The Potential of Nudge Interventions to promote Sustainable Behaviour:

The Influence of using Single Nudges and a Combination of Nudges on Sustainable Travel Behaviour.

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Abstract (English)

Title: The Potential of Nudge Interventions to promote Sustainable Behaviour: The Influence of using Single Nudges and a Combination of Nudges on Sustainable Travel Behaviour.

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This master's thesis investigates the application of nudging techniques in promoting sustainable mobility behaviours. This master's thesis investigates the use of nudging techniques for the promotion of sustainable mobility behaviour. The study investigates the increasing importance of nudging in sustainable decision-making and travel choices, with the aim of aligning individual actions with the broader goal of preserving the environment.

The research methodology includes a comprehensive literature review to establish the theoretical framework, followed by a quantitative approach using an online survey to validate the different hypothesises. The analysis focuses on testing the effectiveness of different nudge interventions, they were presented in a real-life scenario. Participants, distributed randomly into three groups (control group, nudge intervention group and combination of nudge intervention groups), were able to choose a transportation mode for their traveling. Additionally, a moderation analysis was conducted to test sustainable consciousness as a moderator for sustainable behaviour.

The results add to the growing body of knowledge on the potential of nudging to influence environmentally friendly activities and its role in the design of sustainable mobility. The thesis also highlights the need for several factors to facilitate the implementation of nudging strategies. Overall, the thesis provides valuable insights into the intersection of behavioural interventions and sustainable mobility, with implications for policy making and future research directions.

Keywords: Nudging, Sustainable Behaviour, Sustainable Consciousness, Value-Action Gap, Consumers Travel Behaviour, Choice Architecture, Nudge Theory, Framing Information, Order Effect

Resumo (Português)

Título: O potencial das intervenções Nudge para promover um comportamento sustentável: A influência da utilização de um único estímulo e de uma combinação de estímulos no comportamento de deslocação sustentável.

Autor: Philipp Maul

Esta tese de mestrado investiga a aplicação de técnicas de nudging na promoção de comportamentos de mobilidade sustentável. Esta tese de mestrado investiga a utilização de técnicas de nudging para a promoção de comportamentos de mobilidade sustentável. O estudo investiga a importância crescente do nudging na tomada de decisões sustentáveis e nas escolhas de viagem, com o objetivo de alinhar as acções individuais com o objetivo mais amplo de preservar o ambiente.

A metodologia de investigação inclui uma revisão exaustiva da literatura para estabelecer o quadro teórico, seguida de uma abordagem quantitativa utilizando um inquérito em linha para validar as diferentes hipóteses. A análise centra-se no teste da eficácia de diferentes intervenções de nudge, apresentadas num cenário da vida real. Os participantes, distribuídos aleatoriamente por três grupos (grupo de controlo, grupo de intervenção de incentivo e combinação de grupos de intervenção de incentivo), puderam escolher um modo de transporte para as suas deslocações. Além disso, foi efectuada uma análise de moderação para testar a consciência sustentável como moderador do comportamento sustentável.

Os resultados contribuem para o crescente corpo de conhecimentos sobre o potencial do nudging para influenciar actividades amigas do ambiente e o seu papel na conceção da mobilidade sustentável. A tese também salienta a necessidade de vários factores para facilitar a aplicação de estratégias de nudging. Globalmente, a tese fornece informações valiosas sobre a intersecção das intervenções comportamentais e da mobilidade sustentável, com implicações para a elaboração de políticas e para futuras direcções de investigação.

Palavras-chave: Deslocação, Comportamento sustentável, Consciência sustentável, Lacuna valor-ação, Comportamento dos consumidores nas viagens, Escolha Arquitetura, Teoria Nudge, Informações de enquadramento, Efeito da encomenda

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&	And
ANOVA	Analysis of Variance
BE	Behavioral Economics
df	Degrees of Freedom
DV	Dependent Variable
F	F Statistic
$H_{1,2,3}$	Hypothesises 1, 2 & 3
IV	Independent Variable
ISSP	International Social Survey Programme
M	Mean
p	p-value
R^2	R-squared
SC	Sustainable Consciousness
SD	Sustainable Development
SDG	Sustainable Development Goals
TPB	Theory of Planned Behaviour
VAG	Value-Action Gap

1 Introduction

"Climate change knows no borders. It will not stop before the Pacific Islands, and the whole of the international community here has to shoulder a responsibility to bring about sustainable development." - Angela Merkel former German Chancellor in 2018 during her visit to the Pacific Islands

The issue of climate change has gained increasing prominence on the political agenda in recent years (Lindzen, 1994). The recognition of the many risks, especially those that affect future generations, has led not only to a greater emphasis on sustainability in the political sphere, but also to a greater awareness of the issue in society as a whole (Wallis & Loy, 2021). The rise of initiatives such as "Fridays for Future" in 2018, initiated by Greta Thunberg, has catalysed a growing engagement of the younger generation in climate action. These protests started with 27,000 people in around 150 countries in 2018, and according to today's figures, around 3.8 million people have decided to stand up for the safety of our environment (Burke, 2023). This wave of youth engagement has subsequently put pressure on political actors to take proactive measures. In 2015, the Paris Agreement, which aims to combat climate change and to limit the increase in the global mean temperature to less than 2°C, was adopted by 196 parties at the United Nations Conference on Climate Change (Vicedo-Cabrera et al., 2018). According to the 2018 Intergovernmental Panel on Climate Change's (IPCC) report, global mean temperature is very likely to reach 1.5°C between 2030 and 2052, posing a major threat to today's society (Allen et al., 2018).

In this context, politicians and policy makers are looking for even more creative solutions to not only create sustainable awareness, but also influence individuals' decisions to reach sustainable outcomes. In today's complicated and information-rich world, making decisions is an essential skill that drives every aspect of our daily lives. Researchers have gained a clearer understanding of how decision making can be influenced by studying the details of the resulting consequences and exploring ways to manipulate the path to the final decision. One of these ways is through nudges, which Thaler & Sunstein (2008) defined as design elements in how choices are presented that can predictably influence people's behaviour without coercing them and without significantly altering the financial benefits or reasons they have for making their decisions. This is also the case in context such as sustainable decision-making and travel decisions, where nudges are used to improve the outcome of a decision in a more environmentally sustainable way (H. L. Kim & Hyun, 2021; Lehner et al., 2016).

As society's interest in sustainable living has grown, recognising that our current way of life is unsustainable for the ecosystem, researchers have looked more closely at how to shape people's daily lives without a high cost to nature (Tyers, 2018) and, preferably without consumers noticing that they are being nudged (Hansen & Jespersen, 2013). In addition, studies indicate that the implementation of nudges in various contexts, such as mobility (Anagnostopoulou et al., 2020) or hospitality (Cozzio et al., 2020) including hotels and restaurants, can potentially enhance tourist satisfaction (Dolnicar, 2020).

In this thesis, the complex interaction between nudging, sustainable decision making and the resulting influence on travel preferences is explored in more detail by using nudges to influence people's decision in order to observe a more sustainable outcome.

1.1 Academic and Managerial Relevance

With increasing interest in making sustainability a priority, the importance of nudging in travel decision making cannot be overstated as it is a promising way to align individual choices with the broader goal of preserving our planet (Lehner et al., 2016). Especially small and daily choices, which people mostly are not aware of, can have a significant impact. These choices, which range from the daily commute to a leisurely cruise, are not just personal preferences; they are crucial decisions that will shape the path of global environmental sustainability (Ritter & Schafer, 1998). This has led to an increase in the development of attempts to implement nudges as a viable option for policy makers, while strict laws have not been able to achieve the desired results (Howes et al., 2017). In such a scenario, nudges will be employed to improve the outcomes of decisions by leveraging existing research on nudging and the mitigation of cognitive biases that affect decision making (Battaglio et al., 2019).

So far, research has shown that nudging and similar techniques have the potential to be effective in encouraging environmentally friendly activities that can have a positive impact on energy use or recycling (Loidl et al., 2023). In their study, Hummel & Maedche (2019) emphasise that nudges have gone beyond theoretical abstraction and have had a significant impact in the realm of policy making, and subsequently on citizens in numerous countries by implementing departments, which examine the use of nudges. Additionally, these authors highlight that while the use of nudging techniques is well established in certain areas, particularly in health-related domains, its implementation in the context of sustainable mobility remains relatively scarce. Most studies address travel behaviour in urban settings (Schmitt et al., 2013). In other words, these studies analysed certain city travel patterns and attempted to modify them through the use

of nudges (Anagnostopoulou et al., 2020). An example is the field experiment of Franssens et al. (2021) in Amsterdam. The experiment involved giving 4000 commuters on six lines free travel card holder, which displayed a social label branding bus passengers as sustainable traveller. After analysing the number of rides per hour, the results showed that the intervention led to a significant increase in public transport use. Overall, the study provides evidence that nudging can be a successful approach to promote sustainable transportation behaviour. However, the literature in the context of sustainable travel behaviour remains scarce. Therefore, choosing a nudge intervention in the context of sustainable travel decisions is a reasonable assumption to examine sustainable travel behaviour.

1.2 Problem Statement & Research Questions

The results of several studies that have tried to bridge the gap between nudging and sustainable decision making have been mixed. Over the last decade the perception about the harmful effects of climate change has changed. Therefore, the urgency about developing a more sustainable mindset has risen significantly (Chang et al., 2015). However, society still has not changed their actual behaviour although they know about the future damage. Especially tourism and travel are great threats towards the shift to a more sustainable standard of living (Luzecka, 2016). This is why policy makers are looking for a more creative solution to create sustainable awareness and are using nudges to do so. As has already been pointed out, the potential of nudging in terms of sustainability is high (de Ridder et al., 2022). According to Boenke et al. (2022) Nudges can employ social norms and the desire for social approval to encourage sustainable behaviours. In conclusion, my problem statement is defined by finding a solution how to increase the likelihood of individuals in behaving sustainable when it comes to travel decisions, leading to the main research question:

Research Question: How can nudges improve sustainable travel decisions?

Another important factor that is consistently associated with sustainable behaviour, and which is emphasised in the literature, is the value of sustainable consciousness (SC) (Legault & Pelletier, 2000). This implies that a certain degree of awareness, mindset or state of being aligns with sustainable principles (Cheung & To, 2019). According to Di Vaio et al. (2022), there is a positive level of satisfaction with sustainable services. When consumers perceive that their sustainable actions are making a positive impact, they feel a sense of satisfaction and this leads to higher overall satisfaction (Di Vaio et al., 2022). This could be an interesting factor, when examining sustainable travel decisions.

In response to problem statement, an experimental study has been carried out on the measurement of various relationships between several variables.

1.3 Structure of the Dissertation

The dissertation follows a standard dissertation structure. The first and current chapter introduces the research topic and clearly and concisely outlines the objectives, background and scope of the study. The second chapter provides a review of the relevant literature, an analysis of relevant studies, and highlights key existing findings using appropriate theory and methodology. In terms of the experimental design and the procedures for the collection of data, Chapter 3 will give an overview of the procedure. This will be followed by an analysis of the data and a presentation of the results to support the findings of the study in Chapter 4. Chapter 5 will be a discussion of the main findings of the data analysis and a consideration of the literature. Additionally, limitations of the dissertation will be discussed, and suggestions for future research will be provided.

2 Literature Review

The literature review is divided into two main sections. The first section introduces the framework around sustainability and sheds a light on sustainable development, sustainable consumption and sustainable consciousness. The second primary section investigates the principle of nudging, emphasizing its theory, analysing the systems it impacts, and demonstrating its efficacy.

2.1 Sustainable Decision Making & Travel Decisions

To combine the nudging effect with sustainability, this first section provides an overview of different theoretical frameworks regarding sustainability. First, I introduce the concept of sustainability and differentiate between current perceptions and consumption patterns in relation to this topic. As the concept of sustainability is divided into these three pillars, I will examine all three to create a comprehensive understanding of sustainability. These findings lead to a discussion of the Value-Action Gap (VAG), which is a central component of my thesis. Finally, I consider today's travel behaviour to connect it with the nudging effect.

2.1.1 Sustainable Development

The term "Sustainability" has become increasingly important over the last few decades. With increased access to information, people have become more aware of the finite nature of resources and the impact that unchecked consumption and production actually have on the

environment (Hardy et al., 2002; Luzecka, 2016). As a result, a much-needed concept to address and combat the problem has emerged. The definition of the term Sustainable Development (SD) has changed through time. It started with the published Brundtland Report *Our Common Future* by the World Commission on Environment and Development, which defined SD as development which "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. 16). This definition is often quoted today. Even though the concept of SD has evolved over time, it is still based on the three pillars of sustainability: the social, the economic and the environmental (Moldan et al., 2012). According to Holden et al. (2014), the concept of SD remains relevant and has served as the basis for the establishment of the Sustainable Development Goals (SDG) at the United Nations Conference on Sustainable Development in Rio de Janeiro in 2012. As such, SD is a crucial concept, and the fulfilment of the multiple SDGs in the future could be a significant achievement as the SDGs target is to ensure a fundamental life-level for everyone (Moldan et al., 2012; Quental et al., 2011; Singh et al., 2009).

Aligning the thesis' research purpose with the SDGs, particular emphasis is placed on Goal 12, which focuses on responsible consumption and production. By examining this SDG from an alternative perspective, the urgency of achieving its targets is highlighted. There is a consensus in research which highlights a cause-and-effect relationship between the production consumption cycle and the strain on natural resources or production of pollution (Bengtsson et al., 2018; Guevara & Julián, 2019). However, critics argue that the SGDs do not set clear targets or provide effective guidance on how this much-needed development should proceed (Swain, 2018). This is evidenced by empirical data, which illustrate the significant unsustainability of how we have produced and consumed in recent years. This observation implies a need to rethink and transform the SDGs and, by extension, the concept of SD itself. (Staniškis, 2012; Tukker et al., 2008, 2010; Vergragt et al., 2016).

2.1.2 Sustainable Consumption

In the 1970s, as society became aware that unsustainable consumption could negatively impact future generations and the economy (Wang et al., 2019), researchers began to delve more deeply into this topic. The publication of the previously mentioned Brundtland Report in 1987 plays a crucial role again. The concepts of sustainability and sustainable consumption were defined for the first time by the World Commission on Environment and Development and gained worldwide recognition (Keeble, 1988). Based on this report, the term sustainable consumption was defined in 1994 by the Oslo Symposium as "the use of goods and services that respond to

basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations" (Roy, 2021, p. 56). It therefore implies a consideration of fundamental human needs, with an emphasis on avoiding excessive consumption while prioritizing environmental well-being and meeting the needs of future generations (Quoquab & Mohammad, 2020; Wang et al., 2019).

According to research, there are many theories used to explain sustainable consumption and pro-environmental behaviours. The most common ones are the Value-Belief-Norm theory, the Theory of Planned Behaviour (TPB) and the Theory on Affect (Onel, 2020). According to a study comparing the explanatory power of the three mentioned theories, TPB is better at explaining consumers' green purchasing and transport behaviour (Han & Stoel, 2017; Onel, 2020). Therefore, the use of the TPB will assist in contextualising the analytical findings within the current literature.

Like any other form of behaviour, sustainable behaviour is influenced by many factors. TPB proposes that consumers shape their attitudes toward their behaviour through various factors (Leary et al., 2014). The one factor, which influences the actual behaviour is the persons intention. The persons intention is shaped by three factors, which are also influenced by one additional factor each. (Mehrtens et al., 2001; Ruangkanjanases et al., 2020). The first important factor is attitude towards the behaviour, which is influenced by behavioural beliefs, the second is subjective norms, which are shaped by the person's normative beliefs. Finally, perceived behavioural control, which is influenced by control beliefs, is the last factor influencing intention (Wu & Chen, 2014). Lastly, the TPB defines behavioural intention as the main predictor of actual behaviour (Ajzen, 1991). All these factors work together to explain the relationship between behavioural intention and actual behaviour.

Putting TPB in the context of sustainable consumption, several studies were conducted to predict pro-environmental behaviour using this theory. For example, a study by Macovei (2015) found that TPB could be used to predict sustainable behaviour of energy conservation. Muñoz et al. (2016) used TPB to assess cycling indicators and measure attitudes, subjective norms and perceived behavioural control related to cycling in the context of sustainable travel behaviour. The inclusion of the habit concept has been shown to allow TPB to offer a more comprehensive understanding of sustainable behaviours (Heinen et al., 2011). In conclusion, TPB has been

established as a useful framework for predicting sustainable behaviour, as indicated by the previously discussed studies.

In addition to the TPB, the promotion of awareness and education for active participation in sustainable consumption is also an important aspect. (Brody & Ryu, 2006; Fien & Maclean, 2000; Stir, 2006). Institutions play a crucial role in promoting sustainable awareness, a topic that will be discussed in the following section, highlighting their important role in this context.

2.1.3 Sustainable Consciousness

As mentioned before, to achieve SD, it is essential to understand the concepts of sustainability (Ovais, 2023). According to Mihelcic et al. (2003) knowing about sustainability is not enough; it needs to be reflected in how people think and behave. Sustainable Consciousness (SC), often regarded as a cornerstone of responsible living, is defined "as the degree to which a person is oriented toward concern for the environment" (Garvey & Bolton, 2017, p. 293). These three pillars form the basis and can be seen as the three constructs of the SC. In particular, the third pillar, sustainable behaviour, is significantly influenced by sustainable attitude and knowledge (Ovais, 2023). According to Cheung & To (2019), the relationship between attitudes and green purchasing behaviour among Chinese consumers suggests that attitudes towards environmental issues and eco-social benefits have a more pronounced influence on the purchase of green products. Therefore, research has shown that SC involves sustainable behaviour and is influenced by it (Poortinga et al., 2004; Schultz et al., 2005). An example is the study of Y. Kim & Han (2010), which points out the interaction between SC and the intention to pay comparable regular-hotel prices for a green hotel.

Another aspect, when talking about SC is the importance of sustainable knowledge. As already mentioned, it is one of the three pillars of SC (Legault & Pelletier, 2000). The first assumption, based on the knowledge acquired, is that it can shape the values and beliefs of an individual and thus promote a positive inclination towards sustainable behaviour (Zsóka et al., 2013). Further examination of the literature reveals that knowledge enhancement contributes to sustainable behaviour and, consequently, SC (Diamantopoulos et al., 2003; Leiserowitz et al., 2005). An illustrative example is found in Brody & Ryu's (2006) study, which highlights the importance of higher education as a critical component of sustainable approaches. This leads to the conclusion that students and educational institutions are a key group and that they have a pivotal role to play in the advancement of the sustainability agenda (Fien & Maclean, 2000; Murray, 2018).

As has been noted above, there is a strong interplay between SC and sustainable behaviour. However, there is also literature criticising the apparent lack of real change in individual behaviour towards sustainability (Ovais, 2023). This criticism leads to the introduction of the VAG, which will be discussed in more detail in the next section. According to the distinctive role of SC, I decided to investigate this gap in a more detailed way.

2.1.4 The Role of the Value-Action Gap

As outlined in previous sections, the need for environmental initiatives is more urgent than ever (Moldan et al., 2012). Despite the continued relevance of the issue since the 1970s, critics increasingly argue that society is behaving less sustainably than people claim (Barr, 2006; Kollmuss & Agyeman, 2002). Forbes magazine published a global sustainability survey and found that 50% of consumers consider sustainability to be one of their important value drivers. Yet there is often a disconnect between these values and customers' actions (Townsend, 2023). This disconnect is often addressed as a Value-Action Gap (VAG). Fishbein & Ajzen (1977) define the VAG as an inconsistency between what individuals express in terms of their attitudes and their actual behaviour in diverse situations. In 2006 the Sustainable Development Commission defined the environmental VAG as "the observed disparity between people's reported concerns about key environmental, social, economic or ethical concerns and the lifestyle or purchasing decisions that they make in practice" (Sustainable Development Commission, 2006, p. 63). Putting the theory in the concept of sustainability, several studies tried to address the environmental VAG (Blake, 1999). Stern (2000) suggested that personal moral norms play a crucial role in shaping an individual's pro-environmental behaviour. However, he also recognised that a variety of other factors, such as external influences, can have an impact on people's behaviour. In conclusion the complexity of VGA is not necessarily due to the complex nature of such behaviours, but also to the cultural influences that shape them (Barr & Gilg, 2006; Poortinga et al., 2004).

There have been several approaches to the bridge the gap between behaviour and action. Momsen & Stoerk (2014) introduce nudging as an attractive tool to push people in the "right" direction. To persuade people to choose renewable energy, they used the default option nudge. The positive effect of nudging on sustainable consumption has been demonstrated in several other studies (Kroese et al., 2016; Lee et al., 2020; Vandenbroele et al., 2020). Therefore, after looking at today's travel behaviour, I will introduce the concept of nudging and how it can be used in the context of sustainability.

2.1.5 Today's Consumers Travel Behaviour

The COVID-19 pandemic can be considered as one of the most significant events that have influenced the travel behaviour of today's society in the last decade (Matiza, 2020). The tourism industry, in particular, has suffered from the consequences of its unpredictable effects, as people have postponed their travel, threatening the millions of jobs directly related to tourism (Mary & Pour, 2022). As a result, there has been a decline in the demand for travel and transport, which led several researchers to hope that society would change its travel behaviour toward a more sustainable way. However, according to the European Travel Commission (2023), European travel demand continues to approach the frequency before the COVID-19 pandemic, reaching 91% of pre-pandemic levels by the end of 2023. Short trips in particular are a common concern, with people wanting to travel quickly and cheaply to places of interest, but contributing a high share of carbon emission (Malichová et al., 2022). In fact, airlines such as Ryanair, which are offering low fares, are giving consumers the opportunity to reach their travel destination in a unsustainable and cheap way. As a result, it is possible that consumers may engage in unsustainable behaviour (Babutsidze & Chai, 2018; Luzecka, 2016). These low-cost airlines provide an incentive to do so.

However, research suggests influencing consumers to take the train more often instead of an airplane could contribute to lower the greenhouse gas emission output (Aziz & Ukkusuri, 2014). Consequently, competition between air services and High-Speed Trains in Europe has increased in recent years (Albalate et al., 2015; Dobruszkes, 2011). As the market for cheap air travel still seems to be more attractive, the High-Speed Train market came up with their own solutions. An example in Germany is the introduction of Flixtrain, providing cost-effective fares and a speedy transport option for travelling across the country by train (Beria et al., 2023). Nevertheless, consumers choose their travel options according to service quality, travel costs or travel time (Mwale et al., 2022; Smith et al., 2020). Sustainable factors are usually not considered by companies when improving these factors (Janic, 2011). It is therefore clear that improving the attractiveness of the High-Speed Train network is a way of diverting demand away from air travel, thereby helping to reduce greenhouse gas emissions associated with air travel. A nudging intervention would be one way to influence consumers in their travel choice.

2.2 Nudging – A Tool to Influence Choices

The following subchapters provide an overview of the different concepts for a better understanding of the topic. First, I introduce the concept of nudging, showing the efficiency of the framework, and presenting two specific nudges, which will be used during my survey.

2.2.1 Origin of Behavioral Economics

Our daily lives are profoundly affected by the choices we make, as mentioned above. The theory of Behavioral Economics (BE), as explored by Richard Thaler in 1980, building on the earlier research of Tversky and Kahneman (1974), marked a major turning point in our understanding of human rationality. It suggested that people are not as inherently rational as previously assumed, challenging conventional conceptions of human decision-making (Reisch, 2023). Tversky and Kahneman showed that people tend to make biased decisions. By observing decisions made under uncertainty, Prospect Theory showed that people do not consistently maximise their utility, thus refuting the Expected Utility Theory that was introduced by von Neumann and Morgenstern (1947) (Thaler, 2018). These decisions are influenced by cognitive shortcuts (Levy, 1992; Tversky & Kahneman, 1992) referred to in the literature as heuristics. By assessing these heuristics, researchers highlighted the potential of influencing people when they are not aware of it (Hansen & Jespersen, 2013). As a result of these findings, the idea has emerged that human beings do not make irrational decisions at random; as such, it is possible to predict the decisions that individuals make: If people consistently make the same irrational decisions, this suggests the possibility of patterns or underlying causes that make these decisions more predictable than truly irrational (Thaler, 2018). Thus, Prospect Theory, introduced by Kahneman and Tversky in 1979, remains relevant and, although over four decades old, is widely recognised as one of the major contributions to the field of BE (Kahneman & Tversky, 1979; McDermott et al., 2008).

2.2.2 System 1 & System 2 and Nudging

To gain a deeper understanding of how different incentives can influence people's decisions, I will describe the theory that serves as a base for nudges: the dual process theory. Inspired by the main theorists of the dual process theory Petty and Cacioppo, Kahneman introduced the theory referred to in his book *Thinking, Fast and Slow* in 2011. Kahneman distinguished between two distinct modes of processing, named System 1 and System 2. System 1 tends to be described as automated, fast and effortless, whereas System 2 tends to be described as controlled, slow and effortful (Kahneman, 2003). Research suggests that System 1 is often responsible for errors and irrationality, providing the foundation for nudges to function by redirecting System 1 thinking (Ebert & Freibichler, 2017). In fact, individuals are more likely to rely on System 1 thinking the busier they are, the more they have on their minds and the greater their time constraints (Chugh, 2004). In this context, nudges attempt to take advantage of decision heuristics and people rely on mental shortcuts to reach a conclusion (Blom et al.,

2021). In situations where decisions need to be made quickly, this approach is highly beneficial as it allows for quick action without excessive thought, thus increasing decision-making efficiency. However, the tendency to quickly construct a coherent narrative, often defaulting to a plausible and convenient story, even if it is based on faulty information, is a significant challenge to reliance on System 1 thinking (Hansen & Jespersen, 2013).

Another aspect that should be taken into consideration is the type of nudges, which can be used to tackle one of the two systems (Sunstein, 2016). Interventions that aim to address System 1 processes are commonly referred to as Type 1 nudges, while those that aim to influence System 2 processes are categorised as Type 2 nudges (Sunstein, 2016). Therefore, Type 1 nudges, which operate below the agent's conscious radar and are distinguished by their relatively limited transparency, frequently prove to be more efficient (Dhingra et al., 2012). To gain a deeper understanding of the between the differences of Type 1 nudges and Type 2 nudges, an example can be seen in the context of health domain. In this context, a Type 1 nudges could be reducing plate size, while a Type 2 nudges could be introducing calorie labelling or motivational posters (Lin et al., 2017) .

2.2.3 Choice Architects

The role of choice architect is a central element within nudge theory. It is a basic concept around which the authors Thaler and Sunstein (2008) have built their theory. It is defined as a person who attempts with several factors to influence the environment where people make decisions without changing their opinion' objective values (Thaler & Sunstein, 2008). An example of a choice architect could be the head of a school's food services department, who carries out various experiments, such as adjusting the order in which food is displayed (Thaler et al., 2013). These tests are an attempt to manipulate students in their purchasing decisions. The use of choice architecture in the design of nudges has been claimed to mitigate cognitive biases arising from bounded rationality, as described by Selinger & Whyte (2011). These biases are likely to arise in situations with complex problems and time constraints, with the aim of gently guiding individuals towards favourable decisions. In recent years, there has been a growing interest in choice architecture research (Münscher et al., 2016). This has been driven by the promise of applying behavioural insights to areas other than marketing, such as policy making. Even politicians have used nudge-based methods and hired choice architects in the design of public policy. David Cameron, for example, set up a "nudge unit" during his government and hired Thaler as an adviser (Murgea, 2022; Vallgårda, 2012).

When deepening the research on the choice architect many researchers were inspired by the book *The Psychology of Everyday Things* by Donald A. Norman (1988). The main takeaway of this book emphasizes the notion that designers must take into account the constant barrage of options and information that consumers encounter in their daily lives Thaler et al. (2013), to render the environment user-friendly. With this idea as a foundation, Thaler and Sunstein (2013) set out to provide thorough rules for the practice of effective choice architecture. This led to the identification of six different tools that good choice architects can use. 1) understanding defaults, 2) expecting errors, 3) providing feedback, 4) understanding mappings, 5) structuring complex choices and 6) incentivizing (Esmark, 2019; Thaler et al., 2013).

The potential for change in the environment of decision-makers is closely related to the ethical concerns at stake in this issue. The authors Siipi & Koi (2022) explored the ethical considerations surrounding the use choice architecture in climate policies. They concluded that ethical dimensions of nudges should be addressed to ensure their effectiveness. In conclusion, the field of choice architecture is complex, and the key to maximizing the effectiveness of nudges is to understand the function of the choice architect and to explore the ethical issues.

2.2.4 Nudge Theory

As mentioned before, the persistent phenomenon of sub-optimal decision making by human beings is closely related to the constraints of limited rationality and their tendency to make decisions that depart from rational behaviour, often by relying on heuristics. Before this change, neoclassical perspectives dominated models of individual choice (Congiu & Moscati, 2022). These neoclassical models assume that decision makers are rational (Avineri, 2012). This implies that their preferences conform to certain criteria (Congiu & Moscati, 2022). With the significant switch in the research of BE, Thaler and Sunstein introduced the term nudges in 2008. A nudge is “any aspect of the choice architecture that alters people’s behaviour in a predictable way without forbidding any options or significantly changing their economic incentives” (Thaler & Sunstein, 2008, p. 6). Nudges work because they correct for biases and errors in human behaviour. These errors can be influenced in various way such as provision of information, correcting misunderstandings about social norms, altering the profiles of different choices and implementing default options (Lin et al., 2017). Concluding, the principle behind the concept is to motivate people to make better decisions.

The concept of nudging has become more popular in different fields of operations such as health (Lin et al., 2017; Ploug et al., 2012; Saghai, 2013), financial market (Castleman & Page, 2014;

Statman, 2013) and happiness of employees (Bock, 2015; Cai, 2020; Ebert & Freibichler, 2017; Fritz et al., 2023). When it comes to the most common nudges, an example is setting the default options to the decision we want to promote, which have been widely used in the fields of charities (Goswami & Urminsky, 2016) and organ donations (Whyte et al., 2012). Alongside other methods, using nudges offers a novel approach to address environmental issues by influencing choices that can have a positive environmental outcome. Croson & Treich (2014) discussed why nudging can be used in the field of environmental behaviour and come up with three reasons, which make nudges attractive for companies or policy makers. The first point discusses the traditional approach to incentivize environmental behaviour, which typically assumes that people make rational decisions. This assumption is an issue, because individuals often do not make decisions, which are in their best interests, due to psychological biases, even when it makes economic sense to do so. Second, the costs of implementing nudges are generally low compared to other approaches (Ji et al., 2022). The third factor highlights distrust in the market system and traditional economics by consumers. This suggests that there may be a less obvious explanation for the extensive discussion of nudges in environmental economics, which is that there is a general lack of confidence in the market system and in traditional economic theories among those who hold the positions that nudges work.

The preceding details highlight the popularity, and numerous studies demonstrate the broad applicability and attractiveness. I intend to emphasize the effectiveness of applying nudges in the area of environmental travel behaviour throughout this thesis.

2.2.5 Effectiveness of Nudging

As discussed before, nudges can be valuable because they help people make better decisions by both countering their inherent biases and aiding their cognitive thought processes (Congiu & Moscati, 2022). However, due to limitations in cognitive resources, individuals do not have the ability to fully process their environment. It is therefore generally difficult to reach fully rational judgements (Bhui et al., 2021). If you want people to be able to grasp and understand information more easily, it should be presented in a way that does not require a great deal of effort. This approach is in line with the “rule of thumb” that information should be as simple and intuitive as possible (Ballou, 1989; Benartzi & Thaler, 2007). According to Thaler & Sunstein (2008), helping people by using these heuristics to nudge them in the right way is an effective strategy.

However, in the context of the effectiveness of nudges, transparency is an issue that is regularly discussed. On the one hand, academics argue that increasing the transparency of the nudges could help to mitigate their ethical concerns (Wachner et al., 2021). Following the findings of Hansen & Jespersen (2013), it is assumed that the ethical acceptability of a nudge can be improved if the choice architecture either informs individuals about them being nudged or ensures their understanding of the forthcoming situation. This phenomenon can be seen in the case of a kiosk. People tend to look at the products near the checkout area while waiting to make their purchase. These tend to consist of unhealthy options, and because people often buy from this prominently displayed selection, it is likely that they end up buying more unhealthy products. However, if people are made aware of the nudge that is designed to encourage them to make these purchases, they are more likely to recognise it and refrain from making them. Concluding, transparency about nudges increases ethical acceptability by enabling individuals to make more informed decisions. Kroese et al. (2016) published a field experiment by placing healthy food in certain areas and underline the argumentation above.

While nudges have been successful in numerous scenarios, there are situations where nudges do not produce the desired result (Congiu & Moscati, 2022). The effectiveness of nudges is not always universal and can be affected by particular situations or causes. Therefore, it is made clear that the success of a nudge in one situation does not necessarily apply to the circumstances of another situation. According to a widely believed reasoning, nudges lose some of their effectiveness when the target person realizes they have been nudged (Bruns et al., 2018). Yet, some argue that nudges should be transparent for moral reasons to avoid individual autonomy (Bovens, 2008). Moreover, there is also research evidence to suggest that when people are aware that they are being influenced, their behaviour may be at odds with the intention of the action (Arad & Rubinstein, 2017; Bruns et al., 2018). Therefore, full transparency can lead to the opposite outcome because people behave in different ways when being manipulated.

In conclusion, nudges' applicability depends on several factors such as time constraints, individual differences or the number of choices (Lin et al., 2017). Although their effectiveness in promoting better decision making is well established, the extent of their success can be influenced by contextual nuances, and the awareness of being nudged can lead to contrasting outcomes.

2.2.6 Using Framing Information and the Order Effect

As part of my master's thesis, I published a survey to gain more knowledge about how effective nudges are when it comes to sustainable decision making. After reviewing the dual process theory in section 2.2.2, I decided to choose my nudges, which aim to affect System 1. As discussed, these nudges have an impact on automatic processing, where individuals make their decision in an effortless way (Kahneman, 2003). Examples of important nudges would be default options or the use of social norms (Wachner et al., 2021). In my survey I used framing information and the primacy effect. The implementation of these two nudges in the survey will be further elaborated in Section 3.2. Both will be situated in the literature context beforehand.

In the context of the framing information nudge, it involves taking advantage of a cognitive bias that occurs as a result of the way in which information is communicated or presented (Avineri & Owen, 2013; Nelson et al., 2021). In other words, the effect is based on the wording of the information, which can have an impact on people's perception of it. It was previously only proven that people made decisions based only on the information they were given, without considering the presentation of that information (Nelson et al., 2021; Tversky & Kahneman, 1992). Although the framing information nudge covers a wide range of topics from politics to environmental communication, it has been shown to have a positive impact on environmental attitudes as well. For example, in their experiment, White et al. (2011) show that consumer intentions are more positively influenced by messages that are specifically framed as a negative loss when they are paired with a concrete state of mind. Throughout this experiment, it is apparent that there exists a significant interplay between message framing and environmental intentions. The results suggest that when messages are framed as a negative loss, they lead to higher levels of consumer intention to recycle (White et al., 2011). Additional support is provided by the research of van de Velde et al. (2010) which supports the efficiency of framing information for recycling as well. Furthermore, the effectiveness may differ according to sociodemographic characteristics such as gender, age, and education. Men are prone to perceive negative framed messages as more impactful, whilst women are more likely to find positive framed messages persuasive (van de Velde et al., 2010). However, there is a need for further research to have a better understanding of the transition from attitudes to behaviour change in the field of sustainability, especially when it comes to travel decisions (Maibach et al., 2010).

The second nudge that I am going to study in the context of sustainable decision making in my master's thesis is the order effect. The order effect refers to a phenomenon, where the sequence in which information is presented influences the outcome or response (Rey et al., 2020). Most

studies concluded that people are especially effected by the first piece of information they have seen (de Ridder et al., 2022). For instance, when choosing between two items, the initial product you come across can impact your perception of the second one. This includes the possible effects of being the first piece of information (Hollingshead, 1996). The order effect was explored due to many experiments in several research fields. In the field of sustainability, the effect of order is mainly studied in the context of dietary choices, and in particular when it comes to the choice of food options. The experiment of Policastro et al. (2017) investigated the order effect among college students ordering sandwiches to choose healthy ingredients. By showing that products positioned at the top benefit from the primacy effect, the study confirmed the positive impact of the order effect (Vandenbroele et al., 2020). However, there is not a lot of research when it comes to sustainable travel decisions. One possibility could be that unfamiliar travel can leave a lasting negative impression and influences future travel behaviour (Forgas, 2011). This hypothesis is supported by Schmitt et al. (2013) experiment, which investigated the experience of students using public transport for the first time. The experiment showed that the first unfamiliar trip tended to be more negative than the second, which tended to be experienced as familiar.

Several studies have looked at the effectiveness of nudges in the context of sustainable behaviour, but some also combine two nudges to increase the positive impact on sustainability. An illustrative example can be found in the work conducted by Cosic et al. (2018) who carried out an analysis to investigate the recycling behaviour of students in Pisa. As part of this experiment, the researchers also evaluated the effectiveness of the combination of nudges. In summary, the combination of nudges proved to be effective in increasing the use of recyclable cups. By using both nudges, consumers are not only made aware of the behaviour, but are also provided with a simplified and convenient means to actively participate in the desired behaviour (Oh et al., 2022). These findings led to the assumption, that a combination of two nudges can have an even higher positive output in the case of sustainable travel behaviour. Therefore, I combined the order effect with the framing information nudge to investigate the efficiency.

As a result, I have created a scenario using firstly the framing information nudge and secondly a combination of both nudges in the context of sustainable decision making, in line with the hypothesises, I developed through the literature review:

H_1: Participants who receive nudges promoting sustainable transportation options will demonstrate a higher likelihood of choosing environmentally friendly modes.

H_2: SC will moderate the impact of nudging on sustainable behaviour, such that nudging will lead to more sustainable behaviour in participants high in SC in comparison with participants low in SC.

H_3: Participants who receive two nudges jointly promoting sustainable transportation options will demonstrate a higher likelihood of choosing environmentally friendly modes than receiving one nudge.

3 Methodology

In the previous chapters, I established the relevance of nudging in a sustainable context in today's landscape and explored the existing state of knowledge through a comprehensive literature review. Considering the findings of this research, the methodology chapter seeks to describe my chosen research approach to validate the hypotheses. As part of the quantitative methodology, I created an online study using Qualtrics. The study was primarily disseminated through my personal social media platforms. Notably, the study was conducted in English only and was both anonymous and voluntary to complete.

3.1 Experimental Design

The main objective of my thesis was to analyse the impact of a nudging intervention on a travel scenario. To investigate the influence of the choice of transport mode, I chose an experimental design. This particular design allows for a more efficient evaluation of the cause-and-effect relationship (Malhotra et al., 2017). I also decided to use a quantitative method to collect data to find out how consumers perceive themselves in terms of sustainable development. Therefore, I created an online study using Qualtrics. Qualtrics is an online survey platform that is widely used for data collection and analysis in a variety of fields. It offers a user-friendly interface and a powerful analysis tool (Barnhoorn et al., 2014). This makes it a popular tool for researchers. In addition, I have created a scenario that is as realistic as possible. By closely mirroring real life, the study gains external validity, allowing the results to generalise to wider contexts and populations.

3.2 Explanation of the Decision-Making Scenario

To measure the impact of nudges in terms of sustainability, I created a real-life scenario. The scenario described a day-to-day situation in which the participants have to choose between three modes of transport to travel from Cologne to Munich to visit friends for the weekend. I decided to omit the financial part, when choosing the scenario because it is identified as one of the major

reasons when choosing a transportation mode (European Travel Commission, 2023). Thus, participants were not influenced by price when deciding whether to travel by train or by car. The full scenario is described below (including Table 1):

> "Imagine yourself in a scenario where you are planning a weekend trip from Cologne to Munich to visit some friends. During the planning process you must choose between several travel options. You can either fly from Cologne, take the car or use the train. You must travel a distance about 570km. Please find below the information for the trip."

Table 1

Travel Case Scenario Control Group

Option	Duration
Airplane	1h
Car	5h30
Train	4h30

For the application of the chosen nudges, I adapted the explained scenario different for three groups. One group was the control group. This group had no nudges and only had to make a choice based on the information above. The second group was my first treatment group who was nudged by the framing of the information it was exposed to. As discussed before, the way in which information is presented has a certain influence on the consumer (Nelson et al., 2021). As in the first group, the participants could choose a mode of transport. However, they were given negative information about the footprint of the unsustainable choice. It was clearly indicated that choosing the plane would be the worst decision in terms of sustainability. Table 2 below shows the information.

Table 2

Travel Case Scenario Framed Information Nudge

Option	Duration	Footprint
Airplane	1h	113.5kg CO2e
Car	5h30	-31.8kg CO2e
Train	4h30	-112.8kg CO2e

The third group received two nudges: exposure to negatively framed information and the order effect. Similar to the second group, these participants were subjected to negatively framed information, but the transportation modes were rearranged, placing the sustainable option of choosing the train at the top, making it the first choice. This rearrangement should have a positive influence on the decision making process of the participants (Vandenbroele et al., 2020). The information presented to the participants can be found in Table 3.

Table 3

Travel Case Scenario Framed Information Nudge & Order Effect

Option	Duration	Footprint
Train	4h30	0.7kg CO2e
Car	5h30	81.7kg CO2e
Airplane	1h	113.5kg CO2e

3.3 Participants

For my experimental study, I used several social media channels to recruit participants and my personal and professional network. The survey was distributed via Instagram, LinkedIn and WhatsApp, with the inclusion of the Reddit platform to extend outreach beyond my personal network. Additionally, subreddits like r/SampleSize, were used to recruit participants for my Qualtrics survey. There were no restrictions for participating in my survey. Every age, gender and place of origin were allowed. Participants were informed that participation was completely voluntary and anonymous. Additionally, they were afforded the opportunity to provide feedback in any format following the completion of the survey. Before publishing the survey, I asked family and friends to test it in advance. This was done to ensure its internal validity and the clarity of all question wording. Between 27th of October and 29th of November, a total of 182 responses were gathered. Due to the implementation of a randomizer in the study, each participant was randomly allocated to a group to guarantee an equal sample size of all three experimental groups. Since the survey is divided into three groups, a minimum of 60 participants per group was obtained.

3.4 Procedure

As I already mentioned, the survey was implemented in Qualtrics, and it was divided into four parts. The first parts asked for sociodemographic variables, which were gender, age, country of residence, social status, level of education, and employment status were collected. The aim of

the second part was the measurement of the SC of the participants. The third part contains a travel scenario with three different conditions. Two groups received a nudge in their presentation scenario, while one group, the control group, did not experience any nudges. A more detailed explanation of each decision-making scenario can be found in section 3.2. After the travel scenarios an attention check was answered to make sure each participant understood the content of the study. The last part of the survey was to measure sustainable travel behaviour. Additionally, the complete survey can be found in the appendix (see Appendix 1).

3.5 Measurement of Variables

In the next three sections, each variable will have a description and its measurement will be explained. Additionally, the final subsection will examine all control variables within the scope of my research.

3.5.1 Independent Variables

In this experiment, there was only one independent variable: the experimental condition of the behavioural scenario. The condition was either the control group, framing information or mixed nudge in a between-subjects design aiming to test H_1 and H_3. All these three groups were described in more detail in Section 3.2.

3.5.2 Dependent Variables

The study also had only one dependent variable. The choice of transportation mode and involved a dropdown featuring three modes of transportation (car vs train vs airplane). Participants were asked, after reading the scenario they were attributed depending on condition: “Based on the description above, which transport option would you choose?” Therefore, the travel choice will be measured once per group.

3.5.3 Covariate Variables

The first covariate, which aimed to answer H_2, was the level of SC measured. For my questions in this section, I used questionnaires from the International Social Survey Programme (ISSP) in the field of sustainability. ISSP is an international survey programme that conducts an annual survey on changing topics (Scholz et al., 2011). Therefore, participants were asked “I believe that there is no point in doing my bit for the environment if other people do not behave in the same way.” Therefore, participants were asked “I believe that there is no point in doing my bit for the environment if other people do not behave in the same way.” With a five-point Likert scale the participants had the opportunity to express his/her opinion to this topic: 1=Strongly

disagree, 2=Somewhat disagree, 3=Neither agree nor disagree, 4=Somewhat agree, 5=Strongly agree.

The remaining variables were control variables included in my survey to enhance the internal validity and help to minimize the impact of external factors that may inadvertently affect the relationship between independent and dependent variables. The first part of my study asked for sociodemographic variables, which were gender, age, country of residence, social status, level of education and employment status. Age, gender, and origin were gathered through a blank field or dropdown menu. Participants were given several options to choose from for educational level and working status, but also given the option to enter them in a blank field. To measure the social status of my participants I used MacArthur scale of subjective social status. Instead of just asking for the annual income, the ladder takes into consideration the comparison to other people in their own society including wealth, health and social standing (Hoebel et al., 2015).

4 Results

This chapter's objective is to present the primary findings of the analysis that examined the effectiveness of nudging in influencing sustainable travel decisions. To establish a solid basis for the subsequent analysis, descriptive statistics are first carried out. Furthermore, to assess the impact of independent variables on the dependent variables (Pallant, 2020), an assumption check will be performed. Following this, an analysis of the three hypotheses has been conducted to evaluate the effectiveness of the selected nudges in the survey. The chapter is structured as previously outlined and will serve as the foundation for the conclusion and discussion.

4.1 Descriptive Statistics

The published online survey had 182 participants over a one-month period. Unfortunately, due to participants not completing the survey, I had to exclude 42 responses. Furthermore, I identified 30 responses that exhibited characteristics of being generated by bots. As a result, I removed these 30 responses to ensure the accuracy of my data. I also included an attention check, but everyone answered correctly. In this sense, the survey had 110 qualified participants, giving me a final sample size of 110 responses (60.4%) with around 36 participants per group. In my final sample the gender was distributed with 59 female (53.6%) and 50 male (45.5%) participants. One participant did not wish to disclose their gender (0.9%). The age of the participants ranged from 20 years to 95 years, while the average was 29 years. Furthermore, most participants were 25 years old (19.1%). In terms of the variable country of residence

62.7% of responses resided in Germany, while filling out the survey. Germany was followed by Portugal with 18 responses (16.4%) and France with 3 responses (2.7%). In addition, most respondents have a bachelor's degree or equivalent (55.7%), while only 22 participants have a non-academic background. In conclusion, 94 of the participants have a bachelor's degree or higher (85.5%). As for employment status, only 2 participants (1.8%) were unemployed, while 108 participants either had a job or were students (98.2%). The last sociodemographic variable deals with the social status of my respondents. As mentioned before, I used the MacArthur Scale of Subjective Social Status, which ranges from 1 to 10. The average of the social status variable is 6.84. Table 5 has a detailed view and description of the sociodemographic variables (see Appendix 2).

4.2 Assumptions Check

Before proceeding with the analysis, manipulation checks are necessary to ensure the validity and reliability of the study and the interpretations drawn from the data.

4.2.1 Check for Independence

First of all, I had a look at the independence of the survey. Independence is verified through the survey, as the chosen experimental design is a survey. The survey was constructed to ensure that participants were randomly assigned to one of the three groups, which means that each observation is independent of the others.

4.2.2 Check for Normality

In general, there are two methods to test if the variables conform to a normal distribution. Firstly, a visual inspection can be carried out, using histograms to show how the variables are distributed. A second option would be using statistical tests to explore the distribution of the variables. It is important to note that larger sample sizes enhance the dependability of statistical tests. In instances where the data is abnormal, deviations from normality may go undetected in smaller samples. Therefore, I tested the variables with the Shapiro-Wilk test as it is sensitivity to departures from normality and provides a p-value for each variable. I discovered that none of the variables conform to a normal distribution through examining the normality of each variable and interpreting the low p-values (see Appendix 3). As a result, I had to reject the null hypothesis for normalcy. Despite the original distribution of variables, identically distributed random variables approach a normal distribution under specific circumstances, as stated by the central limit theorem (Sirignano & Spiliopoulos, 2020). Therefore, it is suitable for me to use parametric tests such as t-tests or ANOVA tests.

4.2.3 Check for Homogeneity of Variances

The homogeneity of the variances between the variables was the next assumption that needed to be tested. There are various statistical tests that can be utilised for this purpose. Based on the characteristics of my data, I chose the Levene's test of homogeneity. The reason is that this specific test is relatively robust to departure from normality (Conover et al., 1981). There are tests that might be more sensitive to non-normality, such as Bartlett's test. The results of the test varied according to the variables (see Appendix 4). I was therefore able to use t-tests or ANOVA tests for additional analysis in the situations where I was unable to reject the null hypothesis. However, because the Welch-ANOVA test is less restrictive, it was used for the cases where this assumption was broken rather than the standard ANOVA test.

4.2.4 Sociodemographic Variance between Groups

As I have three groups, all three tests need to be examined the variety between the three groups due to ensure reliability in terms of the sociodemographic aspects. It also provided me with my initial impressions of the impact of my nudges. It may be assumed that the nudge itself is the only thing separating the groups if all demographic variances were homogeneous among them. The ANOVA test is a helpful tool because it determines whether there is a difference between the variances. High p-values were observed following the execution of the test. Therefore, I was not able to reject the null hypothesis, which implies that there no differences between the sociodemographic variances. Concluding, there are no statistically significant differences between the three groups. A more detailed overview of the results of the tests can be found in Appendix 5.

4.3 Hypothesis Testing

The next step was to find out if a nudge intervention had a statistically significant and positive influence on the choice of travel mode after all relevant assumptions were confirmed. Since I have two distinct treatment groups, two analyses will be conducted. Furthermore, SC will be tested as a moderator in both analyses, if it has a significant positive impact. As we already tested the impact of the sociodemographic variables on the dependent variable, a third analysis is not provided.

4.3.1 Nudging Effect on Travel Decisions

Before I ran the analysis on the nudging effect, I created Table 4 to have a first look at the distribution of the transportation mode trough the three groups.

Table 4

Distribution of the Transportation Modes across the three Groups

	Train		Airplane		Car	
	n	%	*n*	%	*n*	%
Control Group	24	65	7	19	6	16
Framed Information	26	68	5	13	7	18
Framed Information & Order Effect	30	86	4	11	1	3
Ø	**80**	**73**	**16**	**15**	**14**	**13**

The dominant distribution mode in each group was the train as expected. Nevertheless, participants in the two experimental groups were more likely to choose the train than in the control group. In the control group, just 24 out of 37 participants (65%) chose the train in the scenario, while in the group that received the framed information push, 26 out of 38 (68%) selected the train. The second experimental group revealed an even higher percentage. 30 out of 35 individuals (86%) picked the train, suggesting a nudge effect. The control group exhibited a greater tendency to choose a mode of transport that was not environmentally friendly. Of the total participants, 7 (19%) individuals opted for the plane whilst 6 (16%) chose cars. On the contrary, in the group that received the framed information nudge, only 5 (13%) people chose the plane, and 6 (16%) people chose the car. The group that received a combination of the order effect and the framed information nudge had the lowest percentage of participants making an unsustainable choice. Only 5 (14%) participants out of 35 chose to drive or take the plane.

The two experimental groups showed a preference for sustainable modes of transport, as shown above. Therefore, I created a dummy variable for the choice of transportation. Responses who selected the sustainable option were coded as 1, while those who chose the non-sustainable option were coded as 0. Analysing the means of the groups can be helpful in this regard. Since I had three groups, I performed a one-way ANOVA to compare their means. The assumptions for an ANOVA test were met in the sections before. Upon running the statistical test, the p-value could be seen and examined. For the overall differences of the means between the groups, this test was found to be statistically significant, $F(1, 107) = 4.274$, $p = .036$. The results suggested differences between the three groups. Therefore, the means of the dummy variable

created earlier were examined based on this observation. Participants from the control group (M = .65, SD = .48) chose the more unsustainable option than the participants of the second group with the framed information nudge (M = .68, SD = .47). A bigger difference could be observed between the control group and the second experimental group with the combination of framed nudge intervention and the order effect. With the biggest mean (M = .86, SD = .36), the third group indicated that the combination of nudges could have changed the expected behaviour towards the train. Therefore, from reviewing the results of first tests, I concluded that nudge interventions could have been a positive effect on sustainable behaviour. For more detailed information, please see Appendix 6 & 7.

During the second phase of my analysis, I identified which of the three groups showed differences to test H_3 and have more detailed information about H_1. It is conceivable that the variations exist only within the two groups rather than among all the three groups. These hypotheses were examined with planned contrast of the ANOVA I did before. With the planned contrast I was able do a pairwise comparisons. In my case I had three contrasts: Combination vs. Control (Contrast 1), Control vs. Single (Contrast 2) and Single vs. Combination (Contrast 3). Through the examination of these three cases, I was able to conduct a more detailed investigation of H_1 and H_3. Firstly, I analysed the contrasts surrounding the control group to determine the effectiveness of nudges for H_1. It was found that Contrast 2 was statistically significant $F(1, 107) = 5.549$, $p = .020$, indicating that the framed information nudge had a positive impact on the sustainable behaviour of my participants and therefore supporting H_1. To find further evidence supporting H_1, I also investigated the effect of the combination interventions against the control group. It was found that Contrast 1 was also statistically significant $F(1,107) = 6.483$, $p = .001$. In conclusion, the effectiveness of the selected nudge interventions has been demonstrated. Therefore, I can confirm that H1 is supported. A more detailed overview about the tests can be found in the Appendix 8.

The final step of my analysis was to find a piece of evidence to support H_3 by showing that a combination of nudges can be more effective than a single nudge intervention. To test this hypothesis, I again used a planned contrast. This statistical analysis is most appropriate by having a specific comparison in mind (Beasley & Schumacher, 1995). After testing Contrast 3, it was found to be not statistically significant $F(1,107) = 2.78$, $p = .067$, indicating that the chosen combination of nudge interventions is statistically not more effective than using a single nudge. However, the results are statistically significant at a 10% level, indicating a trend towards higher effectiveness when using a combination of nudge interventions compared to a

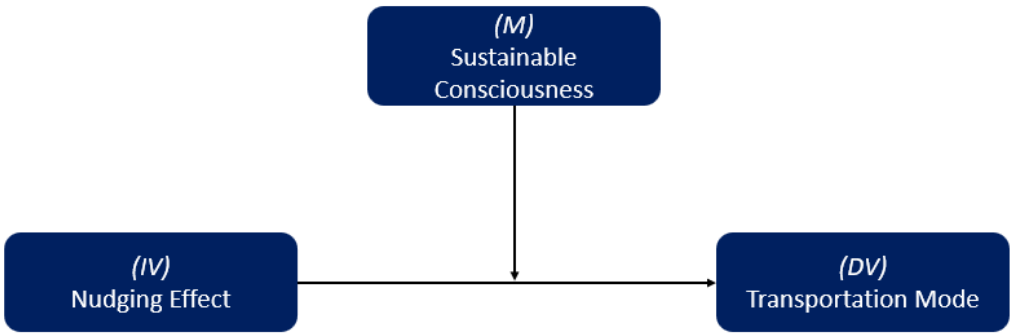
single nudge intervention. Therefore, I did not reject H_3. A more detailed overview about the tests can be found in the Appendix 8.

4.3.2 Moderation Model for SC

With the goal to test my second hypothesis (H_2), I inserted SC as a moderator to my analysis. I already observed the effectiveness of nudges towards choosing the transportation mode, but I also assumed that SC has a strengthening effect as moderator to predict sustainable behaviour. According to these assumptions, the following model can be examined:

Figure 1

Moderation Model for SC as a Moderator



To investigate if SC was serving as a moderator to promote sustainable behaviour, a moderation model was implemented. What I had to consider is that a moderation needs to be calculated in a single model with an interaction term between SC and the nudging effect. In my case, I developed one model with the SC and the nudging effect as independent variables, but also an interaction between both variables to examine the effect on the dependent variable. Within this context, the model evaluated the influence of SC as a moderator between the relationship of the nudging effect and the choice of transportation.

Moderation model: $Transportation\ Mode = \beta_{\text{constant}} + \beta_{\text{nudging effect}} + \beta_{\text{sustainable consciousness}} + \beta_{\text{nudging effect * sustainable consciousness}} + \varepsilon$

The dummy variable was used as the dependent variable, as in the previous analysis. Either way you choose the sustainable transportation mode or the unsustainable one. To define the moderator SC in my case, I mean-centered the results of the questions for SC in my survey and created it as a new variable. Prior to the moderator model being implemented, every variable underwent tests for homogeneity, independence, and normalcy. The reliability of the scale for

measuring the SC was tested with Cronbach's alpha before running the moderation model. The scale demonstrated good reliability with a Cronbach's alpha of .71 (Streiner, 2003).

The regression summary below provides an overview of the outcome of the model. The model is statistically significant, $F(2,107) = 1.035$, $p<.05$ as the p-value is lower than 5%. Furthermore, with an R^2 of .047 the overall exploratory power is very low. According to the moderation effect of SC, it can be observed that SC is not statistically significant. However, a positive relationship with the dependent variable can be observed although it is not significant. This suggested that the moderator SC might not be able to have a moderating role on the effect of the nudge interventions. Upon closer examination of the interaction term, it appeared not to be statistically significant in combination with the nudge interventions. It also indicated a negative relationship, meaning that a combination with nudges could decrease the effect of a high SC. However, it is not statistically significant. The positive relationship of the coefficient can be explained by the coding of the transportation mode variable (Sustainable transport option = 1, non-sustainable transport option = 0). However, SC does not seem to have a moderating role on the effect of nudges as the interaction term is not statistically significant. Nevertheless, since the coefficient of the interaction is insignificant, my second hypothesis (H_2) is not supported. Additionally, it was observed that the hypotheses I previously tested still produce the same results. The statistical significance of the nudging effect remains in the combination group, but not in the framed nudge intervention group.

Table 5

Moderation Model

	Dependent variable:
	Dummy Sustainable Choice
meancenterSC	0.132 (0.166)
Group1	0.344** (0.782)
Group2	0.672** (0.801)
meancenterSC:Group1	-0.089 (0.218)
meancenterSC:Group2	-0.132 (0.221)

Constant	0.185 (0.588)
Observations	110
R^2	0.047
Adjusted R^2	0.053
Residual Std. Error	0.447 (df = 107)
F Statistic	1.035 (df = 2; 107)
Note:	*p<0.1; **p<0.05; ***p<0.01

5 General Discussion

After the analysis of the results of my experimental study, all the results will be the subject of discussion in this section. Based on the literature review the main conclusion will be presented, followed by the academic and managerial implications of the experiment. The last section focuses on limitations and future research.

5.1 Main Findings

The findings of my project support the literature to some extent. Of particular interest is the impact of nudges on sustainable consumption and consumer travel behaviour. As previously noted, a positive effect of nudges can be observed. Furthermore, it also aligns with research in BE (Avineri & Owen, 2013; Nelson et al., 2021). Researchers have highlighted the central role of contextual cues in influencing consumer choices, demonstrating a growing consensus that the choice of framing can have a significant impact on individuals' perceptions. My current findings reinforce these insights, by supporting H_1. However, when selecting a mode of travel, consumers may lack interest in the provided information intended to assist them in making a choice for various reasons. This implicates that the effectiveness of such information relies on the consumer's perception of its reliability and usefulness (Brécard et al., 2009), as the level of interest in the information directly influences the extent to which consumers engage with the provided information. Therefore, the question remains whether the participants consider the provided information as valuable and make their decision based on it. It also reinforces the assumption why framed information can be a such a powerful tool. In conclusion, my results suggest that consumers are influenced by information. Therefore, nudge interventions using framed information might could be an effective tool to promote sustainable consumption.

Another intervention I was interested in is the combination of nudge interventions implemented in the choice of transport mode. As research indicates, there is a lack of research in the area of sustainable travel related to the combination of nudges. However, most studies support a higher effectiveness of a combination of nudges (Möllenkamp et al., 2019). As the positive impact was highlighted in the analysis before, the effect can be used in different context. Nevertheless, the data was only partially able to demonstrates that employing a range of nudges can enhance the effectiveness of nudge interventions. Additionally, identifying which nudge intervention had the greatest impact within the combined group is challenging as there were no significant differences in the impact of the nudge interventions between the two experimental groups. In my initial analysis, an overall significant effect of nudges was observed. However, upon closer examination of the two groups, it became evident that only the combination of nudges demonstrated a statistically significant impact.

The last aim of my study was to examine a moderation role of SC on sustainable behaviour. The hypothesis posited that individuals with higher levels of SC would be more inclined to engage in sustainable behaviour. Contrary to expectations, the data suggests that the link between initial environmental consciousness and sustainable behaviour is not as straightforward as previously thought. Although in some of the study's cases, SC was identified as a moderator in this particular circumstance. (Y. Kim & Han, 2010; Poortinga et al., 2004; Schultz et al., 2005). One reason could be the presence of the VAG as previously explained by the literature. The study uncovered that, despite high levels of environmental awareness among participants, they did not consistently translate this knowledge into sustainable behaviours. Furthermore, the VAG indicates that factors beyond initial SC play a vital role in shaping behaviour (Barr & Gilg, 2006). Possible factors such as conflicting priorities or lack of accessible sustainable options could contribute to this gap. In conclusion, the existence of the VAG emphasizes that interventions should not only focus on increasing awareness, but also address the different aspects that hinder the translation of SC into concrete actions.

5.2 Academic and Managerial Implications

The previous findings of the dissertation delivering valuable insights from an academic and managerial perspective. First of all, nudges are a relatively recent topic, especially in the context of sustainability. Therefore, future research is highly recommended when it comes to the context of travel agencies. Connecting this topic with different combination of nudges could provide a basis for future research. Additionally, considering the results obtained the combination of the two nudes, I recommend trying combination of nudges to maximize the

overall effectiveness. This dissertation dealt with the impact of nudges on travel choices in the context of travel agencies and suggests that nudge interventions are a valuable approach to guide consumers toward a more sustainable travel choice. Furthermore, the dissertation adds to the existing literature that SC is not an important moderator to predict sustainable behaviour. Rather it is addressing the VAG, which researchers should keep in mind as an important factor to find a solution by influencing consumers towards a more sustainable lifestyle.

In the context of managerial interventions, the integration of nudges offers a promising way towards promoting sustainable transportation choices. Firstly, travel companies can use nudges to influence people's choices in favour of environmentally friendly modes of transport. By understanding the decision-making processes and cognitive biases involved, organisations can make nuanced improvements. A second implication is the possibility of considering redesigning incentive structure to align with environmental goals. A reward system for customers selecting a sustainable mode of travel could integrate nudges, thus reinforcing positive transportation decisions. Lastly, I recommend customized nudging strategies. Recognizing the diversity among customers and their different cultural preferences, travel agencies should tailor nudging strategies to specific demographics. This could increase the intervention overall effectiveness.

5.3 Limitations

This experimental study is a valuable contribution to the field of SD using nudge interventions. However, the following limitations highlight the need for further research to address these constraints. One of the primary limitations of this research are focussing on the framework around the thesis. The scope of the study was limited to a specific timeframe and financial resources, affecting the depth of data collection and analysis. A longer research time could have allowed for a more comprehensive examination. The second limitation also focusses on the frame around the study. As I used a survey to collect data, I mainly focused on recruiting participants through my personal network. Reliance on personal relationships may have a limiting effect on the diversity of the sample and skew the representation of some points of view. Therefore, it is not possible to generalise the findings.

In addition, the following limitations regarding the content and the scope of the study have to be taken into account. The third limitation deals with the complexity of the study and the scenario it is based on. Due to the simplified scenario, the complexity of the study is questionable. While meeting friends in a city 500 km away is a real scenario, the choice of

transport mode based on the information provided (duration of travel and footprint) seems obvious and could impact the comprehensiveness of the results. Moreover, participants could comprehend the aim of the survey and adjust their answers. This may result in response bias where participants provide answers they believe are in line with expected behaviour, rather than reflecting their true inclinations. However, simplifying the structure and removing price-related factors enables better focus on the impact of nudges.

Another important limitation is the absence of an experimental design that directly observes real-life behaviour in response to nudges (Kroese et al., 2016). While survey responses offer valuable self-reported data, they may not fully capture the complexity of real-world scenarios. Furthermore, my study was only able to collect data on individuals' sustainable intentions, which may indicate sustainable behaviour. However, it is important to note that there are cases where individuals have sustainable intentions but do not act in a sustainable manner, because of the VAG. Concluding a field experiment should provide a more robust foundation for understanding the causal relationship between nudges and SD.

In conclusion, I would like to emphasise how important it is to remember that nudge treatments are only a temporary way of encouraging people to adopt a more permanent behaviour. Nudges operate at a surface level, while sustainable behaviour often rooted in deeply ingrained values. Therefore, nudges may succeed in influencing immediate decisions, but their impact may weaken over time if they are not combined with strategies that address the root causes of unsustainable choices. As a solution, researchers are encouraged to adopt the approach of nudges with other behaviour change strategies. This may involve combining nudge interventions with educational initiatives (Kurokawa et al., 2023) or policy measures (Hansen & Jespersen, 2013).

5.4 Future Research

Future research can focus on several topics, when examining the effect of nudges in a sustainable context. Firstly, as already mentioned before, the absence of an experimental design that directly observes real-life behaviour in response to nudges decreases the opportunity of examining the effectiveness of nudge intervention. In addition, the use of a field experiment methodology would facilitate the inclusion of additional pertinent elements, such as cost or convenience, that influence customers' decision-making processes (Luzecka, 2016; Mwale et al., 2022). Additionally, I would recommend researchers to deepen their research on the factors why people exactly behave sustainable. Taking geographical and socio-economic factors into

consideration is essential (Sunstein et al., 2019). Different regions may respond differently to specific nudges based on cultural norms, infrastructure and economic factors. Examining the reasons behind it would help to form nudges in a more efficient way. As another interesting point I would encourage researchers to take a deeper look are dynamic changing nudges. In my survey, I choose a specific nudge for each situation. A dynamic nudge could respond to an individual's changing circumstances (Boenke et al., 2022). Understanding how dynamic adaptation influences sustainable travel decisions could provide insights into responsive interventions. In the age of artificial intelligence and machine learning, it would be a forward-thinking approach to the promotion of sustainable travel choices. However, the implementation of nudges would still be a balancing act in terms of ethics, manipulation and persuasion.

References

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Process*, *50*(2), 179–211.

Albalate, D., Bel, G., & Fageda, X. (2015). Competition and cooperation between high-speed rail and air transportation services in Europe. *Journal of Transport Geography*, *42*, 166–174. https://doi.org/10.1016/j.jtrangeo.2014.07.003

Allen, M., Babiker, M., & Chen, Y. (2018). Summary for Policymakers. In: Global Warming of 1.5°C: An IPCC Special Report on Impacts of Global Warming of 1.5°C above Pre-industrial Levels in Context of Strengthening Response to Climate Change, Sustainable Development, and Efforts to Eradicate Pover. *Global Warming of 1.5°C*, 1–24. https://www.cambridge.org/core/product/identifier/9781009157940%23prf2/type/book_part

Anagnostopoulou, E., Urbančič, J., Bothos, E., Magoutas, B., Bradesko, L., Schrammel, J., & Mentzas, G. (2020). From mobility patterns to behavioural change: leveraging travel behaviour and personality profiles to nudge for sustainable transportation. *Journal of Intelligent Information Systems*, *54*(1), 157–178. https://doi.org/10.1007/s10844-018-0528-1

Arad, A., & Rubinstein, A. (2017). The People's Perspective on Libertarian-Paternalistic Policies. *The Journal of Law and Economics*, *62*(2).

Avineri, E. (2012). On the use and potential of behavioural economics from the perspective of transport and climate change. *Journal of Transport Geography*, *24*, 512–521. https://doi.org/10.1016/j.jtrangeo.2012.03.003

Avineri, E., & Owen, W. E. (2013). Applying valence framing to enhance the effect of information on transport-related carbon dioxide emissions. *Transportation Research Part A: Policy and Practice*, *48*, 31–38. https://doi.org/10.1016/j.tra.2012.10.003

Aziz, H. M. A., & Ukkusuri, S. V. (2014). Exploring the trade-off between greenhouse gas emissions and travel time in daily travel decisions: Route and departure time choices.

Transportation Research Part D: Transport and Environment, *32*, 334–353. https://doi.org/10.1016/j.trd.2014.07.016

Babutsidze, Z., & Chai, A. (2018). Look at me Saving the Planet! The Imitation of Visible Green Behavior and its Impact on the Climate Value-Action Gap. *Ecological Economics*, *146*(October), 290–303. https://doi.org/10.1016/j.ecolecon.2017.10.017

Ballou, R. H. . (1989). Heuristics: Rules of Thumb for Logistics Decision Making. *Journal of Business Logistics*, *10(1)*, 122–32.

Barnhoorn, J. S., Haasnoot, E., Bocanegra, B. R., & van Steenbergen, H. (2014). QRTEngine: An easy solution for running online reaction time experiments using Qualtrics. *Behavior Research Methods*, *47*(4), 918–929. https://doi.org/10.3758/s13428-014-0530-7

Barr, S. (2006). Environmental action in the home: Investigating the "value-action" gap. *Geography*, *91*(1), 43–54. https://doi.org/10.1080/00167487.2006.12094149

Barr, S., & Gilg, A. (2006). Sustainable lifestyles: Framing environmental action in and around the home. *Geoforum*, *37*(6), 906–920. https://doi.org/10.1016/j.geoforum.2006.05.002

Battaglio, R. P., Belardinelli, P., Bellé, N., & Cantarelli, P. (2019). Behavioral Public Administration ad fontes: A Synthesis of Research on Bounded Rationality, Cognitive Biases, and Nudging in Public Organizations. *Public Administration Review*, *79*(3), 304–320. https://doi.org/10.1111/puar.12994

Beasley, T. M., & Schumacher, R. E. (1995). Multiple regression approach to analyzing contingency tables: Post hoc and planned comparison procedures. *Journal of Experimental Education*, *64*(1), 79–93. https://doi.org/10.1080/00220973.1995.9943797

Benartzi, S., & Thaler, R. H. (2007). Heuristics and biases in retirement savings behavior. *Journal of Economic Perspectives*, *21*(3), 81–104. https://doi.org/10.1257/jep.21.3.81

Bengtsson, M., Alfredsson, E., Cohen, M., Lorek, S., & Schroeder, P. (2018). Transforming systems of consumption and production for achieving the sustainable development goals: moving beyond efficiency. *Sustainability Science*, *13*(6), 1533–1547.

https://doi.org/10.1007/s11625-018-0582-1

Beria, P., Lunkar, V., Tolentino, S., Pařil, V., & Kvasnička, M. (2023). Long-distance rail in Europe: Comparing the forms of head-on competition across Europe. *Research in Transportation Economics*, *102*(September). https://doi.org/10.1016/j.retrec.2023.101367

Bhui, R., Lai, L., & Gershman, S. J. (2021). Resource-rational decision making. *Current Opinion in Behavioral Sciences*, *41*, 15–21.

Blake, J. (1999). Overcoming the "value-action gap" in environmental policy: Tensions between national policy and local experience. *Local Environment*, *4*(3), 257–278. https://doi.org/10.1080/13549839908725599

Blom, S. S. A. H., Gillebaart, M., De Boer, F., van der Laan, N., & De Ridder, D. T. D. (2021). Under pressure: Nudging increases healthy food choice in a virtual reality supermarket, irrespective of system 1 reasoning. *Appetite*, *160*(January), 105116. https://doi.org/10.1016/j.appet.2021.105116

Bock, L. (2015). *Work Rules!: Insights from inside Google that will transform how you live and lead*.

Boenke, L., Panning, M., Thurow, A., Hörisch, J., & Loschelder, D. D. (2022). Who can nudge for sustainable development? How nudge source renders dynamic norms (in-)effective in eliciting sustainable behavior. *Journal of Cleaner Production*, *368*(7). https://doi.org/10.1016/j.jclepro.2022.133246

Bovens, L. (2008). The Ethics of Nudge. *Preference Change: Approaches from Philosophy, Economics and Psychology*, 282.

Brécard, D., Hlaimi, B., Lucas, S., Perraudeau, Y., & Salladarré, F. (2009). Determinants of demand for green products: An application to eco-label demand for fish in Europe. *Ecological Economics*, *69*(1), 115–125. https://doi.org/10.1016/j.ecolecon.2009.07.017

Brody, S. D., & Ryu, H. C. (2006). Measuring the educational impacts of a graduate course on sustainable development. *Environmental Education Research*, *12*(2), 179–199.

https://doi.org/10.1080/13504620600688955

Brundtland, G. H. (1987). Report of the World Commission on Environment and Development: Our Common Future. In *World Commission on Environment and Development*. https://doi.org/10.9774/gleaf.978-1-907643-44-6_12

Bruns, H., Kantorowicz-Reznichenko, E., Klement, K., Luistro Jonsson, M., & Rahali, B. (2018). Can nudges be transparent and yet effective? *Journal of Economic Psychology*, *65*(February), 41–59. https://doi.org/10.1016/j.joep.2018.02.002

Burke, F. (2023). 5 years of Fridays for Future: Researchers say climate strikes bring slow but sure change. *European Science Communication Institute*.

Cai, C. W. (2020). Nudging the financial market? A review of the nudge theory. *Accounting and Finance*, *60*(4), 3341–3365. https://doi.org/10.1111/acfi.12471

Castleman, B. L., & Page, L. C. (2014). Freshman Year Financial Aid Nudges: An Experiment to Increase FAFSA Renewal and College Persistence Freshman Year Financial Aid Nudges FRESHMAN YEAR FINANCIAL AID NUDGES: AN EXPERIMENT TO INCREASE FAFSA RENEWAL. *Journal of Human Resources*, *29*. http://curry.virginia.edu/uploads/resourceLibrary/29_Freshman_Year_Financial_Aid_Nudges.pdfhttp://curry.virginia.edu/edpolicyworks/wp

Chang, H., Zhang, L., & Xie, G. X. (2015). Message framing in green advertising: The effect of construal level and consumer environmental concern. *International Journal of Advertising*, *34*(1), 158–176. https://doi.org/10.1080/02650487.2014.994731

Cheung, M. F. Y., & To, W. M. (2019). An extended model of value-attitude-behavior to explain Chinese consumers' green purchase behavior. *Journal of Retailing and Consumer Services*, *50*(April), 145–153. https://doi.org/10.1016/j.jretconser.2019.04.006

Congiu, L., & Moscati, I. (2022). A review of nudges: Definitions, justifications, effectiveness. *Journal of Economic Surveys*, *36*(1), 188–213. https://doi.org/10.1111/joes.12453

Conover, W. J., Johnson, M. E., & Johnson, M. M. (1981). A comparative study of tests for

homogeneity of variances, with applications to the outer continetal shelf bidding data. *Technometrics*, *23*(4), 351–361.

Cosic, A., Cosic, H., & Ille, S. (2018). Can nudges affect students' green behaviour? A field experiment. *Journal of Behavioral Economics for Policy*, *2*(1), 107–111.

Cozzio, C., Volgger, M., Taplin, R., & Woodside, A. G. (2020). Nurturing tourists' ethical food consumption: Testing the persuasive strengths of alternative messages in a natural hotel setting. *Journal of Business Research*, *117*(August 2019), 268–279. https://doi.org/10.1016/j.jbusres.2020.05.050

Croson, R., & Treich, N. (2014). Behavioral Environmental Economics: Promises and Challenges. *Environmental and Resource Economics*, *58*(October), 335–351.

de Ridder, D., Kroese, F., & van Gestel, L. (2022). Nudgeability: Mapping Conditions of Susceptibility to Nudge Influence. *Perspectives on Psychological Science*, *17*(2), 346–359. https://doi.org/10.1177/1745691621995183

Dhingra, N., Gorn, Z., Kener, A., & Dana, J. (2012). The default pull: An experimental demonstration of subtle default effects on preferences. *Judgment and Decision Making*, *7*(1), 69–76. https://doi.org/10.1017/s1930297500001844

Di Vaio, A., López-Ojeda, A., Manrique-de-Lara-Peñate, C., & Trujillo, L. (2022). The measurement of sustainable behaviour and satisfaction with services in cruise tourism experiences. An empirical analysis. *Research in Transportation Business and Management*, *45*(11). https://doi.org/10.1016/j.rtbm.2021.100619

Diamantopoulos, A., Schlegelmilch, B. B., Sinkovics, R. R., & Bohlen, G. M. (2003). Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. *Journal of Business Research*, *56*(6), 465–480. https://doi.org/10.1016/S0148-2963(01)00241-7

Dobruszkes, F. (2011). High-speed rail and air transport competition in Western Europe: A supply-oriented perspective. *Transport Policy*, *18*(6), 870–879. https://doi.org/10.1016/j.tranpol.2011.06.002

Dolnicar, S. (2020). Designing for more environmentally friendly tourism. *Annals of Tourism Research*, *84*(November 2019), 102933. https://doi.org/10.1016/j.annals.2020.102933

Ebert, P., & Freibichler, W. (2017). Nudge management: applying behavioural science to increase knowledge worker productivity. *Journal of Organization Design*, *6*(1), 1–6. https://doi.org/10.1186/s41469-017-0014-1

Esmark, A. (2019). Communicative governance at work: how choice architects nudge citizens towards health, wealth and happiness in the information age. *Public Management Review*, *21*(1), 138–158. https://doi.org/10.1080/14719037.2018.1473476

European Travel Commission. (2023). *EUROPEAN TOURISM : TRENDS & PROSPECTS Quarterly report (Q3/2023)*.

Fien, J., & Maclean, R. (2000). Teacher education for sustainability. II. Two teacher education projects from Asia and the Pacific. *Journal of Science Education and Technology*, *9*(1), 37–48. https://doi.org/10.1023/A:1009420923692

Fishbein, M., & Ajzen, I. (1977). *Belief, attitude, intention, and behavior: An introduction to theory and research.* Reading.

Forgas, J. P. (2011). Can negative affect eliminate the power of first impressions? Affective influences on primacy and recency effects in impression formation. *Journal of Experimental Social Psychology*, *47*(2), 425–429. https://doi.org/10.1016/j.jesp.2010.11.005

Franssens, S., Botchway, E., de Swart, W., & Dewitte, S. (2021). Nudging Commuters to Increase Public Transport Use: A Field Experiment in Rotterdam. *Frontiers in Psychology*, *12*(March), 1–7. https://doi.org/10.3389/fpsyg.2021.633865

Fritz, T., Lill, A., Meyer, A. N., Murphy, G. C., & Howe, L. (2023). Cultivating a Team Mindset about Productivity with a Nudge : A Field Study in Hybrid Development Teams. *Proceedings of the ACM on Human-Computer Interaction*, *7*(October). https://doi.org/10.1145/3610184

Garvey, A. M., & Bolton, L. E. (2017). Eco-Product choice cuths both ways: How pro-environmental licensing versus reinforcement is contingent upon environmental consciousness. *Journal of Public Policy & Marketing*, *36*(2), 284–298.

Goswami, I., & Urminsky, O. (2016). WHEN SHOULD THE ASK BE A NUDGE? THE EFFECT OF DEFAULT AMOUNTS ON CHARITABLE DONATIONS. *Journal of Marketing Research*, *53*(5), 829–846.

Guevara, S., & Julián, I. P. (2019). Sustainable Consumption and Production: A Crucial Goal for Sustainable Development—Reflections on the Spanish SDG Implementation Report. *Journal of Sustainability Research*, *1*(2), 1–21. https://doi.org/10.20900/jsr20190019

Han, T. I., & Stoel, L. (2017). Explaining Socially Responsible Consumer Behavior: A Meta-Analytic Review of Theory of Planned Behavior. *Journal of International Consumer Marketing*, *29*(2), 91–103. https://doi.org/10.1080/08961530.2016.1251870

Hansen, P. G., & Jespersen, A. M. (2013). Nudge and the manipulation of choice: A framework for the responsible use of the nudge approach to behaviour change in public policy. *European Journal of Risk Regulation*, *4*(1), 3–28. https://doi.org/10.1017/s1867299x00002762

Hardy, A., Beeton, R. J. S., & Pearson, L. (2002). Sustainable tourism: An overview of the concept and its position in relation to conceptualisations of tourism. *Journal of Sustainable Tourism*, *10*(6), 475–496. https://doi.org/10.1080/09669580208667183

Heinen, E., Maat, K., & Van Wee, B. (2011). The role of attitudes toward characteristics of bicycle commuting on the choice to cycle to work over various distances. *Transportation Research Part D: Transport and Environment*, *16*(2), 102–109. https://doi.org/10.1016/j.trd.2010.08.010

Holden, E., Linnerud, K., & Banister, D. (2014). Sustainable development: Our Common Future revisited. *Global Environmental Change*, *26*(1), 130–139. https://doi.org/10.1016/j.gloenvcha.2014.04.006

Hollingshead, A. B. (1996). The Rank-Order Effect in Group Decision Making. *Organizational*

Behavior and Human Decision Processes, *68*(3), 181–193. https://doi.org/10.1006/obhd.1996.0098

Howes, M., Wortley, L., Potts, R., Dedekorkut-Howes, A., Serrao-Neumann, S., Davidson, J., Smith, T., & Nunn, P. (2017). Environmental sustainability: A case of policy implementation failure? *Sustainability (Switzerland)*, *9*(2), 1–17. https://doi.org/10.3390/su9020165

Hummel, D., & Maedche, A. (2019). How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. *Journal of Behavioral and Experimental Economics* , *80*, 47–58. https://doi.org/10.1016/j.socec.2019.03.005

Janic, M. (2011). Assessing some social and environmental effects of transforming an airport into a real multimodal transport node. *Transportation Research Part D: Transport and Environment*, *16*(2), 137–149. https://doi.org/10.1016/j.trd.2010.10.002

Ji, X., Wu, G., Lin, J., Zhang, J., & Su, P. (2022). Reconsider policy allocation strategies: A review of environmental policy instruments and application of the CGE model. *Journal of Environmental Management*, *323*(September). https://doi.org/10.1016/j.jenvman.2022.116176

Kahneman, D. (2003). A Perspective on Judgment and Choice: Mapping Bounded Rationality. *American Psychologist*, *58*(9), 697–720. https://doi.org/10.1037/0003-066X.58.9.697

Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, *47*(2), 263–292. http://www.jstor.org/stable/1914185%5Cnhttp://www.jstor.org/%5Cnhttp://www.jstor.org/action/showPublisher?publisherCode=econosoc.%5Cnhttp://www.jstor.org

Keeble, B. R. (1988). The Brundtland Report: "Our Common Future." *Medicine and War*, *4*(1), 17–25. https://doi.org/10.1080/07488008808408783

Kim, H. L., & Hyun, S. S. (2021). The anchoring effect of aviation green tax for sustainable tourism, based on the nudge theory. *Journal of Sustainable Tourism*, *29*(7), 1082–1097. https://doi.org/10.1080/09669582.2020.1820017

Kim, Y., & Han, H. (2010). Intention to pay conventional-hotel prices at a green hotel - a modification of the theory of planned behavior. *Journal of Sustainable Tourism*, *18*(8), 997–1014. https://doi.org/10.1080/09669582.2010.490300

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, *8*(3), 239–260. https://doi.org/10.1080/13504620220145401

Kroese, F. M., Marchiori, D. R., & De Ridder, D. T. D. (2016). Nudging healthy food choices: A field experiment at the train station. *Journal of Public Health*, *38*(2), 133–137. https://doi.org/10.1093/pubmed/fdv096

Kurokawa, H., Igei, K., Kitsuki, A., Kurita, K., Managi, S., Nakamuro, M., & Sakano, A. (2023). Improvement impact of nudges incorporated in environmental education on students' environmental knowledge, attitudes, and behaviors. *Journal of Environmental Management*, *325*(PB), 116612. https://doi.org/10.1016/j.jenvman.2022.116612

Leary, R. B., Vann, R. J., Mittelstaedt, J. D., Murphy, P. E., & Sherry, J. F. (2014). Changing the marketplace one behavior at a time: Perceived marketplace influence and sustainable consumption. *Journal of Business Research*, *67*(9), 1953–1958. https://doi.org/10.1016/j.jbusres.2013.11.004

Lee, E. J., Choi, H., Han, J., Kim, D. H., Ko, E., & Kim, K. H. (2020). How to "Nudge" your consumers toward sustainable fashion consumption: An fMRI investigation. *Journal of Business Research*, *117*(December 2018), 642–651. https://doi.org/10.1016/j.jbusres.2019.09.050

Legault, L., & Pelletier, L. G. (2000). Impact of an environmental education program on students' and parents' attitudes, motivation, and behaviours. *Canadian Journal of Behavioural Science*, *32*(4), 243.

Lehner, M., Mont, O., & Heiskanen, E. (2016). Nudging – A promising tool for sustainable consumption behaviour? *Journal of Cleaner Production*, *134*, 166–177. https://doi.org/10.1016/j.jclepro.2015.11.086

Leiserowitz, A. A., Kates, R. W., & Parris, T. M. (2005). Do global attitudes and behaviors support sustainable development? *Environment*, *47*(9), 22–38. https://doi.org/10.3200/ENVT.47.9.22-38

Levy, J. S. (1992). *An Introduction to Prospect Theory Author (s): Jack S . Levy Source : Political Psychology , Jun ., 1992 , Vol . 13 , No . 2 , Special Issue : Prospect Theory and Political Psychology (Jun ., 1992), pp . 171-186 Published by : International Society of*. *13*(2), 171–186.

Lin, Y., Osman, M., & Ashcroft, R. (2017). Nudge: Concept, Effectiveness, and Ethics. *Basic and Applied Social Psychology*, *39*(6), 293–306. https://doi.org/10.1080/01973533.2017.1356304

Lindzen, R. S. (1994). Climate Dynamics and Global Change. *Annual Review of Fluid Mechanics*, *26*(1), 353–378. https://doi.org/10.1146/annurev.fl.26.010194.002033

Loidl, M., Kaziyeva, D., Wendel, R., Luger-Bazinger, C., Seeber, M., & Stamatopoulos, C. (2023). Unlocking the Potential of Digital, Situation-Aware Nudging for Promoting Sustainable Mobility. *Sustainability (Switzerland)*, *15*(14). https://doi.org/10.3390/su151411149

Luzecka, P. (2016). "Take a gap year!" A social practice perspective on air travel and potential transitions towards sustainable tourism mobility. *Journal of Sustainable Tourism*, *24*(3), 446–462. https://doi.org/10.1080/09669582.2015.1115513

Macovei, O.-I. (2015). Applying the Theory of Planned Behavior in Predicting Pro-environmental Behavior: The Case of Energy Conservation. *Economica*, *11*(4), 15–32.

Maibach, E. W., Nisbet, M., Baldwin, P., Akerlof, K., & Diao, G. (2010). Reframing climate change as a public health issue: an exploratory study of public reactions. *BMC Public Health*, *10*(1), 299.

Malhotra, N. K., Nunan, D., & Birks, D. F. (2017). *Marketing research: An applied approach*. Pearson.

Malichová, E., Cornet, Y., & Hudák, M. (2022). Travellers' use and perception of travel time in long-distance trips in Europe. *Travel Behaviour and Society*, *27*(October 2020), 95–106. https://doi.org/10.1016/j.tbs.2021.12.003

Mary, S. R., & Pour, M. H. (2022). A model of travel behaviour after COVID-19 pandemic: TripAdvisor reviews. *Current Issues in Tourism*, *25*(7), 1033–1045. https://doi.org/10.1080/13683500.2022.2039596

Matiza, T. (2020). Post-COVID-19 crisis travel behaviour: towards mitigating the effects of perceived risk. *Journal of Tourism Futures*, *8*(1), 99–108. https://doi.org/10.1108/JTF-04-2020-0063

McDermott, R., Fowler, J. H., & Smirnov, O. (2008). On the evolutionary origin of prospect theory preferences. *Journal of Politics*, *70*(2), 335–350. https://doi.org/10.1017/S0022381608080341

Mehrtens, J., Cragg, P. B., & Mills, A. M. (2001). A model of Internet adoption by SMEs. *Information and Management*, *39*(3), 165–176. https://doi.org/10.1016/S0378-7206(01)00086-6

Mihelcic, J. R., Crittenden, J. C., Small, M. J., Shonnard, D. R., Hokanson, D. R., Zhang, Q., Chen, H., Sorby, S. A., James, V. U., Sutherland, J. W., & Schnoor, J. L. (2003). Sustainability Science and Engineering: The Emergence of a New Metadiscipline. *Environmental Science and Technology*, *37*(23), 5314–5324. https://doi.org/10.1021/es034605h

Moldan, B., Janoušková, S., & Hák, T. (2012). How to understand and measure environmental sustainability: Indicators and targets. *Ecological Indicators*, *17*, 4–13. https://doi.org/10.1016/j.ecolind.2011.04.033

Möllenkamp, M., Zeppernick, M., & Schreyögg, J. (2019). The effectiveness of nudges in improving the self-management of patients with chronic diseases: A systematic literature review. *Health Policy*, *123*(12), 1199–1209. https://doi.org/10.1016/j.healthpol.2019.09.008

Momsen, K., & Stoerk, T. (2014). From intention to action: Can nudges help consumers to choose renewable energy? *Energy Policy*, *74*(C), 376–382. https://doi.org/10.1016/j.enpol.2014.07.008

Muñoz, B., Monzon, A., & López, E. (2016). Transition to a cyclable city: Latent variables affecting bicycle commuting. *Transportation Research Part A: Policy and Practice*, *84*, 4–17. https://doi.org/10.1016/j.tra.2015.10.006

Münscher, R., Vetter, M., & Scheuerle, T. (2016). A Review and Taxonomy of Choice Architecture Techniques. *Journal of Behavioral Decision Making*, *29*(5), 511–524. https://doi.org/10.1002/bdm.1897

Murgea, A. (2022). "To Nudge or Not to Nudge": Public Policies and People's Resistance to Change. *Ovidius University Annals, Economic Sciences Series*, *XXII*(2), 395–403.

Murray, J. (2018). Student-led action for sustainability in higher education: a literature review. *International Journal of Sustainability in Higher Education*, *19*(6), 1095–1110. https://doi.org/10.1108/IJSHE-09-2017-0164

Mwale, M., Luke, R., & Pisa, N. (2022). Factors that affect travel behaviour in developing cities: A methodological review. *Transportation Research Interdisciplinary Perspectives*, *16*(September), 100683. https://doi.org/10.1016/j.trip.2022.100683

Nelson, K. M., Bauer, M. K., & Partelow, S. (2021). Informational Nudges to Encourage Pro-environmental Behavior: Examining Differences in Message Framing and Human Interaction. *Frontiers in Communication*, *5*(February), 1–15. https://doi.org/10.3389/fcomm.2020.610186

Norman, D. A. (1988). *The psychology of everyday things*. Basic books.

Oh, G. E., van der Lans, R., & Mukhopadhyay, A. R. (2022). Choice Architecture Effects on Indulgent Consumption: Evidence from Combinations of Nudges at an Ice-Cream Store. *Journal of the Association for Consumer Research*, *7*(4), 450–460. https://doi.org/10.1086/720454

Onel, N. (2020). Explaining Sustainable Consumption: A Theoretical and Empirical Analysis: An Abstract. In *Marketing Opportunities and Challenges in a Changing Global Marketplace* (pp. 85–86). Springer International Publishing.

Ovais, D. (2023). Students' sustainability consciousness with the three dimensions of sustainability: Does the locus of control play a role? *Regional Sustainability*, *4*(1), 13–27. https://doi.org/10.1016/j.regsus.2023.02.002

Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. McGraw-Hill Education.

Ploug, T., Holm, S., & Brodersen, J. (2012). To nudge or not to nudge: Cancer screening programmes and the limits of libertarian paternalism. *Journal of Epidemiology and Community Health*, *66*(12), 1193–1196. https://doi.org/10.1136/jech-2012-201194

Policastro, P., Smith, Z., & Chapman, G. (2017). Put the healthy item first: Order of ingredient listing influences consumer selection. *Journal of Health Psychology*, *22*(7), 853–863. https://doi.org/10.1177/1359105315617328

Poortinga, W., Steg, L., & Vlek, C. (2004). Values, environmental concern, and environmental behavior: A study into household energy use. *Environment and Behavior*, *36*(1), 70–93. https://doi.org/10.1177/0013916503251466

Quental, N., Lourenço, J. M., & Da Silva, F. N. (2011). Sustainable development policy: Goals, targets and political cycles. *Sustainable Development*, *19*(1), 15–29. https://doi.org/10.1002/sd.416

Quoquab, F., & Mohammad, J. (2020). A Review of Sustainable Consumption (2000 to 2020): What We Know and What We Need to Know. *Journal of Global Marketing*, *33*(5), 305–334. https://doi.org/10.1080/08911762.2020.1811441

Reisch, L. A. (2023). Behavioral economics. *Dictionary of Ecological Economics: Terms for the New Millennium*, *3*, 26–27. https://doi.org/10.4337/9781788974912.B.5

Rey, A., Le Goff, K., Abadie, M., & Courrieu, P. (2020). The primacy order effect in complex

decision making. *Psychological Research*, *84*(6), 1739–1748. https://doi.org/10.1007/s00426-019-01178-2

Ritter, W., & Schafer, C. (1998). Cruise-Tourism: A Chance of Sustainability. *Tourism Recreation Research*, *23*(1), 65–71. https://doi.org/10.1080/02508281.1998.11014821

Roy, M. (2021). *Sustainable Development Strategies: Engineering, Culture and Economics*. Butterworth-Heinemann.

Ruangkanjanases, A., You, J. J., Chien, S. W., Ma, Y., Chen, S. C., & Chao, L. C. (2020). Elucidating the Effect of Antecedents on Consumers' Green Purchase Intention: An Extension of the Theory of Planned Behavior. *Frontiers in Psychology*, *11*(July), 1–13. https://doi.org/10.3389/fpsyg.2020.01433

Saghai, Y. (2013). Salvaging the concept of nudge. *Journal of Medical Ethics*, *39*(8), 487–493. https://doi.org/10.1136/medethics-2012-100727

Schmitt, L., Currie, G., & Delbosc, A. (2013). Measuring the impact of unfamiliar transit travel using a university access survey. *Transport Policy*, *30*, 301–307. https://doi.org/10.1016/j.tranpol.2013.09.003

Scholz, E., Jutz, R., & Heller, M. (2011). ISSP 2010 Germany: National Identity III; GESIS Report on the German Study. *GESIS-Technical Reports*.

Schultz, P. W., Gouveia, V. V., Cameron, L. D., Tankha, G., Schmuck, P., & Franěk, M. (2005). Values and their relationship to environmental concern and conservation behavior. *Journal of Cross-Cultural Psychology*, *36*(4), 457–475. https://doi.org/10.1177/0022022105275962

Selinger, E., & Whyte, K. (2011). Is There a Right Way to Nudge? The Practice and Ethics of Choice Architecture. *Sociology Compass*, *5*(10), 923–935. https://doi.org/10.1111/j.1751-9020.2011.00413.x

Siipi, H., & Koi, P. (2022). The Ethics of Climate Nudges: Central Issues for Applying Choice Architecture Interventions to Climate Policy. *European Journal of Risk Regulation*, *13*(2),

218–235. https://doi.org/10.1017/err.2021.49

Singh, R. K., Murty, H. R., Gupta, S. K., & Dikshit, A. K. (2009). An overview of sustainability assessment methodologies. *Ecological Indicators*, *9*(2), 189–212. https://doi.org/10.1016/j.ecolind.2008.05.011

Sirignano, J., & Spiliopoulos, K. (2020). Mean field analysis of neural networks: A central limit theorem. *Stochastic Processes and Their Applications*, *130*(3), 1820–1852. https://doi.org/10.1016/j.spa.2019.06.003

Smith, M., Ikeda, E., Hawley, G., Mavoa, S., Hosking, J., Egli, V., Zhao, J., Mackay, L., Donnellan, N., Amann, R., Mackie, H., & Witten, K. (2020). An integrated conceptual model of environmental needs for New Zealand children's active travel to school: Environmental needs for active school travel. *Journal of Transport and Health*, *16*(August 2019), 100814. https://doi.org/10.1016/j.jth.2019.100814

Staniškis, J. K. (2012). Sustainable consumption and production: How to make it possible. *Clean Technologies and Environmental Policy*, *14*(6), 1015–1022. https://doi.org/10.1007/s10098-012-0535-9

Statman, M. (2013). Mandatory Retirement Savings. *Financial Analysts Journal*, *March*. https://doi.org/10.2139/ssrn.2230546.This

Stern, P. C. (2000). Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, *56*(3), 407–424.

Stir, J. (2006). Restructuring teacher education for sustainability: student involvement through a "strengths model." *Journal of Cleaner Production*, *14*(9–11), 830–836. https://doi.org/10.1016/j.jclepro.2005.11.051

Streiner, D. L. (2003). Starting at the Beginning An Introduction. In *Journal of personality assessment* (Vol. 80, Issue 1, pp. 99–103).

Sunstein, C. R. (2016). People prefer system 2 nudges (kind of). *Duke Law Journal*, *66*(1), 121–168. https://doi.org/10.2139/ssrn.2731868

Sunstein, C. R., Reisch, L. A., & Kaiser, M. (2019). Trusting nudges? Lessons from an international survey. *Journal of European Public Policy*, *26*(10), 1417–1443. https://doi.org/10.1080/13501763.2018.1531912

Sustainable Development Commission. (2006). *I will if you will: towards sustainable consumption*.

Swain, R. B. (2018). A Critical Analysis of the Sustainable Development Goals. *World Sustainability Series*, 341–355. https://doi.org/10.1007/978-3-319-63007-6_20

Thaler, R. H. (2018). From cashews to nudges: The evolution of behavioral economics. *American Economic Review*, *108*(6), 1265–1287. https://doi.org/10.1257/aer.108.6.1265

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving Decisions about Health, Wealth and Happiness*. England: Penguin Books.

Thaler, R. H., Sunstein, C. R., & Balz, J. P. (2013). Choice Architecture. In *The Behavioral Foundations of Public Policy*. https://doi.org/10.1002/hast.997

Townsend, S. (2023). *Busting The Sustainability Value-Action Gap*. Forbes. https://www.forbes.com/sites/solitairetownsend/2023/07/26/busting-the-sustainability-value-action-gap/?sh=1d1ea01865ec

Tukker, A., Cohen, M. J., Hubacek, K., & Mont, O. (2010). Sustainable consumption and production. *Journal of Industrial Ecology*, *14*(1), 1–3. https://doi.org/10.1111/j.1530-9290.2009.00214.x

Tukker, A., Emmert, S., Charter, M., Vezzoli, C., Sto, E., Munch Andersen, M., Geerken, T., Tischner, U., & Lahlou, S. (2008). Fostering change to sustainable consumption and production: an evidence based view. *Journal of Cleaner Production*, *16*(11), 1218–1225. https://doi.org/10.1016/j.jclepro.2007.08.015

Tversky, A., & Kahneman, D. (1992). Advances in Prospect Theory: Cumulative Representation of Uncertainty. *Journal of Risk and Uncertainty*, *35*(5), 297–323. https://doi.org/10.15358/0340-1650-2006-6-331

Tyers, R. (2018). Nudging the jetset to offset: voluntary carbon offsetting and the limits to nudging. *Journal of Sustainable Tourism*, *26*(10), 1668–1686. https://doi.org/10.1080/09669582.2018.1494737

Vallgårda, S. (2012). Nudge-A new and better way to improve health? *Health Policy*, *104*(2), 200–203. https://doi.org/10.1016/j.healthpol.2011.10.013

van de Velde, L., Verbeke, W., Popp, M., & van Huylenbroeck, G. (2010). The importance of message framing for providing information about sustainability and environmental aspects of energy. *Energy Policy*, *38*(10), 5541–5549. https://doi.org/10.1016/j.enpol.2010.04.053

Vandenbroele, J., Vermeir, I., Geuens, M., Slabbinck, H., & Van Kerckhove, A. (2020). Nudging to get our food choices on a sustainable track. *Proceedings of the Nutrition Society*, *79*(1), 133–146. https://doi.org/10.1017/S0029665119000971

Vergragt, P. J., Dendler, L., de Jong, M., & Matus, K. (2016). Transitions to sustainable consumption and production in cities. *Journal of Cleaner Production*, *134*(Part A), 1–12. https://doi.org/10.1016/j.jclepro.2016.05.050

Vicedo-Cabrera, A. M., Guo, Y., Sera, F., Huber, V., Schleussner, C. F., Mitchell, D., Tong, S., Coelho, M. de S. Z. S., Saldiva, P. H. N., Lavigne, E., Correa, P. M., Ortega, N. V., Kan, H., Osorio, S., Kyselý, J., Urban, A., Jaakkola, J. J. K., Ryti, N. R. I., Pascal, M., … Gasparrini, A. (2018). Temperature-related mortality impacts under and beyond Paris Agreement climate change scenarios. *Climatic Change*, *150*(3–4), 391–402. https://doi.org/10.1007/s10584-018-2274-3

Wachner, J., Adriaanse, M., & De Ridder, D. (2021). The influence of nudge transparency on the experience of autonomy. *Comprehensive Results in Social Psychology*, *5*(1–3), 49–63. https://doi.org/10.1080/23743603.2020.1808782

Wallis, H., & Loy, L. S. (2021). What drives pro-environmental activism of young people? A survey study on the Fridays For Future movement. *Journal of Environmental Psychology*, *74*(March), 101581. https://doi.org/10.1016/j.jenvp.2021.101581

Wang, C., Ghadimi, P., Lim, M. K., & Tseng, M. (2019). A literature review of sustainable

consumption and production : A comparative analysis in developed and developing economies. *Journal of Cleaner Production*, *206*, 741–754. https://doi.org/10.1016/j.jclepro.2018.09.172

White, K., MacDonnell, R., & Dahl, D. W. (2011). It' s the Mind-Set that Matters: The Role of Construal Level and Message Framing in influencing Consumer Efficacy and Conservation Behaviors. *Journal of Marketing Research*, *48*, 472–485.

Whyte, K. P., Selinger, E., Caplan, A. L., & Sadowski, J. (2012). Nudge, nudge or shove, shove-the right way for nudges to increase the supply of donated cadaver organs. *American Journal of Bioethics*, *12*(2), 32–39. https://doi.org/10.1080/15265161.2011.634484

Wu, S.-I., & Chen, J.-Y. (2014). A Model of Green Consumption Behavior Constructed by the Theory of Planned Behavior. *International Journal of Marketing Studies*, *6*(5), 119–132. https://doi.org/10.5539/ijms.v6n5p119

Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production*, *48*, 126–138. https://doi.org/10.1016/j.jclepro.2012.11.030

Appendices

Appendix 1: Research survey

Start of Block: Introduction Sentence

Welcome and thank you for participating in this survey as part of my master thesis at Católica Lisbon School of Business and Economics.

This study consists of one decision scenario and some questions. I kindly ask you to answer them as honestly as possible. It will take around 5 minutes to complete this survey. All answers are anonymous and the collected information will be only used for research purposes. There are no "right" or "wrong" answers. The participation in this study is voluntary and you can stop it at any time, by closing the web page. If you have any concerns or questions about this study, please contact me: Philipp Maul (s-pmaul@ucp.pt)

Q1 What is your gender?

o Male

o Female

o Other

_____

o Prefer not to say

Q2 How old are you?

_____

Q3 In which country do you currently reside?

▼ Afghanistan (1) ... Zimbabwe (1357)

Q4 What is your highest level of education?

o Less than highschool degree

o High school degree or equivalent

o Some college but no degree

o Bachelor's degree or equivalent

o Master's degree

o Doctoral degree

o Other (Please specify)

_____

Q5 What is your current employment status?

o Employed

o Unemployed

o Student

o Worker and Student

o Retired

o Other (Please specify)

_____

Q6 Think of a ladder as representing where people stand in your country's society. At the top of the ladder (rung 10) are the people who are the best off – those who have the most money, the most education, and the most respected jobs. At the bottom (rung 1) are the people who are the worst off – those who have the least money, least education, the least respected jobs, or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom.

1 2 3 4 5 6 7 8 9 10

Where would you place yourself on this ladder, where 1 = worst off and 10 = best off? ()	

Below, you will read a few statements. Please indicate the extent to which you agree or disagree with each statement.

Q7 For the good of the environment, we should be all willing to reduce our current standard of living.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q8 Through our way of life, we are also responsible for many environmental problems in other countries.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q9 Our consumption of resources should be no greater than the rate of replenishment.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q10 I believe the use of the car does a great deal of damage to the environment.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q11 I believe that there is no point in doing my bit for the environment if other people do not behave in the same way.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q12 I see myself as a sustainable person.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

You are now going to be presented with one scenario. Please try to imagine yourself in the situation and answer as realistically as possible. Thank you very much!

Q14 Scenario: Traveling from Cologne to Munich (Control Group)

Imagine yourself in a scenario where you are planning a weekend trip from Cologne to Munich to visit some friends. During the planning process you must choose between several travel

options. You can either fly from Cologne, take the car or use the train. You must travel a distance about 570km. Please find below the information for the trip.

Option	Duration
Airplane	1h
Car	5h30
Train	4h30

Q15 Based on the description above, which transport option would you choose?

▼ Car (1) ... Airplane (3)

Q16 Scenario: Traveling from Cologne to Munich (Framed Information Group)

Imagine yourself in a scenario where you are planning a weekend trip from Cologne to Munich to visit some friends. During the planning process you must choose between several travel options. You can either fly from Cologne, take the car or use the train. You must travel a distance about 570km. Please find below the information for the trip.

Option	Duration	Footprint
Airplane	1h	113.5kg CO2e
Car	5h30	-31.8kg CO2e
Train	4h30	-112.8kg CO2e

Q17 Based on the description above, which transport option would you choose?

▼ Car (1) ... Airplane (3)

Q18 Scenario: Traveling from Cologne to Munich (Combination of Nudges Group)

Imagine yourself in a scenario where you are planning a weekend trip from Cologne to Munich to visit some friends. During the planning process you must choose between several travel options. You can either fly from Cologne, take the car or use the train. You must travel a distance about 570km. Please find below the information for the trip.

Option	Duration	Footprint
Train	4h30	0.7kg CO2e
Car	5h30	81.7kg CO2e
Airplane	1h	113.5kg CO2e

Q19 Based on the description above, which transport option would you choose?

▼ Car (1) ... Airplane (3)

Q20 I believe I performed well in this task.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q21 I am confident with my answer.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q22 I feel confident to recommend a decision to a friend of mine.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q23 To make sure you read this question carefully, please select "Somewhat agree".

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q24 To see as much of the world as possible, I like to go on holiday to other countries.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q25 I could imagine using public transportation for the trip.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q26 For my everyday transportation, I use the bicycle, public transport or walk.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q27 Even if public transport is available, I take the car because it is more convenient.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q28 I am aware that my transport behaviour has an influence on climate change due to the greenhouse effect.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q29 I am willing to contribute to environmental protection by using public transport.

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

During the survey I used nudges to try to influence your decision to a more sustainable outcome. Nudging is a behaviour change strategy: getting people to choose a desired behaviour without coercion.

Q31 Would you feel comfortable if websites, travel agencies, etc. would use nudges to influence to a more sustainable outcome?

o Strongly disagree

o Somewhat disagree

o Neither agree nor disagree

o Somewhat agree

o Strongly agree

Q32 Answering the questions of this study was...

o Extremely difficult

o Somewhat difficult

o Neither easy nor difficult

o Somewhat easy

o Extremely easy

Q33 Imagining the previously described scenario was...

o Extremely difficult

o Somewhat difficult

o Neither easy nor difficult

o Somewhat easy

o Extremely easy

Q34 How much attention did you pay during this survey?

o None at all

o A little

o A moderate amount

o A lot

o A great deal

Q41 Do you have any comments you would like to share with the researcher? *If so, please write them in the box below. Otherwise just leave it blank.*

_____

Appendix 2: Sociodemographic overview of the participants

Table 6

Sociodemographic Responses per Group

	Control *(n=37)*	**Treatment 1** *(n=38)*	**Treatment 2** *(n=35)*
Gender, (%)			
Male	16 (43.2)	15 (39.5)	19 (54.3)
Female	20 (54.1)	23 (60.5)	16 (45.7)
Prefer not to say	1 (2.7)	0	0
Age, (%)			
<20	0	0	0
20 till 35	32 (86.5)	34 (89.5)	30 (85.7)
35 till 50	2 (5.4)	2 (5.3)	2 (5.7)
50 till 65	3 (8.1)	1 (2.6)	3 (8.6)
<65	0	1 (2.6)	0
Country of Residence, (%)			
Australia	1 (2.7)	0	0
Austria	2 (5.4)	1 (2.6)	0
Belgium	0	0	1 (2.9)
Brazil	1 (2.7)	1 (2.6)	0
Burkina Faso	1 (2.7)	0	0
Canada	0	2 (5.3)	1 (2.9)
Fiji	0	0	1 (2.9)
Finland	0	1 (2.6)	0
France	1 (2.7)	1 (2.6)	2 (5.7)
Germany	24 (64.9)	24 (63.2)	21 (60.0)
Italy	0	0	1 (2.9)
Portugal	5 (13.5)	7 (18.4)	6 (17.1)
Singapore	1 (2.7)	0	0
United Kingdom of Great Britain and Northern Ireland	1 (2.7)	1 (2.6)	1 (2.9)
United States of America	0	0	2 (5.7)

Education, (%)			
Bachelor's degree or equivalent	21 (56.8)	22 (57.9)	21 (60.0)
Doctoral degree	2 (5.4)	0	0
High school degree or equivalent	2 (5.4)	0	2 (5.7)
Less than highschool degree	1 (2.7)	1 (2.6)	1 (2.9)
Master's degree	9 (24.3)	12 (31.6)	7 (20.0)
Some college but no degree	2 (5.4)	3 (7.9)	4 (11.4)
Employment Status, (%)			
Employed	14 (37.8)	15 (39.5)	13 (37.1)
Retired	2 (5.4)	1 (2.6)	0
Student	11 (29.7)	11 (28.9)	10 (28.6)
Unemployed	0	1 (2.6)	1 (2.9)
Worker and Student	10 (27.1)	10 (26.3)	11 (31.4)
MacArthur Scale of Subjective Social Status, (%)			
2	0	0	2 (5.8)
3	1 (2.7)	2 (5.3)	1 (2.9)
4	0	1 (2.6)	1 (2.9)
5	2 (5.4)	5 (13.2)	1 (2.9)
6	9 (24.3)	8 (21.1)	6 (17.1)
7	13 (35.1)	12 (31.6)	10 (28.6)
8	8 (21.6)	5 (13.2)	9 (25.7)
9	3 (8.1)	4 (10.5)	5 (14.3)
10	0	1 (2.6)	0

Appendix 3: Normality Test

Table 7

Shapiro-Wilk test for normality

	Variables	***Statistic***	***Sig.***	***Decision***
Soziodemographic	Gender	.670	.000	Rej. H0
	Age	.590	.000	Rej. H0
	Educational Degree	.790	.000	Rej. H0
	Employment Status	.805	.000	Rej. H0
	Social Status	.923	.000	Rej. H0
Independent	Groups	.531	.000	Rej. H0
	SC (Meancentered)	.922	.000	Rej. H0
Dependent	Dummy sustainable choice	.557	.000	Rej. H0

Note: H0 = Variables follow a normal distribution. Decision at a 5% significance level.

Appendix 4: Homogeneity Test

Table 8

Levene's test for homogeneity of variances

	Variables	*df*	*Statistic*	*Sig.*	*Decision*
Soziodemographic	Gender	2	.199	.819	Not Rej. H0
	Age	2	.072	.931	Not Rej. H0
	Educational Degree	2	.265	.768	Not Rej. H0
	Employment Status	2	.039	.962	Not Rej. H0
	Social Status	2	.758	.471	Not Rej. H0
Independent	Groups	2	.274	.793	Not Rej. H0
	SC (Meancentered)	2	.083	.921	Not Rej. H0
Dependent	Dummy sustainable choice	2	2.274	.108	Not Rej. H0

Note: H0 = Variables have equal variances across groups. Decision at a 5% significance level.

Appendix 5: One-Way ANOVA for Sociodemographic Variables

Table 9

One-Way ANOVA for Gender

	Df	*Sum SQ*	*Mean SQ*	*F-Value*	*p-value*
Between Groups	2	.489	.245	.912	.405
Within Groups	107	28.684	.268		
Total	109	29.173			

Note: H0 = There are no differences between the mean values of the individual groups. Decision at a 5% significance level.

Table 10

One-Way ANOVA for Age

	Df	*Sum SQ*	*Mean SQ*	*F-Value*	*p-value*
Between Groups	2	45	22.45	.187	.83
Within Groups	107	12865	120.23		
Total	109	12910			

Note: H0 = There are no differences between the mean values of the individual groups. Decision at a 5% significance level.

Table 11

One-Way ANOVA for Educational Degree

	Df	***Sum SQ***	***Mean SQ***	***F-Value***	***p-value***
Between Groups	2	1.51	.755	.937	.395
Within Groups	107	86.16	.805		
Total	109	87.67			

Note: H0 = There are no differences between the mean values of the individual groups. Decision at a 5% significance level.

Table 12

One-Way ANOVA for Employment Status

	Df	***Sum SQ***	***Mean SQ***	***F-Value***	***p-value***
Between Groups	2	.28	.142	.08	.923
Within Groups	107	190.89	1.784		
Total	109	191.17			

Note: H0 = There are no differences between the mean values of the individual groups. Decision at a 5% significance level.

Table 13

One-Way ANOVA for Social Status

	Df	***Sum SQ***	***Mean SQ***	***F-Value***	***p-value***
Between Groups	2	2.56	1.279	.502	.607
Within Groups	107	272.50	2.547		
Total	109	275.06			

Note: H0 = There are no differences between the mean values of the individual groups. Decision at a 5% significance level.

Appendix 6: One-Way ANOVA for the Choice of the Transportation Mode

Table 14

One-Way ANOVA for the Dummy Sustainable Transportation Mode

	Df	*Sum SQ*	*Mean SQ*	*F-Value*	*p-value*
Between Groups	2	.89	.445	4.274	.036
Within Groups	107	20.93	.196		
Total	109	21.82			

Note: H0 = There are no differences between the mean values of the individual groups. Decision at a 5% significance level.

Appendix 7: Comparison of the Means for the Choice of the Transportation Mode

Table 15

Comparison of the Means for Dummy Sustainable Transportation Mode

	n	*Mean*	*SD*	*Median*	*Trimmed*	*Min*	*Max*
Control Group	37	.65	.48	1	.68	0	1
Framed Nudge Group	38	.68	.47	1	.72	0	1
Framed Nudge & Order Effect Group	35	.86	.36	1	.93	0	1

Appendix 8: Planned Contrast for the Choice of the Transportation Mode

Table 16

Planned Contrast for Transportation Mode

	Case	*Df*	*Sum Sq*	*Mean Sq*	*F-Value*	*P-Value*
Control vs. Single	2	1	2.68	2.68	2.778	.067
Single vs. Combination	3	1	2.69	2.69	5.549	.020
Combination vs. Control	1	1	2.364	2.364	6.483	.001

Note: Decision at a 5% significance level.