Yoong, Hall, Stacey, et al., 2020; Arno & Thomas, 2016; Broers, Van

den Broucke, et al. 2019). However, this is not found to necessarily apply to cases concerning sustainable mobility. That is because of the factors of attitude toward public transport and the fact that travel behavior is more of a habit than a one-time choice. They are reasons that set nudging in mobility apart from its use within other sectors, where the target group does not incur sunk costs, such as is the case in food choices. In food choices, it is often the case that one could easily buy a different product at any time without having to compensate for their previous purchases. Interestingly, the effect of attitude has not been discussed within previous literature on the application of nudges, neither in their widespread use nor specifically in mobility. Therefore, the significance of one's attitude toward public transport provided new insights into the connection between urban planning and citizens' mobility choices. In line with this finding regarding people's attitudes and perceptions toward public transport, Thaler and Sunstein, in their interview with McKinsey also shed light on the idea that nudges work best if they are in line with people's values (Hagman, Andersson, Västfjäll, et al. 2015; Fusaro & Sperling-magro, 2021). This point was supported and raised earlier by two critics of the Nudge theory - Hausam and Welch (2010).

Mobility behavior is found to be more of a habit, as supported by empirical data. Unsustainable mobility behavior is also responsible for excessive CO₂ emissions. However, nudges cannot reshape habits, therefore, they fall short of addressing the excessive CO₂ emissions within mobility. That could be proof of nudges not being effective in addressing climate change which was raised earlier by other critics. The sequence of argumentation is derived from the findings of the empirical data. This is also in line with Goodwin's (2012) paper claiming that nudges are not the kind of strategy to handle issues such as climate change and excessive emissions. Therefore, it is of high value to extend the theory and the measures it includes, at least within the field of mobility, to advance its effectiveness to be able to address unsustainable mobility behavior.

Moreover, hard interventions, such as economic incentives and congestion charges, were overall found to be more effective within mobility. Supported by the findings, for nudges to be effective, the target group should indicate an interest in changing behavior, which arguably is consistent with Hagman, Andersson, Västfjäll, et al. (2015) and Fusaro and Sperling-magro (2021) papers

claiming people's goals and values should be in line with the purpose behind nudges. In this regard, and in the case of encouraging more use of sustainable modes of mobility, it is worth mentioning that people's overall attitude toward sustainability and concerns over environmental matters was found to be polarized, as the empirical evidence supports. This is in a situation where nudges require interest from their target group to be effective. Therefore, employing nudges for a polarized society to promote more use of sustainable modes of mobility to preserve the environment, could potentially prove unsuccessful with the pace required to address the excess CO2 emissions of unsustainable modes such as private vehicles. That is further supported by Yoong, Hall, Stacy, et al, (2020) who then explain the importance of intrinsic values in the extent to which nudges are effective. For the decision-makers to potentially eliminate the risk of a part of society not responding to nudges, making them a policy could be an option. Though, implementing nudges together with making them a policy does not fully align with the theory definition (Thaler & Sunstein, 2008; 2021; Selinger & Whyte, 2012; Gigerenzer, 2015; Kusters & Van der Heijden, 2015). All in all, it is apparent that nudges, without additional tools and considerations of what other measures humans respond to, could not be the optimal tool in increasing the use of sustainable modes of travel with the pace required to achieve the climate goals.

5.2 Nudge Categories Special Observations

Among the seven nudge categories outlined in the theoretical framework, default option, disclosure, frictionless and social norms were found to be the center of focus in implementing nudging in mobility. However, it is worth mentioning that they are not categorized as such and are only recognized as 'nudge' as the overarching strategy. Regardless, as outlined in the Empirical Data chapter, the above four nudge categories have been employed with similar characteristics as defined in the theoretical framework. Though, one unexpected observation was for the frictionless nudges where they indicated a contrary function in the example of the carpooling platform with a more time-consuming sign-up process. That presents a more nuanced understanding of the nudging phenomena and its effects on mobility.

Furthermore, effective communication and disclosure of information are proven to be successful within the context of mobility. That is because disclosing information to the citizens as a way of nudging them is only a way of being mindful of decision frameworks, as supported by empirical data. Presenting information with the goal of promoting certain decisions, as Schmidt and Engelen (2020) explained, is inevitable as finding a neutral way to frame decisions is challenging and is still a form of choice architecture. Furthermore, even the nudge critics such as Goodwin, Hausam, and Welch would agree on the importance of making information available and accessible for individuals to preserve their freedom of choice in making decisions. This gains importance in scenarios where the individuals would make a different choice if they had the full information as claimed by our respondents. That finding confirms the existing evidence that people are rationally bound as explained by Simon and Bendor. People's cognitive constraints, such as limited memory and attention (Selten, 1990; Bendor, 2015), could impose limitations on their willpower and consequently their decision-making (Mullainathan & Thaler, 2000; Rabin, 1998). This was further supported by another observation throughout the bike service example in which people could receive biking lessons and maintenance services for their bikes for free, an activity they probably would not have tried otherwise.

5.3 Contributions

The effective application of nudges within sustainable mobility is limited, which is mainly due to the theory's lack of consideration for habits. That refers to whether the behavior in question is a habit or one-time behavior where the target group does not incur a sunk cost. Mobility behavior is complex; therefore, in order for nudge strategies to be effective, they need to be implemented with other measures that integrate the aforementioned complexity and take factors such as attitude and one's perception toward sustainability into account. Increasing the effectiveness of nudges together with other measures, in the case of mobility, could be through the application of policy and infrastructural developments. As for the policy, once a nudge becomes a policy, the target audience, irrespective of their values, is required to follow the measure. In addition, a developed city infrastructure that allows for sustainable modes of transport could provide the opportunity for people to adopt more sustainable modes.

In summary, the analysis concludes that implementing nudges on their own and based on their original definition proposed by Thaler and Sunstein (2008; 2021) is ineffective, hence rejecting the hypothesis. However, nudges could be more effective:

- if combined with hard measures,
- if the environment together with infrastructural development is suitable, and
- if the citizens' attitudes are positive towards three aspects of
 - the use of public transport,
 - the willingness to change, and
 - pro-environmentalism.

6. Conclusion

The study has aimed to broaden understanding of nudges within the field of mobility and to assess nudge effectiveness in reshaping citizens' behavior toward more sustainable modes of transport, specifically a modal shift from private vehicles to cycling, walking, using public transport, and carpooling. The aim of the study was developed given the insufficient empirical evidence on behavioral interventions reorientating citizen behavior toward sustainable modes of transport.

The study has followed an extensive review of the literature, highlighting the increasing popularity of nudges across a wide variety of sectors, particularly health care, and food, since the introduction of the concept by Thaler, and Sunstein, in 2008. As a result, a theoretical framework derived from the Nudge theory was designed to contribute to a better understanding of the application of nudges within mobility and potentially extend the literature within behavioral economics in regard to soft interventions.

To gather and analyze empirical data for this purpose of the study, the research has used a design of a single case study. The chosen case under scrutiny is a decision-maker implementing a nudge in the context of a city with the goal of promoting sustainable modes of transport. After

conducting interviews with a diverse group of respondents, the study has found that nudges in mobility are generally ineffective, however, three sets of determinants exist to ensure their success. First, a combination of hard measures and nudges is what could help address the issue of excessive emissions that transportation contributes to. Then, nudges should witness changes in the environment, or in other words - infrastructural development, in order to have the right context for better effectiveness. Lastly, nudges should target citizens with an existing positive attitude toward sustainable mobility - pro-environmental views and no negative perceptions towards using public transport. In case such attitude was lacking, the choice architects, before implementing a nudge, should consider designing measures for a change of citizen attitude.

6.1 Limitations

In relation to the results, the study had potential limitations of which time constraints and limited prior research on the topic of this paper were the significant ones. It was discovered that behavioral measure studies often use a quasi-experimental method; however, given that the time for the research project was limited to three months, for the authors to gather data, conduct interviews, and assess the findings, the extent to which the research could be expanded became limited, hence, an abductive method was implemented. The study could benefit from an experiment to assess the validity of the findings retrieved from the interviews. However, this requires a time frame in which the authors not only gather some data through interviews but also design a nudge in addition to the time it takes to implement and assess the test results.

Furthermore, the nudge theory is fairly new; therefore, there could still be additional research exploring nudges when it comes to implementing them in situations where the behavior in question is habits. In addition, the use of nudges has been limited in mobility; therefore, there were almost no to very limited studies established in the field of mobility, especially from the perspective of decision-makers. Although this paper benefited from multiple perspectives, the limitation of prior studies on nudges within mobility from the choice architects' perspective posed challenges for this paper. That is due to the fact that there was little literature found to additionally support the conclusion and results of this study, especially given that the research was limited in time.

6.2 Future Research

To further advance this line of study, three main areas of future research are identified.

Future studies could examine how the combination of hard measures, such as regulations, and financial taxes or incentives, can work together with nudges to encourage more effective behavioral change in the mobility field. This research could delve into how to tailor and integrate these two approaches to specific situations or groups. It may also be valuable to conduct comparative studies to assess the sustainability and effectiveness of interventions that utilized both hard measures and nudges, compared to those that rely solely on one approach.

Furthermore, it would be value-adding to investigate how infrastructure development, including public transportation systems, cycling lanes, and pedestrian-friendly pathways can interact with nudges to promote sustainable transportation choices. Understanding the role of infrastructure in supporting desired behavior can inform the design of effective interventions that align with a built environment.

To confirm and extend the findings of this research, one last possible track to conduct could be a replication of this study. The research could be conducted in an identical manner but develop an experiment as a method of data collection. A larger number of participants and a more narrow level of analysis could be employed, where researchers may be able to evaluate the generalizability, and durability of the findings of this paper. To establish trust in the results, it is essential to ensure that the replication of this study involves appropriate control over samples and reflects on the original research design of this study.

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Appendices

Appendix 1.

INTERVIEW GUIDE

Introduction (5-10 mins)

1. We introduce ourselves
2. Purpose of study
 - a. “Understand how public transport actors (institutions, authorities, entrepreneurs) can target citizen behavior toward more sustainable modes of transport - walking, cycling, use of public transport and other CO2-friendly solutions.”
 - b. Nudges - ways to influence someone’s behavior without limiting their options
 - c. Sustainable modes of transport - means walking, cycling, using public transport, carpooling, or other modes reducing general greenhouse gas emissions
3. Introduce the structure of the interview
 - a. Type of questions
 - b. How long will it take
4. Do you have any objections to us recording this interview? Your consent is necessary for us to use the information given for our analysis of research question
5. Do you have any questions before we start?

Interview Questions (15-30 mins)

1. Can you tell us more about your professional background?
 - a. Can you tell us more about x
 - b. Please explain y
2. What types of nudges have you done or come across?
 - a. *If you haven't - were there any other similar behavioral interventions you have worked with?*

- i. *Goals of that project*
 - ii. *Design and Implementation*
 - iii. *Outcomes*
- b. Can you tell us more about x
 - c. Please explain y

Closing remarks (5 mins)

1. Is there any additional information you want to share regarding this topic? Do you know someone who could help us further?
2. Assure individual confidentiality
3. If asked, provide information about sending over the results of a study
 - a. Sending over a company presentation we will prepare for the partner companies.
4. Thank you for agreeing to share this information with us and dedicating a time slot for us.

Appendix 2.

Respondent 5		
Relevant quote	Comments & interpretations	topic
Core things that public transport passengers find the most important are a reliable journey. Trains and buses that run on time - absolutely core thing that people want. Value for money is a thing that influences user choices the most in public transport. Services that run from place A to place B.	Reliability, convenience and good value for money as core factors influencing behavior in public transport	success factors
People's views on environment are very polarized. Spread of people who are passionate about the environment and another end of scale full of people that are "climate deniers". Environmental considerations play a very small part in people's choices. Some people did want to make a change, but they felt overwhelmed by the scale of the problem and the impacts they can make in it.	Environmental matters in transport and people's attitude	attitudes
We dont have any transport focused policy on nudging. We found that it does not have a big potential in being effective, since they are very small measures.	rejection of nudge theory	problems with nudging

Punitive measures like congestion charges, restrictions are any possible ways to change people's behavior	hard measures to be more effective, from a personal perspective	problems with nudging
Overall there is a good understanding that reliable and convenient services are the most attractive. And that's what transport companies want to offer.	What should pt companies focus on	what affects travel behavior
The less users, the less money plowed into the network, the less resources on improving the services	Vicious circle of pt improvement	implementation
Low income household sees it cheaper to run an inexpensive car than relying on trains, since its a family, which makes convenience more important for them	Cars in low income families	what affects travel behavior
People find cars convenient	Convenience of a car	cost of a car
Huge will on a government level has a huge will for environmentally friendly transport. They see the same problem though, that on an individual level it's hard to change what people choose. I support sustainable choices, but I live in an area where it would be hart to get to a train, making it more costly and less convenient.	Governments focus and importance of this problem	what affects travel behavior
If a congestion charge was brought in to a city of Manchester, making my journey into the city center more expensive by 5 pounds, then suddenly my value for money would drop if I take a car.	Congestion charge as an effective measure	types of interventions
In Leicester, they have a bus enhanced partnership. Its intended to be the local authority and the bus companies working together to try make bus services better for people. In Leicester, they are considering a workplace parking levy.	Leicester and other areas implementing workplace parking measures	types of interventions
People's negative views on buses have not been mentioned. "It's not for me" kind of attitude is common among non users of buses.	Negative perception of buses among non users	attitudes
Smart ticketing system in London, which makes it very different and people love it	Importance of apps and simplifications	types of interventions
Personalization of the journey. When you get into a car you get the music you want you get the temperature you want. In public transport, you have no behavior of people or the temperature. Its part of the reason people pay for first class tickets, to personalize their experience and limit the level of people. The behavior of passengers affects people's behavior the most.	Importance of personalization, security and safety	attitudes

