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# Digital nudging in air travel:

## An exploration of its impact on passenger sustainable behaviours

Master thesis 15 HEC, course INFM10 in Information Systems

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ABSTRACT (MAX. 200 WORDS):

The aviation industry contributes to greenhouse gas emissions, demanding the adoption of sustainable practices. Digital nudging, described as the use of design elements in user interfaces to guide decision-making, can encourage sustainability in aviation. This research aims to explore the perceptions and responses of passengers towards digital nudges aimed at promoting sustainable behaviour in air travel. Previous research in this area shows a knowledge gap by only using experimental methodologies. Therefore, we conducted qualitative semi-structured interviews to gain insights on passenger perspectives. Our findings reveal novel factors influencing the effectiveness of digital nudges in promoting sustainable decision-making in air travel, such as the importance of information availability, motivation from observing the impact of sustainable choices, trust in airline reputation, the significance of additional services, and design factors. The study also highlights the need to balance personal, environmental, and behavioural factors and adherence to ethical guidelines to increase the digital nudge effectiveness. Overall, despite mixed feelings, participants express a willingness to explore digital nudging's potential. This research contributes to existing IS research by providing valuable insights for interface designers and IS researchers, thereby promoting sustainability in air travel.

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# 1 Introduction

*This section describes the background and the problem of the study, research question, purpose, and potential delimitations.*

## 1.1 Background

The aviation sector, pivotal for economic growth and societal well-being, is also a significant contributor to climate change (Lee et al., 2009). Worldwide, aviation contributes approximately 2% to global greenhouse gas emissions while also supporting 8% of the world's economic activity in terms of Gross Domestic Product (GDP) (Bailey et al., 2023). Meske et al. (2022) claim that passenger flights contribute around 4–5% of the total global greenhouse gas emissions and represent one of the rapidly increasing sources of human-made emissions. Studies claim that during the COVID-19 pandemic, the ICT sector exhibited potential environmental benefits by reducing work-related travel (Meske et al., 2022). As climate change intensifies, there's an urgent need for the aviation sector to adopt sustainable practices to mitigate its environmental impact (Lee et al., 2009). While significant strides in technology are underway, one avenue for addressing sustainability in aviation involves influencing passengers towards more sustainable flight booking behaviours (Meske et al., 2022). Behavioural change, in this context, involves modifying actions to diminish environmental impacts. While reducing flights is an option, it is crucial to acknowledge the social and economic significance of air travel. Rather than solely questioning whether to fly, the emphasis is on exploring methods to minimize environmental impacts through how we choose to fly.

Digital nudging is a behavioural design intervention defined as “a subtle form of using design, information, and interaction elements to guide user behaviour in digital environments, without restricting the individual’s freedom of choice” (Meske & Potthoff, 2017). The field of digital nudging research is rapidly expanding, and many studies have highlighted the efficiency and power of nudging interventions in prompting environmentally friendly choices across diverse contexts (Loidl et al., 2023). In a context of 'Green Nudges' within legal and ethical frameworks, nudges prove to be an effective mechanism for translating laws and regulations into actionable behaviours for change (Loidl et al., 2023). Also given the surge in flight bookings through online platforms, digital nudging emerges as a promising approach to address the escalating emissions linked to aviation.

The objective of this research is to explore the pivotal role of digital nudging in shaping passenger’s behaviours toward sustainability in air travel, a domain where a dearth of exploration exists. Investigating how these subtle digital nudges, integrated within airline interfaces, influence decisions on carbon offset programs, eco-friendly choices, and travel habits promises to revolutionize the aviation sector towards sustainability (Meske et al. 2022). The study's implications extend beyond the aviation industry, aligning with global sustainability agendas. By dissecting behavioural dimensions in air travel sustainability, this research contributes to United Nations Sustainable Development Goals, notably climate action and responsible consumption and production, offering pathways to cultivate a more eco-conscious travel culture.

## 1.2 Problem

Individuals encounter choices every day, and the result of each choice is shaped not only by rational considerations of the available options, but also subconsciously by the design of the choice environment in which the information is presented (Weinmann et al., 2016). With the technological advancements in recent decades, decisions are increasingly made on digital interfaces, and nudging has also transitioned to the digital environment through the use of information systems (Zimmermann et al., 2021). Using digital nudges can be particularly effective in promoting changes in behaviour (Zimmermann et al., 2021). Since the design of digital choice environments consistently affects people's choices, whether intentionally or unintentionally, understanding the impacts of digital nudges within these settings can help designers in guiding users toward the most desirable choice (Weinmann et al., 2016).

Most of the research on nudging has been conducted in offline settings (Weinmann et al., 2016), the emerging concept of digital nudging is gaining prominence in recent information systems literature (Zimmermann et al., 2021). Though the nudging mechanisms remain the same in digital contexts, there are notable differences for choice architecture alterations and the effects of the respective nudges (Zimmermann et al., 2021).

Digital nudging is interdisciplinary in nature, and the concept extends to various research fields (Zimmermann et al., 2021). Digital nudging for sustainable behaviour changes is examined in psychology, business and marketing, and in environmental sustainability (Zimmermann et al., 2021). In past research there have been mixed results on the effectiveness of digital nudges, primarily assigned to contextual factors such as the targeted groups, timeframe, and the application field (Zimmermann et al., 2021).

For now, there remains limited research on digital nudging for promoting sustainable behaviour in air travel. Székely et al. (2016) explore the low adoption of carbon-offset donations among air travellers and investigate how digital nudges can promote environmentally sustainable decision-making. They developed a prototypical online environment in which online experiments with different nudges were conducted. The results show that proposing higher levels of default payments significantly increases carbon-offset donations. Similarly, Meske et al. (2022) focus on addressing the lack of attention for environmental concerns in online flight booking websites, particularly on aviation emissions. They present findings from a digital nudging design process experiment with two types of nudges—an informational nudge as an emission label and an understanding mapping nudge as an emission converter.

While these existing studies make valuable contributions to digital nudging research and design practices, they show a knowledge gap by not qualitatively examining passengers' perceptions and responses to digital nudges and do not offer insights beyond experimental methodologies. Additionally, given the limited exploration of digital nudging in the context of promoting sustainable behaviour among air travel passengers, this research paper enhances the understanding within the information systems research field.

### 1.3 Research Question

The aim of this research is to investigate the effects of digital nudging on the adoption of sustainable behaviours among air travel passengers. Consequently, our research question is:

*What are the perceptions and responses of passengers towards digital nudges aimed at promoting sustainability in air travel?*

### 1.4 Purpose

The global aviation sector is an important contributor to economic growth and global connectivity. Airlines serve as crucial components for global business and tourism fostering economic development and creating job opportunities (Perryman et al., 2022). However, the industry's growth comes at a substantial environmental cost, with aviation accounting for a significant share of anthropogenic greenhouse gas emissions (Bailey, et al. 2023; Gössling & Humpe, 2020; Rothengatter, 2010). Bailey, et al. (2023) highlight the alarming rise in aviation CO<sub>2</sub> emission, escalating from around 3.5% of Global Greenhouse Emissions during the 1990s to an anticipated 15% to 40% by the year 2025. As climate change intensifies, there's an urgent need for the aviation sector to adopt sustainable practices to mitigate its environmental impact. Traditionally, sustainability efforts in aviation have primarily focused on technological advancements, such as the development of more fuel-efficient aircraft and the implementation of operational improvements (Baumeister, 2020; Perryman et al., 2022). While these measures are undeniably important, effectively tackling environmental issues within the aviation sector requires a holistic approach that goes beyond just focusing on technological advancements. Behavioural changes among passengers, especially in their choices during air travel, emerge as a critical yet insufficiently researched element in the pursuit of sustainability. Baumeister (2020) explains the importance of behavioural change in reducing the environmental impacts in the aviation industry. Baumeister (2020) contends that while air passengers may not singularly transform the aviation industry into a green entity, their environmentally conscious actions can encourage the industry to enhance its environmental impact by actively opting for greener flight alternatives.

This research is motivated by the urgent need to understand the passenger's behaviours towards adopting sustainable practices within the airline industry. Despite numerous efforts by airlines to encourage environmentally friendly behaviours among passengers, there exists a substantial gap in comprehending the effectiveness of behavioural strategies, particularly digital nudging, in influencing sustainable choices. Digital nudging, a concept rooted in behavioural economics and technology, according to Meske et al. (2022), it represents a form of behavioural design strategy involving the utilization of interface components to steer individuals towards preferred choices, thereby enabling external influence on the decision-making process. Although extensively studied in various domains such as marketing and health, its application within the context of sustainable behaviours in the airline industry remains largely unexplored. This research seeks to fill this significant gap by investigating the role and impact of digital nudging in shaping passenger's decisions and behaviours towards sustainability during air travel. Understanding how digital nudges, embedded in airline interfaces, influence passenger's choice whether in opting for carbon offset programs, choosing eco-friendlier amenities, or altering travel habits holds immense potential for encouraging a more sustainable aviation sector (Meske et al. 2022). Also, the outcomes of this

study are not only relevant to the aviation industry but also align with global agendas for sustainability. By addressing the behavioural aspect of sustainability in air travel, this research contributes to the United Nations Sustainable Development Goals, particularly those related to climate action and responsible consumption and production.

## 1.5 Delimitations

The primary focus of this study is on the impact of digital nudges in promoting sustainable behaviours among individuals who travel by air. To gather in-depth insights, we have chosen semi-structured interviews as our data collection method, aiming to understand the perceptions and experiences of those individuals who make their flight bookings online. Given the extensive population of air travel passengers, diverse factors need to be carefully considered. It is worth noting that interviews, while rich in depth, require a rather small sample size compared to qualitative surveys, making it challenging to capture optimal diversity among participants. To address this issue, purposive sampling method is used to ensure a varied representation of participants in the study. Moreover, it is important to acknowledge that the study centres on understanding passengers' perceptions, where the possibility of subjectivity and personal bias might arise and influence responses. Additionally, considering the specific focus on digital nudges concerning sustainability, respondents might choose to provide answers that align with socially accepted norms rather than giving insights about their true opinions and experiences. To conclude, given the study's scope and chosen methods, there are potential limitations and challenges, necessitating careful purposive sampling and precise interpretation of the findings.

## 2 Theoretical background

*For the theoretical background, we searched through the AIS eLibrary, IEEE Xplore and Google Scholar using keywords such as ‘digital nudging’, ‘air travel’, ‘behavioural change’, ‘sustainability’ and ‘carbon offsetting’. The literature was selected by evaluating its validity, specifically by checking citation counts, seeing if it was cited in other influential studies, selecting peer-reviewed journals and sources, and checking whether the content is relevant to our research. This chapter delves into existing research on the aviation industry’s behavioural impact on climate change, discussing carbon offset programs, the attitude-behaviour gap, and choice architecture. It then describes the concept of digital nudging, including its types, design methods, and ethical considerations. Finally, we examine studies on the use of digital nudging to promote sustainability and summarize our findings.*

### 2.1 Behavioural impact

The aviation industry’s environmental impact, particularly in terms of greenhouse gas (GHG) emissions and its contribution to climate change, is a significant concern. The Intergovernmental Panel on Climate Change (IPCC) estimates that aviation contributes around 2-3% of total global CO<sub>2</sub> emissions, and this figure is expected to rise due to increasing air travel demand (Baumeister, 2020). Addressing the environmental impact of aviation requires behavioural change among consumers. Environmentally friendly human behaviour in this context of air travel should be understood using air transportation in a way that causes less harm to the environment. Among the possible approaches to changing people’s behaviour, the psychological effects are more persuasive than external changes (Zimmermann et al., 2021). Although, behavioural change as a strategy for mitigating environmental impacts in aviation industry has not been extensively explored in the existing literature, numerous authors have recognized behavioural change as holding significant potential for mitigation efforts. Davison et al. (2014) claims that emission reduction relies more on changes in human behaviour than on further technological advancements. Gössling et al. (2007, p.20) emphasizes the importance of behavioural change in their research by stating “technological and behavioural change will be necessary to bring aviation onto a sustainable emissions path, with behavioural change having the more important role to play.” Psychological mechanisms encompass a range of incentives, both monetary and non-monetary, that drive sustainable behaviour. Monetary incentives commonly used to encourage such sustainable behaviour include subsidies, taxes, or incentive schemes (Zimmermann et al., 2021). For instance, governmental bodies may implement tax increases on air travel and fossil fuels to incentivize the use of public transportation.

#### 2.1.1 Carbon offsetting and factors influencing passengers’ willingness to pay

Other mechanisms encouraging sustainable behaviour include carbon-offset programs, wherein air passengers take responsibility for their air travel consumption by compensating for the carbon emissions produced during their flights by paying for carbon offset programs either directly procure these services from providers or make donations to NGOs equivalent to the amount of carbon they wish to offset (Cordes et al., 2023). These organizations carry out projects like renewable energy installations, reforestation, or energy efficiency initiatives that

help reduce greenhouse gas emissions. The motivation to offset carbon emissions by the passengers comes from their full understanding of one's own environmental responsibilities. Baumeister (2020) emphasises this fact and claims that as the negative impacts of climatic change becomes more visible, the concern about the environment and future generations will increase. Although carbon offsetting mechanism has proven record of promoting sustainable practices, it has received many criticisms regarding its effectiveness and transparency of carbon offset markets among many others. Offsetting allows consumers to maintain their consumption habits without fully addressing the root cause of emissions, potentially leading to a false sense of environmental responsibility (Cordes et al., 2023). This might cause rebound effect wherein air travellers alleviate their perceived guilt by offsetting and tend to engage in increased air travel rather than adopting more sustainable behavioural practices (Baumeister, 2020; Cordes et al., 2023).

According to Cordes et al. (2023), the motive of passengers to offset carbon emissions depends on their willingness to pay (WTP) scale. WTP explains the factors that affect passenger's decision-making process and the maximum price a consumer will accept to buy a product or service (Cordes et al., 2023). Further, WTP serves as a crucial measure in understanding passengers' attitudes towards environmental sustainability initiatives within the aviation industry. In the context of booking flight tickets, certain airlines offer passengers the option to pay additional fees for various environmentally conscious features (Cordes et al., 2023). This may include the choice to utilize environmentally friendlier airports or to offset their flight-related carbon emissions by paying extra for biofuels (Berger et al., 2022).

Several factors influence WTP for carbon offsetting by passengers in air travel, as evidenced by recent studies. Xu et al. (2022) explains the five key factors that influence WTP: social trust, attitude, perceived risks, education level, and age. According to the research by Xu et al. (2022), higher social trust, positive attitudes and education level increase WTP, while increased perceived risks decrease it. Rice et al. (2020) found that there is a negative correlation between WTP and factors such as flight ticket price and travel distance, based on their research. Seetaram et al. (2018) also claims that the ticket price of flights and trip type-long haul or short haul flights are important factors that affect WTP. According to Jou & Chen (2015), the socio-economic factors like monthly income of a consumer, frequency of flight travel, awareness about the environmental issues and trust on carbon offset programs play a major role. Table 2.1 outlines the important factors influencing WTP for carbon offsets by air passengers, providing a comprehensive overview of the multifaceted determinants shaping passenger's decisions in this domain.

**Table 2.1:** Factors influencing passenger's decisions on willingness to pay (WTP) for carbon offset programs

Categories	Factors	Influence on WTP
Demography	Monthly Income	Positive correlation
	Gender	The correlation is mentioned as negative by most authors. But some say that females are more willing to pay than males.
	Age	The result is mixed, and many researchers conclude it has minimal influence.

	Education Level	Positive correlation
Attitude	Attitude towards environment	Positive correlation
Carbon offset programs	Social Trust	Positive correlation
	Awareness	Positive correlation
	Perceived Risks	Negative correlation
Travel Behaviour	Ticket Price	Negative correlation
	Travel Distance	Negative correlation
	Travel Frequency	Negative correlation

The existing literature provides different perspectives with regards to the influence of demographic factors and travel behaviour of individuals to have an impact on sustainable behaviour.

### 2.1.2 Attitude-behaviour gap

Despite the availability of voluntary offsetting programs, most passengers are unwilling to pay extra for carbon offsets. According to the research by Berger et al. (2022) on pro-environmental behaviour, they could only explain 21% of the differences between what individuals state they would do and what they actually did. This finding underscores a significant gap in understanding, as the remaining 79% of the differences remain unexplained (Berger et al., 2022). This discrepancy between passenger's intentions and actions results in attitude-behaviour gap. Antimova et al. (2012, p.2) explains awareness/attitude-behaviour gap to be "associated with a range of personal and psychological barriers that restrain pro-environmental behaviour".

The author Stieglitz et al. (2023) argues that despite the growing awareness of environmental issues and a greater desire among individuals for sustainable lifestyles, this environmental consciousness frequently fails to translate into tangible actions and behaviours. Sometimes, heightened awareness and attitude about environmental issues does not help in behavioural change of people (Antimova et al., 2012). The survey experiment conducted by Berger et al. (2022) revealed the disparity between environmental attitudes and subsequent behaviours concerning air travel. Despite participants expressing strong pro-environmental sentiments and demonstrating consistent low-cost environmentally friendly actions like recycling, these self-reported measures did not consistently translate into high-impact environmental actions like paying for carbon offsets in air travel. Lorenzoni et al. (2007) cited in (Antimova et al., 2012) explains the reasons for attitude-behaviour gap among individuals as:

- Lack of political action and government participation regarding carbon offset programs to address climatic change.

- When people believe that their individual contributions to environmental protection will not have a significant impact to the overall outcome. This is called the “free-rider effect”.
- Influence of social norms regarding air travel, e.g., frequent air travel is considered a symbol of status, success, and leisure in many societies, despite their awareness of the carbon footprint associated with flying.
- As people become accustomed to a certain level of consumption and lifestyle, they may resist changes that would disrupt their comforts and conveniences, even if such changes are environmentally beneficial.
- People use the reasons like distrust and risks on carbon offset programs as an excuse to behavioural change.
- Lack of self-motivation can hinder individual’s willingness to prioritize environmental concerns.

Numerous theories and models have been proposed to explain the attitude-behaviour gap. These theories delve into factors such as cognitive processes, social influences, and situational constraints that may contribute to discrepancies between attitudes and behaviours.

#### **Norm-activation model:**

One of the most influential theories according to many researchers, the norm activation theory offers valuable insights into understanding human behaviour, particularly in the context of pro-social and altruistic actions, including pro-environmental behaviour (Antimova et al., 2012). Davison et al. (2014) explains that according to the norm-activation model the human behaviour is shaped by a combination of internal beliefs and values, as well as external factors such as perceptions of social expectations and personal responsibilities.

Central to the norm activation theory is the idea that awareness of the consequences of one's actions and a sense of personal responsibility play crucial roles in activating these moral norms (Davison et al., 2014). When individuals understand the potential impact of their behaviour on the environment and feel personally accountable for their actions, they are more likely to experience a heightened moral consciousness (Antimova et al., 2012). This heightened awareness and sense of responsibility helps to drive pro-environmental behaviour in individuals. Cognitive factors, such as awareness and knowledge about environmental issues, are important prerequisites for the development of moral norms (Bamberg & Möser, 2007). Antimova et al. (2012) also mentions emotional factors, including feelings of guilt, also to play a significant role in motivating individuals to adhere to these norms.

#### **Rational-actor model:**

Traditionally, the rational agent model has been used to explain human decision-making, assuming individuals to be rational actors who make choices based on a thorough evaluation of available information and a consistent optimization of their preferences (Antimova et al., 2012; Davison et al., 2014). Within this framework, decision-making includes a comprehensive analysis of the probabilities, costs, and benefits associated with each available option (Antimova et al., 2012; Mertens et al., 2022). By carefully evaluating these factors, individuals aim to identify the option that maximizes their expected utility, thereby selecting the most favourable course of action (Mertens et al., 2022). This approach assumes that human behaviour is guided by a systematic process of weighing alternatives to arrive at the most rational decision. Many environmental policies like the fuel and road pricing have been

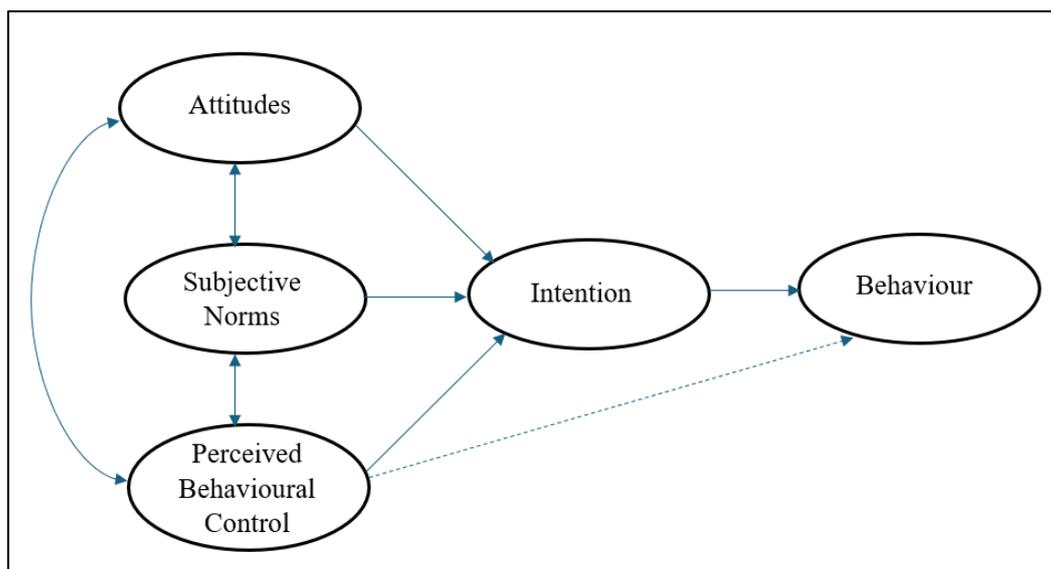
implemented based on this model to induce change in travel behaviour of the public but the results were mixed and this model was not 100% successful in reducing the negative environmental impact (Antimova et al., 2012). To this, many researchers claim that individuals always do not reply on rational decisions but a mixture of self-interest and social motives (Davison et al., 2014).

In contrast to traditional approaches, recent intervention strategies from behavioural sciences challenge the assumptions of the rational agent model. These approaches recognize that individuals are not always capable of making fully rational decisions due to cognitive limitations (Davison et al., 2014; Mertens et al., 2022). From the dual-process theories of cognition and information-processing, these models acknowledge that human behaviour often relies on automatic, less intensive forms of decision making (Mertens et al., 2022). For this, the contextual and situational factors play a major role. To exemplify, when an individual plans to change to healthier eating behaviour but the individual is surrounded by unhealthy snacks. Despite their intention to eat healthily, the presence of unhealthy options in their environment makes it more challenging for them to stick to their goal. This illustrates how external factors can influence one's rational decision. Davison et al. (2014) and Mertens et al. (2022) also support the fact that external factors like context and situations can create cognitive bias and disrupt the rational decision-making process of individuals.

### **Theory of Planned Behaviour:**

The Theory of Planned Behaviour (TPB) stands as one of the most influential models for understanding pro-environmental behaviour and is an extension of rational-actor model (Ajzen, 1991). According to Ajzen (1991, p.33), the central factor of this theory is the "individual's intention to perform a given behaviour". Intentions reflect individuals' willingness to exert effort and try hard to perform a behaviour. Generally, stronger intentions indicate a higher likelihood of behaviour performance (Ajzen, 1991). Behaviour performance also depends on non-motivational factors such as the availability of resources and opportunities and they represent the individual's actual control over the behaviour (Ajzen, 1991). For instance, even if someone intends to recycle, they may not be able to do so if recycling facilities are not accessible in their area or if they lack the necessary knowledge or skills.

TPB identifies attitudes, subjective norms, and perceived behavioural control as key determinants of behavioural intentions. Attitudes represent an individual's evaluation of a behaviour, reflecting the degree to which they perceive it favourably or unfavourably (Ajzen, 1991). Subjective norms, on the other hand, refer to perceived social pressures to engage or not engage in the behaviour, often stemming from the beliefs about what significant others expect them to do (Ajzen, 1991). Lastly, perceived behavioural control captures individuals' perceptions of the ease or difficulty of performing the behaviour and their confidence in their ability to do so (Ajzen, 1991). The more favourable the three factors are, the more likely the intention and action are to occur. Perceived behavioural control plays a crucial role in the TPB, as it influences both intention formation and actual behaviour enactment (Ajzen, 1991). Individuals who believe they have the necessary resources, skills, and opportunities to perform a behaviour are more likely to intend to engage in it and ultimately follow through with action (Ajzen, 1991). The below figure 2.1 illustrates this theory as a flow diagram.



**Figure 2.1:** The Theory of Planned Behaviour model (adapted from Ajzen 1991)

All these different theories and models offer complementary insights to understand the complex human behaviour and decision-making processes. The literature contains much research that discusses the influence of broad range of elements like the psychological, situational, social and contextual factors on human behaviour, as an extension to these theories (Davison et al., 2014).

### 2.1.3 Choice architecture

Choice architecture represents a promising approach to behaviour change, offering a way to effectively influence decisions by understanding and working with the cognitive limitations in human decision-making processes (Mertens et al., 2022). It offers a complementary approach to traditional intervention strategies like rational-actor model for behaviour change. From the previous sub-section on different behavioural models, the rational-agent model assumes that individuals make decisions based on thorough analysis of available options to maximize utility (Antimova et al., 2012; Mertens et al., 2022). Willermark & Islind (2022) believe that it is impossible for an individual to make informed decisions in every possible situation as it would result in cognitive overload. Hence, to make a well-informed decision, an individual should be equipped with the required resources and cognitive capacity. Choice architecture interventions capitalize on the mentioned cognitive limitations by designing decision environments to guide individuals towards desirable behaviours.

Traditional interventions based on rational-agent model aim to increase the utility of desired behaviours through education or economic incentives (Mertens et al., 2022). However, choice architecture interventions recognize that individuals' decisions are often influenced by cognitive biases and heuristics. Cognitive biases represent inherent tendencies in human decision-making that can lead to deviations from rationality (Willermark & Islind, 2022). Heuristics are mental shortcuts that simplify decision-making of individuals by relying on limited information or past experiences (Mele et al., 2021). They help make judgments quickly but can sometimes lead to cognitive biases (Mele et al., 2021).

Nudge theory, rooted in the field of behavioural economics describes different ways of influencing decisions by implementing changes in the local environment (Willermark & Islind, 2022). In nudging, the design of the choice architecture is altered to change individual's behaviour in a predictable way (Zimmermann et al., 2021). Building on the foundation of choice architecture, digital nudging represents an evolution of these principles in the context of digital environments.

## 2.2 Digital nudging

### 2.2.1 Concept of digital nudging

As more decisions are made on screens, the concept of nudging has transitioned to the digital context and is gaining prominence in IS research. The term 'digital nudging' was initially introduced by Weinmann et al. (2016), and since then, researchers have contributed different perspectives and definitions for it. However, most definitions align with the idea that it involves using design elements in user interfaces to guide user behaviour in digital choice environments without restricting choice, aiming to predictably influence decision-making (Lembcke et al., 2019a; Meske & Potthof, 2017; Mirsch et al., 2017; Weinmann et al., 2016). These digital choice environments can include websites, mobile apps, games, enterprise resource planning (ERP), customer relationship management (CRM) and other systems (Meske & Amojó, 2020a; Mirsch et al., 2018). User interface (UI) design elements can include graphic design, content, wording, user reviews and ratings (Mirsch et al., 2018). Digital nudging works by altering either the content or the presentation of a choice (Schneider et al., 2018).

Guidelines for implementing offline nudges cannot always be transferred to the digital environment (Schneider et al., 2018). Online users are more willing to disclose information but are also more cautious about accepting default options (Schneider et al., 2018). Moreover, due to the extensive amount of information available online, people often make different choices in the digital environment as they struggle to process all the information necessary to make optimal decisions (Mirsch et al., 2017). Additionally, internet users often feel anonymous, disassociate from reality, and think less about the consequences of their actions (Bhatt et al., 2023).

Therefore, nudging can be a valuable tool to help guide individuals' decision-making in the digital context. Advantages of implementing nudges in the digital environment include simplicity, speed, and cost-effectiveness, as it only involves adjusting the user interface (Mirsch et al., 2017). Furthermore, information systems can enable real-time tracking, behaviour analysis, and access to contextual data, facilitating rapid modifications to achieve desired outcomes (Schneider et al., 2018).

In the initial influential article on digital nudging by Weinmann et al. (2016), several nudging principles were introduced, and over time, researchers have supplemented them with additional ones. Various authors have categorized types of nudges based on context, purpose, and underlying psychological biases (Bhatt et al., 2023). In Table 2.2, some of the most frequently mentioned nudge types are summarized and described.

**Table 2.2:** Digital nudge types

Type	Definition
Status quo bias/Default	Using default settings to reduce the mental effort required by decision-makers and can also suggest the preferred option (Bhatt et al., 2023).
Decoy	Displaying an option alongside a decoy option that is unattractive and unlikely to be chosen (Schneider et al., 2018).
Framing	Shaping how decisions are perceived by designing them in a particular way, which can influence outcomes and probabilities, such as by highlighting certain aspects of a decision to guide behaviour (Mirsch et al., 2017).
Social norms/ Social Reference Point	Informing users about others' actions to either trigger a desire to belong or be accepted within a group, or to encourage them to follow cues from others when they are uncertain (Bhatt et al., 2023).
Middle option	Presenting three or more options arranged sequentially, such as by price, in a way that encourages the user to select the middle option (Schneider et al., 2018).
Scarcity/loss aversion	Limiting the availability of the option to make rare items seem more appealing or desirable to the user (Schneider et al., 2018).
Priming	Preparing individuals for decision-making by introducing specific topics or information beforehand to influence their choices (Mirsch et al., 2017).
Anchoring and adjustment	Presenting different starting points or initial clues when making estimates or judgments (Mirsch et al., 2018).
Feedback	Providing relevant feedback, warnings, and reminders to help the user when they need it (Bhatt et al., 2023).
Goal setting	Guiding users to set clear goals and plans for what they want to achieve, promoting a sense of achievement when they reach those goals, thus encouraging behaviour change Zimmermann et al. (2021).

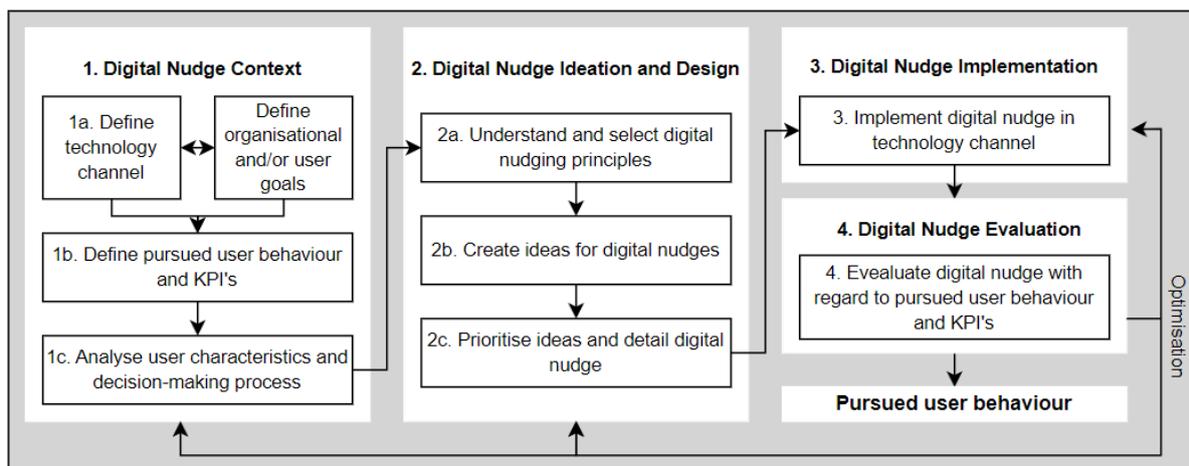
It is not always possible to predict the outcomes of implementing a specific nudge (Schneider et al., 2018). Designs of digital choice environments that unintentionally affect people's decisions can result in negative consequences (Weinmann et al., 2016). Therefore, designers must understand the designs' effects on users' choices to decide whether to intentionally nudge users or mitigate the nudging effect to promote free will (Weinmann et al., 2016). Another crucial point to consider is that digital nudging, just like nudging in offline settings, relies on heuristics and biases (Mirsch et al., 2018). Designers of digital choice environments must be careful and consider the underlying psychological principles of human decision making to improve usability and develop tailored, effective nudges for specific contexts and goals (Mirsch et al., 2017; Schneider et al., 2018). For instance, blindly adopting alleged best practices from competitors without effective modification can lead to unintended outcomes (Mirsch et al., 2018).

### 2.2.2 Design models

Several guidelines have been established for the digital nudge design process. Through an analysis of literature on nudging and persuasion, Meske and Potthof (2017) developed a three-phase process model for practitioners to use when designing digital nudges. The first phase of their model involves collecting and analysing requirements to develop a target behaviour for a target audience. The second step is identifying the right elements to design the digital nudge based on motivations, goals, and characteristics of the user. The last step is evaluation whether desired behaviour is achieved after implementing the digital nudge and if modifications are necessary.

Meanwhile, Schneider et al. (2018) developed a design cycle, drawing upon guidelines for implementing offline nudges, while highlighting the unique opportunities information systems bring. The first step of this cycle involves defining the goal of the nudge by understanding the organization's overall goals. The next step is to understand user biases and heuristics. Following that, the third step is to design the nudge, which includes selecting appropriate nudging mechanisms that will align with the set goal and implementing them. The final step is to test the effectiveness of the nudge, by using methods like A/B testing. If it fails to produce the desired impact, the designer can come back to any of the previous steps to understand how to improve the nudge and identify any overlooked aspects.

Mirsch et al. (2018) argue that the aforementioned digital nudge design approaches are conceptual, abstract, lack empirical validation, and neglect UX/UI requirements. Consequently, they aimed to address this gap by developing a digital nudge design (DND) method drawing from previous research and methods, as well as gathering insights from experts. This method has been evaluated extensively and stands as the most detailed method for crafting digital nudges (Meske & Amojó, 2020a). The method consists of four primary stages - digital nudge context, digital nudge ideation and design, digital nudge implementation, and digital nudge evaluation - each encompassing sub-stages, tools, and techniques (Mirsch et al., 2018). The method is illustrated in figure 2.2.



**Figure 2.2:** Digital nudge design method (adapted from Mirsch et al. 2018)

The purpose of a digital nudge design model is to provide choice architects with a tool to implement digital nudge elements into software systems (Meske & Potthof, 2017). The DND model, designed by Mirsch et al. (2018), offers a practical method grounded in theory and

practice, helping practitioners and researchers systematically influence user decision-making through user interface design.

### 2.2.3 *Ethical Considerations in Digital Nudging*

Because digital nudges impair people's autonomy at some level, it sparks significant ethical debate (Willermark & Islind, 2022). Moreover, there is no neutral manner to present choices, all decisions regarding user interface design influence users' behaviour (Weinmann et al., 2016). For this reason, digital choice architects must keep ethical considerations in mind throughout the nudge design process (Lembcke et al., 2019b). They need to first understand the intentions, heuristics, and biases of the users and also acknowledge that users can engage in either reflective or unreflective thinking (Meske & Amojó, 2020b).

The next step for the choice architect would be to determine the goal a digital nudge aims to achieve (Meske & Amojó, 2020b). Nudges can have three types of goals: selfish goals of the nudger (e.g. for personal profit), pro-social (e.g. promoting gender equality) and pro-self goals (e.g. encouraging exercise) (Lembcke et al., 2019b). The selfish goals are hard to ethically justify as they do not assist individuals in making better decisions (Lembcke et al., 2019b). For instance, certain airlines implement nudges to encourage the purchase of non-essential extras during flight bookings (Weinmann et al., 2016). Unethical nudges like these may yield short-term benefits for the company, but in the long run they have negative effects (Weinmann et al., 2016).

Influencing users' behaviour without sufficient understanding of their preferences may pose a risk of manipulation (Meske & Amojó, 2020a). The risk of manipulation is also influenced by the transparency of the nudge (Meske & Amojó, 2020a). A transparent nudge is one in which both the intention behind it and the methods used to achieve behavioural change are clear to the individual being nudged (Bhatt et al., 2023). Non-transparent nudges, on the contrary, are subtle and are not easily noticeable to the person being nudged (Meske & Amojó, 2020b).

A lack of transparency in digital nudging can conceal the availability of options, thus risking informed and free choice (Lembcke et al., 2019a). In addition to preserving nudgees' freedom of choice, they must also recognize when and where they are being influenced, understand the nudger's goals, and comprehend how and why the nudge works (Lembcke et al., 2019b). Subconscious nudges often have the greatest impact, potentially leading designers to prioritize less transparent implementations, making them less visible or understandable to those being influenced (Meske & Amojó, 2020b). Therefore, choice architects should aim to align with user interests, but if this seems challenging, they can also disclose the intentions behind the nudge and request the user's consent (Meske & Amojó, 2020b).

To guide practitioners and researchers in designing ethical nudges, Meske and Amojó (2020b) provide a conceptualization of ready-to-use ethical guidelines derived from offline nudging literature. Their developed checklist consists of four steps: understanding user intentions, heuristics, and biases; deriving the goals of digital nudging; designing and implementing the nudge; and evaluating the digital nudge and iterating as needed. The third step is divided into subsections based on the nudge type, with checkpoints differing based on whether the nudge targets unreflective thinking (fast, unconscious decision making) or reflective thinking (slow, conscious & sequential/critical thinking), as well as whether the nudge is transparent or non-transparent.

When evaluating the ethics of digital nudging, it is challenging to categorize these considerations as strictly right or wrong, but this doesn't excuse choice architects from responsibly considering and addressing the ethical implications of their actions (Lembcke et al., 2019b). Choice architects should keep in mind ethical considerations from the conceptualization phase through the design phase to prevent unethical nudges (Lembcke et al., 2019b). Provided guidelines for designing ethical nudges can assist them in this process (Meske & Amojó, 2020b).

### 2.3 Digital nudging for promoting sustainable practices

Digital platforms and information systems are becoming increasingly important for making environmentally sustainable choices, such as purchasing eco-friendly products online or managing energy consumption through digital systems (Berger et al., 2022). Within this context, green nudges emerge as potential tools for promoting pro-environmental behaviours (Beermann et al., 2022). While traditional nudges effectively guide individual behaviour, they may not fully align with societal interests, whereas green nudges prioritize societal well-being over individual preferences (Beermann et al., 2022).

Numerous studies in IS research have explored the use of digital nudging to promote sustainable behaviour across various domains. For example, Zimmermann and Hein (2023) conducted an online experiment to assess the effectiveness of decoy and default nudges in encouraging people to choose public transportation over private options. While these types of nudges did not individually produce significant results, combining both nudges resulted in a statistically significant increase in the possibility of choosing public transportation. This highlights the potential of digital nudging to facilitate behavioural change towards environmentally friendly transportation options.

Moreover, Meske et al. (2022) investigated the effectiveness of digital nudging on online flight booking websites to mitigate the increase in aviation-related emissions. By employing the digital nudge design method, they developed an informational nudge presented as an emission label and an understanding mapping nudge presented as an emission converter in an experimental setting on an artificial flight booking website. Additionally, the authors followed the ethical guidelines set by Meske & Amojó (2020b), implementing an option to avoid the nudges to increase transparency and ease of resistance. Results show that both nudges effectively influence booking behaviour, with participants in the treatment groups demonstrating increased awareness of sustainability and a greater willingness to consider sustainable options. Their findings suggest that digital nudges can play a pivotal role in guiding decision-making toward sustainable behaviour in online flight booking websites.

Similarly, Székely et al. (2016) conducted online experiments to test the effectiveness of default payment nudges in promoting carbon-offset donations on online flight-booking platforms. They found that proposing higher default payments significantly increased the number of carbon-offset payments, indicating that defaults not only influence intention but also behaviour. Their study shows that design choices regarding carbon-offset payment options during online flight bookings can promote sustainable decision-making.

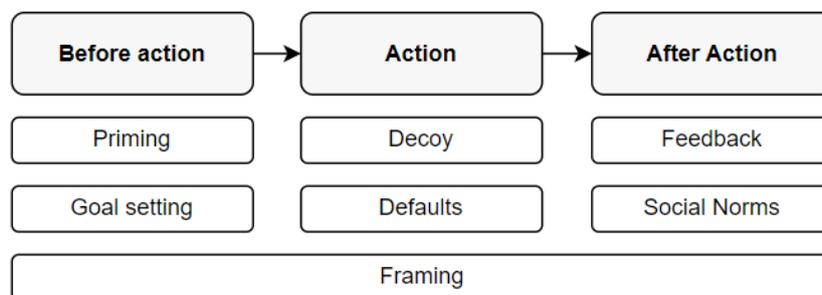
Additionally, Michels et al. (2022) examined the effectiveness and user perspectives of various nudging methods on promoting environmentally sustainable shipping options in an

online store. They evaluated defaults, active choice, and self-nudging, finding all effective in encouraging sustainable decisions. However, default nudges, while effective in increasing sustainable choices, lead to negative perceptions among consumers in terms of empowerment and ethics.

Furthermore, Mirbabaie et al. (2021) explored the impact of default and social norm digital nudges on purchasing decisions related to green fashion products in e-commerce. However, the results of the online experiment did not demonstrate statistically significant relationships between the nudging strategies and purchase decisions. This contradicts previous research suggesting that such nudging strategies could motivate consumer behaviour towards purchasing sustainable products.

In conclusion, digital nudges for promoting sustainable behaviour can vary in effectiveness. Some literature reviews have organized and examined existing research on digital nudges for pro-environmental behaviour, categorizing findings to provide guidance for researchers, policymakers, and organizations in designing effective nudges (Beermann et al., 2022; Berger et al., 2022; Zimmermann et al., 2021). Beermann et al. (2022) explored the applications, contexts, and outcomes of digital nudges for sustainable behaviour, identifying six types of nudges primarily explored in the literature, including priming, goal setting, default, feedback, social reference, and framing. They organized their findings into three categories of behaviour change outcomes: altering existing behaviours, reinforcing existing behaviours, and forming new behaviours. Their research revealed that combinations of nudges, rather than individual ones, are particularly effective in promoting pro-environmental behaviours. For example, feedback and social reference nudges, often used together, were successful in changing existing behaviours, while default nudges alone were more effective in forming new target behaviours.

Zimmermann et al. (2021) examined literature on various types of digital nudges applied to promote pro-environmental behaviour, identifying seven different classes, including priming, decoy, goal setting, defaults, feedback, social comparison, and framing. They found that digital nudges vary significantly in their mechanisms depending on when they are applied within a decision-making process, making it also a useful aspect to categorize by. Figure 2.3 shows a mapping of categorizations and the corresponding types of digital nudges. The study suggests that digital nudges applied before an action are least effective, while those during and after an action show significant positive effects on promoting pro-environmental behaviour.



**Figure 2.3:** Digital nudging categories for pro-environmental behaviour (adapted from Zimmermann et al. 2021)

Similarly, Berger et al. (2022) categorized digital nudges based on their time of application, including social norms into the nudge list based on findings from research articles, and

replaced the simplification nudging element with decoy. Their findings complement those of Zimmermann et al. (2021), highlighting that priming shows mixed results, social norms are effective when combined with other nudge types like goal setting, and default rules are the most effective across all contexts. Additionally, feedback proves effective in energy and water contexts, while simplification demonstrates effectiveness in e-commerce contexts.

## 2.4 Summary of Theoretical Background

This section on Summary of Theoretical Background aims to provide a comprehensive overview of the existing research and knowledge related to the behavioural impact of the aviation industry, particularly related to climate change concerns.

The Theoretical Background chapter begins by exploring the potential and possibilities of behavioural change strategies over technological changes to promote eco-friendly behaviour among air passengers, specifically in the digital context of online flight booking process. Options like carbon offset programs and its effectiveness impacting factors are discussed. The concept of attitude-behaviour gap, which highlights the disparity between individual's environmental attitudes and their actual behaviours are discussed with different theoretical frameworks to understand the complexity of human decision-making process with regards to sustainability context.

Further, the Theoretical Background chapter explores the concept of choice architecture and nudge theory as promising approaches to behaviour change. Later, Digital nudging, the most powerful and influential approach is discussed, and different types of digital nudges are explored. Ethical considerations surrounding digital nudging are also addressed, emphasizing transparency and user consent throughout the design process. The section further explores the application of digital nudging in promoting sustainable practices, highlighting studies investigating its effectiveness in encouraging pro-environmental behaviours among air travellers, such as choosing public transportation, considering carbon offsets, and opting for sustainable products.

Table 2.3 provides an overview of the discussed themes alongside the references used to establish the theoretical background.

**Table 2.3:** Overview of Theoretical Background

Themes	Sub-themes	References
Behavioural impact in Aviation	Potential and possibilities of behavioural change	Davison et al. (2014), Gössling et al. (2007), Zimmermann et al. (2021)
	Carbon-offset program	Baumeister (2020), Berger et al. (2022), Cordes et al. (2023)
	Willingness To Pay (WTP) factors	Jou & Chen (2015), Rice et al. (2020), Seetaram et al. (2018), Xu et al. (2022)

	Attitude-Behaviour Gap	Antimova et al. (2012), Berger et al. (2022), Lorenzoni et al. (2007)
Theoretical frameworks	Norm-Activation Model	Antimova et al. (2012), Davison et al. (2014)
	Rational-Actor Model	Antimova et al. (2012), Davison et al. (2014), Mertens et al. (2022)
	Theory of Planned Behaviour	Ajzen (1991), Davison et al. (2014)
Digital Nudging	Choice Architecture and Nudge Theory	Antimova et al. (2012), Mertens et al. (2022), Mele et al. (2021), Willermark & Islind (2022), Zimmermann et al. (2021)
	Concept	Weinmann et al. (2016), Lembcke et al. (2019a), Meske & Potthof (2017), Mirsch et al. (2017), Meske & Amojó (2020a), Mirsch et al. (2018), Schneider et al. (2018), Bhatt et al. (2023)
	Different nudge types	Mirsch et al. (2018), Schneider et al. (2018), Bhatt et al. (2023), Zimmermann et al. (2021)
	Design Models	Mirsch et al. (2018), Schneider et al. (2018), Meske and Potthof (2017), Meske & Amojó (2020a)
Application of Digital nudging to promote sustainability		Berger et al. (2022), Beermann et al. (2022), Zimmermann & Hein (2023), Meske et al. (2022), Meske & Amojó (2020b), Székely et al. (2016), Michels et al. (2022), Mirbabaie et al. (2021), Zimmermann et al. (2021)
Ethical Considerations		Willermark & Islind (2022), Weinmann et al. (2016), Lembcke et al. (2019b), Meske & Amojó (2020b), Meske & Amojó (2020a), Bhatt et al. (2023), Lembcke et al. (2019a)

Overall, the literature review underscores the potential and significance of behavioural change strategies, theoretical frameworks, and digital nudging as valuable tools for promoting environmental sustainability within the context of the aviation industry. It emphasizes the importance of considering ethical considerations, context-specific approaches, and the design of decision environments to guide individuals towards sustainable choices effectively. The next chapter will discuss the research methodology and the motivation behind the choices.

## 3 Research methodology

*In this chapter we outline our methodology and explain research design choices. We begin with clarifying the adopted research philosophy and research approach. Following that, we elaborate on the data collection and data analysis methods. Lastly, the chapter concludes by discussing ethical considerations and reflecting on the scientific quality of our research study.*

### 3.1 Research philosophy

The selection of a research philosophy holds paramount importance as it forms the fundament of every research. Given its implicit guidance that underpins the researcher's approach, methodology, and interpretation of data, a careful section is important to maintain coherence for the overall research process. Our objective in this research is to explore how passengers respond to digital nudging to gain an in-depth understanding of their subjective interpretations and experiences specifically to their interactions during online flight ticket booking, i.e., the digital touchpoints. The aim is to study the potential influence of digital nudging on passenger's decision-making processes within this context.

The ontological perspective for this study pertains to a social constructivist view. According to Goldkuhl (2012), the constructivist perspective acknowledges that reality and knowledge are socially constructed and context dependent. In the case of examining the influence of digital nudging on sustainable behaviours, this perspective recognizes that an individual's interpretations and understandings of sustainability within the context of air travel are shaped by social and experiential factors. So, the research paradigm must be interpretive in nature to study and understand the social meanings which is dependent on the constructivist ontology (Goldkuhl, 2012). This is evident from the explanation for interpretive paradigm:

Ontologically, interpretive information systems research assumes that the social world (that is, social relations, organizations, division of labor) are not "given". Rather, the social world is produced and reinforced by humans through their action and interaction. The nature of reality is seen as multiple and subjective, influenced by individual perceptions and societal constructs (Orlikowski & Baroudi, 1991, p.19).

Goldkuhl (2012) mentions two different research paradigms in qualitative research which are interpretivism and pragmatism. The pragmatism paradigm centres on practical knowledge that is applicable for action and implementation while interpretivism aims to study the subjective meanings in a social context using qualitative research methods and utilize them to build theories (Goldkuhl, 2012). The opposite to interpretivist approach is the positivist research philosophy which focuses on the rigid and objective nature of data interpretation (Lee, 1991). Given the nature of the research questions, which involves exploring passenger's responses to digital nudging and their subjective interpretations regarding sustainable behaviours, a positivist approach might overlook the nuances, diverse perspectives, and context-specific factors that contribute to these behaviours. Hence, interpretivism which values subjective interpretations, open-endedness, and qualitative methods to understand human behaviours within their social contexts is seen as an appropriate research philosophy for our research area.

Our research process involves conducting semi-structured interviews with airline passengers from diverse experiential, age, and social backgrounds. The collected data from the interviews is analysed to study the diverse perceptions of individuals on the influence of digital nudging towards making sustainable decisions while booking online tickets for air travel. This helps to gain a holistic understanding of the influential power of digital nudging in the context of air travel. The emphasis on subjective and shared meanings within the social world underscores the need to extract meaningful insights and knowledge from these interviews, enriching our research contextually. In line with Goldkuhl (2012), the interpretive approach resonates strongly when investigating specific contexts, validating our choice of paradigm for open-endedly and comprehensively understanding passenger's responses to digital nudging towards making conscious sustainable decisions within the context of air travel.

### 3.2 Research approach

According to Ågerfalk (2013), the establishing of a suitable research design to decide on the research methods is guided by the research question. To address the identified research problem and to effectively answer the research questions of this study, a qualitative research approach with inductive analysis has been selected. An emerging problem domain or subject area is often at first studied using qualitative approaches, because they are characterized by explorability and complexity (Recker, 2013). Explorability refers to the extent to which a research strategy helps to find previously unknown observations, while complexity refers to the extent to which a research strategy contributes to in-depth and multifaceted knowledge (Recker, 2013). In the context of the emerging topic of the effectiveness of digital nudging in promoting sustainable behaviour in air travel, the qualitative approach allows for the exploration of unforeseen patterns and perceptions. This is especially important, as previous research surrounding this topic only explores the quantitative side of the phenomenon and does not investigate user reflections. Moreover, regarding complexity, the study's comprehensive exploration of passengers' perceptions and experiences on digital nudging contributes significantly to the study area. The research questions require an approach that can capture the complexity of decision-making and human behaviour, making qualitative methods as the most appropriate choice.

Qualitative methods are designed to help understand the phenomena within specific contexts and can prioritize contextual subjective accuracy over generality (Morgan & Smircich, 1980). This approach offers the opportunity to explore the contextual relevance of digital nudging within the specific setting of air travel. The context is then further narrowed down to investigate the impact of digital nudges in promoting sustainable behaviour in air travel. This real-world context contributes to the practical usefulness of the study's findings. Moreover, qualitative methods are better in exploratory research compared to quantitative approaches as they reveal complex, multifaceted, and hidden phenomena, providing a comprehensive, multi-perspective view (Recker, 2013). This is particularly important when studying a relatively novel area, such as the impact of digital nudging on sustainable behaviours in air travel. In conclusion, the chosen qualitative research approach aligns well with the research questions, providing the opportunity to explore the passengers' personal experiences, views, and decision-making regarding the context of sustainable choices in air travel influenced by digital nudges.

### 3.3 Data collection methods

Qualitative research methodology has been selected for our research study to develop a comprehensive understanding of the influential power of digital nudging on the passenger's decision-making towards making conscious sustainable decisions in the online ticket booking process within the context of air travel. For this, interviews are considered as one of the most effective qualitative research methods due to their flexible property. Interviews are recognized for their capacity to yield comprehensive and detailed insights into subjective opinions and evaluation, making them a suitable tool for this research study (Recker, 2013). The selection of participants for interviews involves a purposive sampling strategy. When compared to quantitative methods, qualitative inquiry focuses in depth on smaller number of samples selected on purpose (Patton, 2014). Purposive sampling, also called purposeful or judgement sampling in qualitative methods, helps to select information-rich samples for study in-depth (Patton, 2014). A diverse range of airline passengers is targeted, considering factors such as demographics (age group, gender), level of commitment to sustainable practices, and travel behaviour and preferences. This selection aims to capture a comprehensive spectrum of perspectives and experiences related to sustainable behaviours in air travel influenced by digital nudging.

Among different interview types like descriptive or exploratory interviews, we have chosen semi-structured interview as the primary data collection method for our research investigation. Semi-structured interviews are flexible in nature as they start with a pre-defined interview protocol and continue with follow-up questions like a conversation with the interviewees (Recker, 2013). The primary advantage of this interview approach is that "semi-structured interviews will provide not just answers but also the reasons for the answers" (Recker, 2013, 100). This type of interview fits well for our study as it enables open-ended discussions with passengers, allowing for a nuanced exploration of their perceptions, experiences, and attitudes towards digital nudges influencing sustainable behaviours in air travel.

Regarding the semi-structured interview protocol, an interview guide comprising open-ended questions has been developed and can be found in Appendix 3. It aligns with the themes discussed in the theoretical background and focuses on passengers' encounters with digital nudges during their travel experiences, their overall views of the phenomenon, and their reflections on various digital nudge examples in this context. Questions revolve around their awareness, perceptions, and decision-making influenced by these nudges regarding sustainable practices, ensuring flexibility for detailed exploration while maintaining consistency across interviews. Additionally, the last part of the interview includes screen sharing 6 visual examples of digital nudge types, identified in the theoretical background, corresponding to the context of the study. The guide was inspired by the need to bridge gaps in existing research and to gain in-depth insights into user perspectives on sustainability in air travel. This structure enables us to gather rich, qualitative data and explore the complex interplay between digital nudges and sustainable decision-making.

Pilot interviews are known as an effective tool to test the defined questions and gain practice (Majid et al., 2017). Furthermore, the results of these interviews allow for the identification of needed modifications to the interview guide (Majid et al., 2017). For this reason, we decided to conduct the first interview as a pilot interview, slightly improve the interview guide, and then proceed to the subsequent interviews. In total, we conducted five interviews, including

the pilot interview, which we also included in the data analysis, as it remained valid for use and the modifications to the interview guide were minor.

The interviews were conducted via Zoom, ensuring flexibility and accessibility for participants. Right before the interview process, every respondent was asked to read and sign a consent form which explained the purpose of the interview, information on how the interview will be conducted, and how the information will be used. This consent form can be found in Appendix 1. Moreover, participants were given a document containing background information on the study's topics to ensure their familiarity with the phenomena before the interview. This description is available in Appendix 2. Data collection continued until data saturation was achieved, ensuring that a comprehensive range of perspectives and experiences related to digital nudges and sustainable behaviours in air travel is captured adequately. With participants' consent, interviews were recorded to ensure accuracy in capturing responses and to facilitate easy transcription using Whisper AI. These transcriptions serve as the primary dataset for further data analysis.

### 3.4 Data analysis methods

After the data collection phase involving semi-structured interviews with passengers, the next step was to analyse the collected transcript data. Qualitative research is rich and complex, therefore large amounts of data are produced, which need to be analysed, manipulated and reduced (Kaplan & Maxwell, 2005). This also applies to our collected data, because the participant responses encompass various perspectives and experiences regarding digital nudging for sustainable decisions in air travel, making it complex for analysis. To address this challenge there are various analytical strategies, techniques and tools that can be used to explore the different aspects of qualitative data (Kaplan & Maxwell, 2005). Coding is one of the most widely used techniques for qualitative data analysis and is used in this study, as it is good for reducing and transforming data to meaningful information (Recker, 2013). By using this technique, segments of data are sorted into categories that facilitate insight and comparison, assigning meanings to the segments (Kaplan & Maxwell, 2005). Coding is used to organize data based on identified concepts, key ideas, themes, essentially representing categorized interpretations (Recker, 2013). There are multiple coding approaches, but open coding has been chosen for this study. Open coding involves identifying concepts within the data, which can then be grouped into broader categories, to ensure coverage of all concepts (Recker, 2013). This approach is suitable for our study because it enables the exploration of themes among passengers' perceptions and experiences without predefined categories. Moreover, we use an inductive approach in our analysis process, which enables patterns to naturally emerge from the raw data without the constraints of structured methodologies (Thomas, 2003). This method allows us to synthesize extensive and diverse text data into a concise summary format (Thomas, 2003). This approach aligns best with our research question, as the collected data reflects diverse perceptions and unanticipated themes.

It is important to note that qualitative data analysis typically consists of three phases: data reduction, data display, and conclusion drawing (Recker, 2013). In our case, data reduction involves applying coding to raw interview data to reduce its volume and organize it into concepts. Recker (2013) notes that discarded data should be retained, as there may arise a need for re-examining data previously considered unnecessary. Data display involves representing the main findings, themes, patterns, or interpretations from qualitative data in

formats like diagrams, tables, charts, and other graphical formats (Recker, 2013). At this stage, we created structured representations of the main themes of the perspectives and responses of passengers that emerged from the coding of interview data. Lastly, conclusions were drawn from the organized and categorized findings. The mentioned methods and approaches are well-suited for this study, as they are effective with rich and complex data found in interviews, particularly in the case of semi-structured interviews. They are suitable for capturing passenger awareness, perceptions, and decision-making influenced by digital nudges promoting sustainable behaviour.

### 3.5 Ethical considerations

Our study employs a qualitative research methodology, focusing on data collection primarily through semi-structured interviews with selected candidates relevant to our research objectives. Ethics helps to address queries concerning morality, encompassing the concepts of good and bad, right and wrong, justice, and virtue (Recker, 2013). This discipline explains the guiding principles of conduct, the boundaries between ethical and unethical behaviours within societal or professional realms (Recker, 2013). Individuals, functioning as autonomous moral agents, utilize ethical principles as guiding frameworks to steer their choices and behaviours (Recker, 2013). Hence, ethical considerations play a pivotal role while handling the primary data collected from the participants of the interview.

The following ethical aspects are considered for the data collection process. Right before the interview process, every respondent is explained the purpose of the interview, information on how the interview will be conducted, and how the information will be used. Participants were asked to provide voluntary and informed consent to participate in the research. Patton (2014) emphasizes the importance of seeking participant's consent before recording interviews. Without permission from the interviewee, recording of the interview is not ethically sound. Respecting participant's preferences regarding recording ensures compliance with ethical standards (Patton, 2014; Recker, 2013). Participant's confidentiality is strictly maintained throughout the research process. To ensure confidentiality, participants are informed about the anonymity of their responses. This commitment ensures that their shared information is handled with utmost confidentiality and will not be disclosed to others, preserving the privacy of their contributions throughout the research process (Patton, 2014; Recker, 2013). Participation in the research is entirely voluntary, and pressure is exerted upon potential participants to take part. Interviewees are also informed about their rights, e.g. the right to withdraw from participation at any stage. With these steps, we follow the ethical protocols, including informed consent, confidentiality, and voluntary participation, and are strictly adhered to throughout the data collection process. Prior to commencing the interview, the disclosure of ethical considerations to the interviewee is conducted and is incorporated into the introductory segment of the interview (Patton, 2014).

Recker (2013) highlights the importance of ethical considerations while analysing the collected data. Ensuring ethical data analysis practices includes transparent and thorough reporting of the analysis process (Recker, 2013). This includes the honest disclosure of all results, even if they contradict the overall research design (Recker, 2013). Unethical data analysis behaviours include evaluating hypotheses with incomplete or biased analysis, segmenting data to favour hypotheses, or creating hypotheses based on post-analysis results (Recker, 2013). These unethical practices are strictly avoided to maintain integrity and

honesty in the research. These ethical considerations uphold the principles of respect and justice, ensuring the protection of participants' rights, privacy, and well-being throughout the research on the impact of digital nudging on sustainable behaviours in the airline industry.

### 3.6 Scientific quality

It is often argued that qualitative research lacks scientific rigor due to insufficient motivation behind the adopted methods, lack of transparency in the analysis, and the risk of findings being influenced by researcher bias (Noble & Smith, 2015). These risks also apply to our qualitative study, as we are conducting semi-structured interviews. Noble and Smith (2015) state that to address this issue, researchers can employ strategies to ensure trustworthiness in their findings. These strategies include considering personal bias, acknowledging bias in sampling, keeping records to show a clear decision path, inviting participants to comment on the interview transcript, among others (Noble & Smith, 2015). We follow these guidelines to ensure reliability of our research, keeping in mind the risk of bias, documenting decisions and interpretations, and offering participants the possibility to review the transcripts at any time.

In qualitative research, validity refers to the appropriateness of the used tools, processes, and data (Leung, 2015). Validity implies that the research question aligns with the desired outcome, the chosen methodology is appropriate for answering the research question, the research design is suitable for the methodology, the sampling and data analysis methods are appropriate, and lastly that the results and conclusions are suitable for the sample and the study context (Leung, 2015). Having described our research design in the previous sections and justified our choices, explaining why they are the most appropriate for this study, we believe that our research aligns with these aspects of validity.

According to Recker (2013), generalizability refers to the extent to which the study's findings and observations can be applied to other cases beyond the examined data. Quantitative studies, especially when employing surveys, are typically more generalizable beyond the examined data than qualitative studies, which are more dependent on the research context (Recker, 2013). Due to this limitation for qualitative research, the focus is not on generalizing findings. Instead, scientific quality centres around reliability and validity to ensure the trustworthiness and appropriateness of this research.

This chapter described our research methodology and approach choices, providing justifications based on our research question. Furthermore, we explained ethical considerations and scientific quality. The next chapter will present the results identified from our analysis.

## 4 Empirical findings

*In this chapter, we present the results of the analysed data that were collected through interviews. We begin by outlining the demographics of the participants. Subsequently, we delve into the identified themes from the interview transcripts, first describing the behavioural influences shaping participants' travel habits. Then, we explain the identified sustainability factors and ethical implications. Following this, we describe the factors influencing the effectiveness of digital nudges and highlight findings from presenting participants with visual examples of digital nudge design elements. The identified themes and underlying codes can be found in Appendix 4.*

### 4.1 Overview of participants

We employed purposive sampling when selecting the interview participants to ensure that they could provide valuable insights on the phenomenon. The participants represent diverse demographics, including various age groups, nationalities, genders, education levels, and professional statuses. Additionally, we selected participants who engage in sustainable practices to some extent and have booked flight tickets online multiple times in recent years. This behaviour is discussed in the next section. This ensures that they would have an interest in promoting sustainable behaviour and are familiar of flight booking platform user interfaces. Table 4.1. outlines participant demographics.

**Table 4.1:** Participant demographics

Participant	Age	Gender	Country	Education level	Professional status
P1	23	Male	Latvia	Bachelor's degree	Employed
P2	23	Female	Germany	Bachelor's degree	Working student
P3	43	Male	Latvia	High school	Employed
P4	33	Male	Turkey	Master's degree	Student, unemployed
P5	26	Female	India	Master's degree	Student

The participants range in age from 23 to 43 and come from four different countries. They have educational backgrounds ranging from high school to master's level, and they include students, employed individuals, or both. This sample sufficiently represents the diverse demographics we aimed to include.

### 4.2 Behavioural influences

After gathering information regarding participant demographics, we asked questions aimed at understanding the participants' air travel behaviour. This helped us establish how their typical

choices might influence the effectiveness of digital nudging in promoting sustainable choices during flight booking.

#### 4.2.1 Usual flight frequency and distance

We asked the participants how frequently they travel by plane and what is the distance of their usual flights to get an overview of their travel behaviour. These characteristics are summarized in table 4.2.

**Table 4.2:** Participants' air travel behaviour

Participant	Air travel behaviour
P1	Short flights, once every 1.5 months.
P2	Mostly avoid flight travel, maybe one short-distance flight per year.
P3	Sometimes once a week, sometimes once in a few months.
P4	Short flights 5-6 times a year.
P5	From 2021 to 2023, one round-trip per month. In the last one year, it has reduced.

The participants usually fly short distance flights with varying frequency from once a month to once a year. This means that they have bought flight tickets often enough for them to be familiar with airline interfaces and have likely encountered some type of digital nudging elements, even if not in the context of sustainability.

#### 4.2.2 Key factors influencing participants' flight ticket booking

The participants were also asked to name the factors they consider most when booking flight tickets. Their responses are summarised in table 4.3.

**Table 4.3:** Factors influencing participants' flight ticket booking

Participant	Booking factors
P1	Time and price
P2	Direct flights, nearest airports, price, airline's reputation in sustainability and service-level consideration.
P3	Less transfer, less transfer time, services that the airline offers.
P4	Lowest price.
P5	Lower price, maximum number and amount of baggage allowed, and lesser transfers.

The most important aspects identified by participants are price, flight time and minimal transfer. We have labelled these factors accordingly in the interview transcripts. They also play a significant role in the digital nudge effectiveness, which is discussed in a later subsection.

### 4.2.3 Travel type influence on behaviour

Two participants noted that they also fly for business purposes, not just personal trips. This could potentially also influence their response to digital nudges, especially if tickets are booked by companies or if employees must adhere to strict guidelines when booking tickets themselves. For example, participant P4 explained *“both personal and also job-related flights. They were all related to economy, actually. So, ... I'm always trying to pick the cheapest flight”* (P4:14). For them, the key factor in flight booking is price, whether it is for business or personal travel, but it could be different for other travellers.

Another important aspect is whether the travel is solo or group. When traveling with others, their preferences also need to be taken into account. This can also affect how passengers interact with digital nudges aimed at promoting sustainable choices. For instance, participant P1 stated *“I mean, if I was travelling with someone I would ask “do you want to just add this thing?”, but if I would be alone traveling, I wouldn't click it”* (P1:65). This suggests that passengers' decisions regarding sustainable choices may be influenced by the presence of companions during travel.

## 4.3 Sustainability factors

### 4.3.1 Taking initiative and participating in sustainable activities

All participants engage in sustainable behaviour to some extent. Most participate in waste sorting, while some opt for more sustainable food choices or purchase second-hand clothes and furniture. Two of the participants also try to make sustainable transportation choices. Participant P3 explained *“we try to avoid the flights, use trains, maybe walk more if it is possible and it is reasonable”* (P3:6). Participant P2 similarly described their approach, stating, *“I mostly try to avoid air travel. For most years, I didn't use air travel at all. When going on vacation, I opt for nearby places where I can travel by train”* (P2:11). Moreover, the participants' willingness to consider sustainable options when presented with digital nudge examples also suggests a tendency for sustainable behaviour. These findings are summarized in a later section.

### 4.3.2 Sustainability awareness and responsibility rating

To quantify the participants' level of sustainability awareness and responsibility, we asked them to rate themselves on a scale from 1 to 10. The responses are summarized in table 4.4.

**Table 4.4:** Participants' sustainability awareness and responsibility

Participant	Sustainability awareness and responsibility
P1	Aware 9, Responsible 4-5
P2	7-8
P3	6-7
P4	8
P5	Aware 6-7, Responsible 5

Overall, participants demonstrated varying degrees of sustainability awareness and responsibility, with most rating themselves moderately high in awareness and lower in responsibility. However, it must be noted that these ratings are subjective and represent the participants' self-assessment.

#### 4.3.3 Awareness of digital nudging to promote sustainability in air travel

To better understand participants' exposure to digital nudges aimed at promoting sustainability in air travel, we asked them whether they have seen these elements in airline booking website user interfaces. All participants except one have encountered these digital nudges before when booking flight tickets. Participant P4, who couldn't recall seeing them, explained, *"I don't recognize them at all ... I was not so aware of sustainability till this year. So, maybe that's why I didn't pay attention to the details that much"* (P4:16). Participant P5, who noticed them for the first time last year (P5:28), said, *"I think it is there, but it's like very minimum, like bare minimum. It is not like on your face while you're trying to book. It is just somewhere down in the corner, I would say"* (P5:32). This suggests that exposure to digital nudges depends on both an individual's sustainability mindset and the placement of the nudges.

#### 4.3.4 Attitude towards digital nudging to promote sustainable behaviour in air travel

Throughout the interviews, the participants expressed mixed feelings about the use of digital nudging to promote sustainable behaviour in air travel. On one hand, some participants believe that it has the potential to raise awareness of environmental issues in aviation and that it has a positive motive. Participant P1 describes their view on this context as *"for a sustainability cause I would say positive"* (P1:26). Participant P3 believes there is potential to this approach, and expressed their view as *"at the moment, it is nonsense, but let's see how it works out in long term"* (P3:24).

Participant P4 expressed their view as *"I actually support them to use digital nudging for people to use more sustainable ways. But if they push people to choose them ... , it is not okay for me"* (P4:22). Additionally, participant P2 stated *"so if like there's still a transparency on how I can opt out of this, and it is not made extra hard, then I don't see a problem,"* (P2:17) indicating that if airlines adhere to ethical considerations and transparency, then digital nudging is acceptable in this case.

Participant P5 believes that digital nudging has little effect on the global picture of sustainability and says:

*But from my personal perspective, traveling is inherently impactful on the environment anyway. Whether it is 2% less or 10% less emissions, it doesn't make much of a difference in the grand scheme of things. It is harmful either way. So, right now, I don't think it would matter that much to me. However, my opinion might change in the future, especially once I'm financially stable.* (P5:34)

From these reflections and other statements made by the participants, it can be concluded that while they may doubt the effectiveness of digital nudging right now, they are willing to see what opportunities it will bring in the future.

#### 4.3.5 Raising awareness about sustainability among passengers

Some participants believe that digital nudging aiming to promote sustainable behaviour can be an effective tool to raise awareness about the environmental issues of aviation. Participant P3 explains *“No, of course we need to get somehow person's attention ... to this problem in general. So maybe this is not the best way to do it, but they are trying to approach this question”* (P3:35). Additionally, participant P4 said *“Well, I mean, if your first goal is to promote the sustainability, I think that they can be paid more attention to these digital nudging concepts. But I don't think that it is their main issue”* (P4:20). Participant P1 also supported this view (P1:35). From these reflections, it can be understood that although digital nudging has positive potential in this context, there are some doubts among participants.

#### 4.3.6 Suggestion for companies to take direct action for sustainability

Two participants expressed concerns about the digital nudging approach in this context, suggesting that direct deduction from the company's profits could be preferable. Participant P1 described this opinion by stating *“if airlines really wanted to decrease it in a bigger way, they would just increase the ticket price for let's say the same amount”* (P1:35). Moreover, while presented with digital nudge examples, participant P4 proposed an improved approach:

*It is only for PR, because they have the option to still put this price thing and cut 2.99 euros from their profit. ... For example, they can say that okay, if you donate 2.83 euros, we will also donate for example 60 euros to the charity or to the sustainable companies, then it will make a little bit more sense.* (P4:46)

This suggests scepticism about airline digital nudging approaches, making passengers question whether this is truly the only method for airlines to address environmental concerns.

## 4.4 Ethical implications

### 4.4.1 Concerns regarding company profit/marketing

Some participants were sceptical of digital nudging used to promote sustainable choices in air travel and perceive it as marketing and corporate profit-seeking. Participant P1 describes their reflections on this as *“just the irritation of ... larger corporations ... making ... people pay more because they want to earn more”* (P1:85). Furthermore, participant P3 expressed their view as *“that's just a marketing trick, that's all. I don't think they really care about nature, they only care about income”* (P3:20). Participant P4 believes that one of the reasons why aviation companies employ these digital nudges is: *“they need to pay more attention because of ... the European regulations .... I don't think that they will put that much performance on this issue”* (P4:20). This participant also mentions in their reflections on digital nudge examples that the nudges are just a marketing approach, and companies are trying to get more money from passengers (P4:28, P4:42).

#### 4.4.2 Persuasion

Several participant reflections indicated the feeling of persuasion when discussing the digital nudging concept. Participant P1 believes that airlines try to emotionally manipulate passengers to evoke guilt. They explain, *“I guess the ethical part here is that it is good that they make it aware, but it is wrong that they are trying to guilt trip a customer into thinking that the company itself cannot really do anything in this case unless you help them”* (P1:35). Furthermore, participant P4 believes that there is a fine line between an ethical digital nudge and one that is persuasive. They stated, *“it is okay for them to use digital nudging in a level, but if they push you a lot, then it is not okay for me. I don't... I don't like these kinds of pushing people to choose some ... things that they actually do not want to consider”* (P4:22). On the contrary, participant P5 describes their reflections on this as *“I think it is if any, if you're doing it for the greater good, then yeah, I mean, it doesn't matter that much”* (P5:38). These reflections suggest that the majority have some doubts about digital nudges and that they can easily become overly persuasive, although not all are concerned about it.

#### 4.4.3 Importance of transparency

When asked about participant reflection of transparency in the design of digital nudges, participant P1 explains, *“I guess the transparency part is very important for me because ... you don't really know if it really works. So, you question do you really want to try to do that, if you don't really see the results or anything related to that”* (P1:38). Additionally, participant P5 supports this view by stating:

*They have to be extremely transparent because if I don't know what I'm paying for, then I'll definitely not pay for it. ... Yeah, because there's a lot of greenwashing every day and you know, you need to see where your money is going because at the end of the day, everybody cares about their own business and making money.* (P5:40)

Participant P4 provides a different perspective by saying *“as much as I understand, the main reasoning behind these nudges are actually pushing people without explaining the reasons behind them ... So, from the ethical perspective ... if you don't push people a lot, I think it is okay”* (P4:24). To conclude, while participants highlight the importance of transparency in digital nudges, they also emphasize the need for ethical considerations to avoid excessive persuasion.

#### 4.4.4 Concerns regarding personal data collection

The participants also expressed their perspectives regarding personal data collection in this matter. Participant P1 takes a more relaxed stance, stating *“The personal data not really. I mean, almost everything collects information so yeah a few clicks more doesn't really change anymore anything about the money spent”* (P1:28). In contrast, participant P3 expressed significant concern, explaining *“because I don't like that my data is resold somewhere to the some kind of third party, and unknown third party, and maybe there are lots of them. I don't like my data to go on like, on free market”* (P3:26). This indicates that attitudes toward personal data collection in digital nudging depend on participants' general views on data privacy, suggesting that such concerns are not increased by the context of digital nudging.

#### 4.4.5 Questioning the ethical implications of default option digital nudge

During questions where different digital nudge examples were shown to the participants, the default option design prompted ethical reflections among participants. In this type of nudge the sustainable choice is checked by default. Participant P1 commented on it:

*From a user perspective it is the only thing that's a bit unethical from my standards is that it is already ... clicked in. So, that would be a bit unethical for some people that just try to reserve the ticket faster. So, you accidentally overpay without maybe willing to support this cause, or you're not a believer in sustainable things, and then you're just mad or everything else, so it can backfire in PR. (P1:44)*

Participant P3 added to this view by saying:

*From my point of view that is not really a correct like approach. I don't like it that I'm already included in something. I'm pushed so there should be no checkbox at the moment. I should be able to check it by myself then yes, that's a free choice. Now it is not a free choice from my point of view. (P3:30)*

Participant P4 further expressed their view on the default nudge “*you are actually trying to get more money from the passenger... people cannot be aware of the fact that they actually add the sustainable aviation fuel if they are in hurry*” (P4:28). It can be concluded that this type of nudge has potential issues with transparency and the freedom of choice, indicating that other nudge designs might make users feel more confident.

## 4.5 Factors influencing the effectiveness of digital nudges

In this study on the influence of digital nudges towards individual's behaviour towards sustainability, we found various factors to play an eminent role in shaping its effectiveness. Factors like availability of sufficient information along with a digital nudge, the significance of personal considerations in booking decisions and the reputation of an airline company are found to be crucial factors. Some participants in the interview process also reflected on the importance of additional benefits liked to choose sustainable choices while booking flight tickets to be very motivating. Furthermore, we studied how motivation, particularly the visualization of results, and the preference for a multitude of options, significantly impacted the potency of digital nudges.

### 4.5.1 Importance of information availability

All the five participants strongly emphasised on the availability of proper and sufficient information regarding the effectiveness of the carbon offset programs of the airline company and how does paying for carbon offsets affects the environment. Participant P1 expressed a feeling of confusion and uncertainty to decide on opting for carbon offset options saying “*How..., how does it really impact it, it is just that you can pay for it but nothing else no information under provided usually in the web pages*” (P1:26). A similar comment was provided by participant P5 who says “*If we don't know where the money goes, there's no point in paying for carbon offsets. Yeah, because there's a lot of greenwashing every day and you know, you need to see where your money is going*” (P5:40).

When participant P2 was questioned to decide on booking a flight ticket with framing nudges that had symbols and labels to denote carbon emission levels, the participant expressed uncertainty saying that the labels denoting “low”, “medium” and “high” was not providing enough information on emission levels by saying:

*But, gosh, I mean, that's just like, I would perceive it as a more rough indicator. Like, but I mean, you have these different, I don't know, like variations in colour. I think that would like only medium convince me because I would be like, okay, I need probably some more data. Like, I would say, okay, but how was the emission compared? Is it 90%? 80%? There would be like, okay, I want more data. (P2:36)*

This observation underscores the importance of clear and detailed communication in nudges, especially when addressing complex topics like carbon emissions.

A common behaviour observed during flight ticket booking is the tendency of individuals to rush through the process, leading to hasty decision-making. This behaviour was emphasized by participant P3 who claimed to routinely deselecting options, particularly those related to sustainable aviation fuel, due to a lack of clear understanding. Participant P3 added to this view by saying:

*And this point I would check do not add sustainable fuel, because I don't understand really what it is and why I need extra fuel or something like that. I don't have clear understanding from this four-line text, because something is hidden again. There's a uh... "i" letter in the circle after the sustainable aviation fuel text, but then I need to open it and then it is again something is hidden. (P3:32)*

A similar response was captured from participant P4 who expressed confusion regarding the utilization of sustainable aviation fuel when booking flight tickets. They expressed uncertainty about how the airline would implement this option for the specific flight, especially when only a small number of passengers choose it by saying:

*Okay five passengers choose the sustainable aviation fuel, so we need to give the sustainable aviation fuel for five people to the flight. I mean, I don't understand. I don't understand the reasoning behind it. So I would definitely not choose none of them because I don't understand the difference between the sustainable aviation fuel usage for the same flight. (P4:52)*

This comment underscores the need for clear and transparent information about the operational processes behind such initiatives for making informed decisions.

#### 4.5.2 Importance of personal booking considerations

Regarding personal booking considerations, all the 5 participants had different priorities. Participants P2, P4 and P5 who are currently students' express price of traveling to be a significant factor in choosing airlines and flight tickets. In regard to buying sustainable aviation fuels, participant P4 commented that they will consider paying for biofuels if the price is not too high which is evident from their comment “*I consider my budget more than other people maybe.*” (P4:30). Huge price differences while choosing sustainable options matters to participants P1 and P3 who are working individuals too. Participant P1 explains their view on price differences saying:

*And if it isn't like huge change in price, then I would pick it, but if it is like 20 euros or more than, then that's more questionable and then probably choose the cheaper version, thinking that I can try to offset by using it in other places. (P1: 58)*

Participant P2 expressed a strong responsibility towards environments by saying “I mostly try to avoid air travel. For most years, I didn't use air travel at all.” (P2: 11). They also expressed their concern regarding high price differences to choose sustainable option commenting “Currently, price would be slightly more important for me than sustainability” (P2: 15). Hence, our study claims price difference to be an important factor for expressing varying degrees of consideration for sustainability options, depending on the affordability and personal values of individuals.

Other personal considerations like the baggage allowance which impacts travel plans and expenses and travel time which includes the factors like arrival times and layovers were important deciding factors reported by two participants. Participant P4 explains that if the arrival time of the flight, one with sustainable option doesn't differ too much, they would consider paying for the sustainable option (P4: 60).

Personal beliefs and values play an important role in considering what is sustainable action and what is not. An interesting perspective was provided by participant P5 who expresses a pragmatic view, acknowledging the inherent environmental impact of air travel regardless of slight variations in emissions reduction. From their standpoint, the marginal difference between choosing flight options with 2% or 10% less CO<sub>2</sub> emissions does not significantly alter the overall harm inflicted on the environment, which is evident from their comment:

*But from my personal perspective, traveling is inherently impactful on the environment anyway. Whether it is 2% less or 10% less emissions, it doesn't make much of a difference in the grand scheme of things. it is harmful either way. So, right now, I don't think it would matter that much to me. However, my opinion might change in the future, especially once I'm financially stable. (P5: 34)*

Sometimes, the information nudge like the above can lead to demotivation. While the intent is to convey emissions levels and encourage informed decision-making, the abstract nature of percentages may not be easily grasped by individuals, especially in a rushed decision-making scenario. Utilizing relatable analogies could enhance understanding. For example, explaining that opting for a flight with 10% lower emissions is akin to removing a certain number of cars from the road for a year could provide clearer context and motivation for sustainable choices.

#### 4.5.3 Importance of company reputation

Trust is reported as an important factor by almost all the participants of our study in many ways. This trust is multifaceted which includes confidence in the airline's commitment to sustainability, the effectiveness of their initiatives, and the transparency of their practices. For all the participants, trust was a crucial factor to decide to support sustainable practices by paying extra money. Participant P1 expresses this fact by comparing two different airlines by saying:

*If I can add I mean I would never buy extra for airline company X like for the CO<sub>2</sub> emission decrease the company is known for... for trying to get the money out of*

*everything. But in comparison like airline company Y, which is place D's company, they already are kind of using it, so I assume if I had the chance there and excess cash then I would buy it, because already known that the company tries to decrease it. (P1: 30)*

Participant P2 also expresses similar sentiments when we questioned regarding a priming nudge. The participant explained from the image we showed her on priming that the effort taken by the airline looks obvious to explain about biofuel option with some fun fact and encouraging wordings through nudges. The participant also comments on company trust by saying:

*I think this text is actually great because it does provide the facts and context without overcrowding me with information ... And it provides some credibility. Because maybe I should also say that I'm a bit suspicious of carbon offsetting with some airlines, like sometimes I don't really trust them to do that effectively. So, this explanation text of some facts ... And also, like this thing about "it is the small steps that matter," etc., ... And yeah, it just provides credibility. (P2: 40)*

#### 4.5.4 Importance of additional services

Two participants P4 and P5 reflected their ideas tangible additional benefits and incentives by airlines as an encouragement to selecting sustainable options while booking flight tickets. Participant P4 expresses feeling of trust on airline companies when they provide bonus points for selecting sustainable options with the comments:

*So the second option, like earn 500 euro bonus extra points. I don't know how this euro bonus extra point makes sense, ... I mean, if it is more valuable than three euros, then I can understand that the company actually provides something from itself. So then I can pick that biofuel option. I don't know how the extra bonus extra points work, but if it is more valuable than three euros, then I can pick that biofuel option right now. (P4: 64)*

An interesting insight is that when airline companies provide extra benefits from your pocket with an intention to encourage passengers opting for sustainable options, *it is easy for individuals to trust the carbon offset program and the airline company for taking such initiatives.* This fact was again reflected by participant P4 who commented “*Now I can understand the value they give to this option, but if they just ask money for me to, well, then I am more sceptical.*” (P4: 66).

Participant P5 suggests incentivizing eco-friendly travel by offering cashback rewards or discounts for choosing green flights. The participant also proposed introducing reward programs or loyalty schemes for green travellers, where frequent flyers could earn perks like free seat selection, thereby nudging travellers towards more sustainable choices.

#### 4.5.5 Motivation of seeing the impact of sustainable choices

Some participant expressed motivation from seeing tangible results of their sustainable actions. Participant P1 exemplifies this fact with sustainable shopping practices, such as reusing bags and minimizing plastic usage and realizing the actual impact and effectiveness of such practices while participating in community clean-up events.

Participant P3 expresses their confusion while showing an image of social norm nudge. The participant questions on how to understand the actual impact of paying 3 euros by saying “*I like to... I like to see more detailed information, what actually we do with these three euros we add to the price. What is a real impact?*” (P3: 40).

Participant P1 comments that *it is* challenging to directly observe the impact of air travel due to the sheer volume of flights worldwide. The participant suggests that by drawing comparisons to other activities and realizing the potential for impact, individuals can better understand the significance of their actions, which is evident from their comments:

*I mean for airplanes it is harder to see it, because there are millions... million flights all over the world, and you cannot really see how it impacts it. But trying to compare it to something else then realizing that it actually impacts and can change, so seeing also similarities and I do a lot smaller thing that offsets it by a million times less, so kind of doing this would also change it a million times more.* (P2: 71)

An important observation from our study is to incorporate individual efforts towards larger positive outcomes into the design of digital nudges aimed at promoting sustainable travel behaviour. This approach can enhance the effectiveness of nudges aimed at encouraging passengers to mend their travel behaviour.

#### 4.5.6 Preference for availability of multiple options

When considering sustainable travel options, individuals often value having a range of choices to select from, as evidenced by the preferences expressed by participants in our study. Participant P1, when asked to choose the most influential nudge design, chose the framing nudge that allowed them to choose between various impact levels, such as low, medium, or high, indicating their preference for decisions with multiple alternatives, which is evident from their comments “*the idea was there that you can choose it, and you can actually see the change in like very very wide um... spectrum that uh... medium, uh... high, or low impact*” (P1: 88).

Participant P2 explains that the middle option nudge is convincing in a way as there is an option to compare between the three alternatives with regards to benefits, carbon offset options and price difference. Having options helps individuals to compare and decide based on the benefits. Participant P2 expresses this fact with the below comments:

*Yeah, I think this is also quite convincing. Like, because now I have this comparison between the three and I feel like I get quite a lot like compared to the other versions and also in ratio to the price. So, I would think this is a good deal because I can compare it to the other ones and yeah, I think the utility I would get from this is quite high.* (P2: 32)

This preference for the middle option suggests that individuals may gravitate towards choices that offer a balance between sustainability benefits and price.

Participant P4 found the availability of multiple options to be beneficial as it allowed them to understand the differences between each choice. They appreciated being able to see the distinctions between options, indicating that this framing was better for their decision-making process. Participant P4 expresses this fact with the below comments:

*I think this is the best because as I said I can understand them. I can understand that they are different anyway and I can see the difference between them right now. But if I have to choose the same flight with more different fuel option ... in this case I can see that they are different so this framing is better, yes. (P4: 68)*

## 4.6 Participant Preferences for Digital Nudges

The interview participants were shown images from Appendix 3, Figures A1 to A6, illustrating six distinct types of digital nudges within the context of online flight ticket booking. These nudges aimed to encourage the selection of sustainable options like paying for carbon offsets, paying for biofuels, choosing a sustainable flight based on emission levels and statistics regarding air pollution to reconsider travel choices. This section captures the important insights of certain digital nudges, participants' comments and preferences of digital nudges and their reasons.

The participants were questioned about the most influential digital nudge in their perspective at the end of the interview. We found that the social norm nudge and priming nudge was less influential than the other types with mixed comments. Three out of five participants expressed negative sentiments regarding the social norm nudge with comments like "nice marketing" (P4: 42), "try to make me a minority" (P3: 38). Four out of five participants commented that the priming nudge was not influential in many ways. Participant P3 expresses this fact by saying "This information is kind of too general for me. We can write something like this about many things, so - no." (P3: 50). Participant P4 expresses their emotion regarding the priming nudge as "...but they are pushing a little bit more than it is necessary." (P4: 62). The most influential nudge according to our study as chosen by the participants would be the Feedback nudge and Middle option nudge. The comments from the participants can be found in the Table 4.3.

### 4.6.1 Not spending too much time on the choice

All the participants of our study expressed time constraint as an important factor that influences willingness to engage with a given content. While some participants were willing to invest time in understanding their options, others preferred to skip over detailed explanations, especially if they were familiar with the concepts involved or if they're not interested. Two participants P1 and P2 expressed positive feedback on default setting nudge saying that individuals may leave it selected due to the convenience of not needing to take an extra step, potentially impacting their decision to support the default option. P1's comments on default setting nudge "*Maybe some people are lazier than others and just choose to leave it like that because they don't need to do additional step*" (P1: 42). This provides an insight into the importance of default setting nudge given that the cost contribution is kept as low as possible, minimizing the effort required for individuals to deselect it.

When the participant P3 was shown a middle option nudge and social norm nudge to give their opinion, the participant explained that extra time was required to understand the different sustainable options to make informed decisions. The participant P3 also expressed negative sentiments regarding the default setting nudge saying they will uncheck all default options when in a hurry to book tickets. P3's comments on this regard is presented below:

*Usually I'm in a rush and I usually uncheck all the boxes, which I can. And this point I would check do not add sustainable fuel, because I don't understand really what it is and why I need extra fuel or something like that. (P3: 32)*

Participant P4 expressed similar sentiments regarding time constraints when questioned about social norm nudge as below:

*So, as I said, if this is the first time I would, I mean, of course it depends on the time constraints. So I am free right now, so I have time. I can read them, but if I don't have time, I would probably skip them. So it depends on the time. (P4: 56)*

#### 4.6.2 Nudge placement and visual representation.

Participants expressed various opinions regarding the visual layout of nudges, highlighting aspects such as labelling, font size, colour schemes and space occupied by the nudges. Participant P5 noted that the labelling of high and low values in the emission label radar of the framing nudge seemed misleading initially, as it deviated from the typical left-to-right, low-to-high convention. This provides an insight into designing digital nudges with conventional design principles and colour conventions. Participant P5's comment in this regard is presented below:

*I think it is a little bit misleading with the label because usually it goes from left to right, low to high, but here it says high is towards left and lowest towards right. I think maybe it is just like a color mismatch or something like that, but it is a little bit misleading. Like when you're looking at it for the first time, I would say, ... left is high and right is low because you usually don't pay much attention to these things when looking at flights. (P5: 54)*

Participant P4 mentioned that certain visual cues, such as green signs denoting sustainable options, helped them differentiate between choices and influenced their decision-making process positively with the following comments:

*So I know that it is different from the others, although it is ... the price is higher. I can see that they actually want to provide more sustainable ways to have flights. So this visual makes more sense to me. (P4: 58)*

The device types also influenced participants' perceptions. Participant P1 found the visual representation of the priming nudge acceptable on a computer but would have felt annoyed while booking via mobile phone for the reason that the nudge information takes a lot of space. The comments of P1 in this regard is presented below:

*When I'm checking from phone, I feel annoyed, because it takes a lot of space and you have to search where it is, but uh... on computer I read it and it is like okay. (P1: 85)*

The default setting nudge gained many positive comments with regards to the design of the nudge. Participant P4 expressed positive sentiments on the visibility, size and spacing of this nudge with the comments "I think it is well placed ... it doesn't take lots of space on the screen ... And also, the price is actually well located. And the size of the price is, I mean, it is okay." (P4: 26). Participants P1 and P5 also reflected on the size of the nudge and its simplicity in the design in a positive way.

**Table 4.5:** Participants' comments and preferences of digital nudges.

Nudge Type	Preference of digital nudges by participants	Comments by participants
Default settings nudge	P5	<p><i>“I think it is a good nudge. It is a nice way of pushing you towards choosing that option. ..., you don't mind paying extra \$2.99 for the sustainable fuel. But like I said, there should be full transparency and you should actually know what that sustainable aviation fuel is and how it is different from the normal one.”</i> (P5: 42)</p>
Feedback on emissions (after selecting sustainable choice)	P3, P2, P1	<p><i>“Yeah. Somehow, this caught my attention”</i> (P3: 56)</p> <p><i>“Yeah, this one. Or I mean, it is kind of like a combination now with the middle option, right? Because it is also the middle option here.”</i> (P2: 48)</p> <p><i>“And... and uh... from actually already when I'm booking the ticket and getting nudged, then I would say the getting the "yeah you did a good job" part where you already click it”</i> (P1: 88)</p>
Social norm nudge	-	-
Middle option nudge	P5, P2, P1	<p><i>“This is extremely influential. Yeah. Yeah, it is. I've chosen a lot of such options.”</i> (P5: 52)</p> <p><i>“Yeah, this one. Or I mean, it is kind of like a combination now with the middle option, right? Because it is also the middle option here.”</i> (P2: 48)</p> <p><i>“Yeah, that I can kind of feel how much I impacted and that and it shows in... in what ways do I impact it.”</i> (P1: 92)</p>

Framing: visually emphasizing the eco-friendly option	P4, P1	<p><i>“I think this is the best because as I said I can understand them. I can understand that they are different anyway and I can see the difference between them right now. ... in this case I can see that they are different so this framing is better, yes.”</i> (P4: 68)</p> <p><i>“the idea was there that you can choose it, and you can actually see the change in like very very wide um... spectrum that uh... medium, uh... high, or low impact.”</i> (P1: 88)</p>
Priming: introducing information beforehand	-	-

This chapter examines the participants’ travel habits, sustainability factors, and interactions with digital nudges in flight booking. While participants acknowledge that digital nudges could increase awareness of sustainable options, they also raise concerns about ethical issues such as persuasion, transparency, and data collection. Clear, available information on the sustainability options is deemed crucial due to confusion or lack of trustworthiness. Additionally, decisions are influenced by personal factors such as cost and trust in the airline's reputation. Tangible results and bonus incentives motivate participants to opt for sustainable choices. The design of the nudge and the availability of multiple options also has a positive impact on participant decisions.

## 5 Discussion

*This chapter delves into a detailed discussion of our research findings by comparing it with the literature and theories presented in chapter 2 with respect to investigating the potential of digital nudging to promote sustainable behaviour among air passengers in the context of booking online flight tickets. This chapter will discuss the important unexpected insights provided by our research findings on the feasibility and effectiveness of digital nudges. Further in this chapter, we will discuss the important sustainability factors and behavioural factors that play a major role in driving behavioural change towards taking sustainable actions in digital context. The perspective of air passengers on ethical implications of digital nudges is also discussed to provide an overall picture with regards to the potential, acceptance, and effectiveness of digital nudging to promote sustainability in air travel in a digital context.*

### 5.1 Factors influencing the effectiveness of digital nudges

We identified eight different factors based on coding the study results that acted as deciding factors to make a sustainable decision in a digital context. Among these factors, five emerged as novel contributions to the existing literature on willingness to pay (WTP) factors. These factors include importance of information availability, motivation of seeing the impact of sustainable choices, reputation of an airline that provides carbon offset programs, additional services, and design factors. The other factors like importance of personal booking consideration includes results that reflects on the established concepts in the literature. Price emerges as a key consideration in participants' booking decisions among students and working individuals and this complements with the research by Jou & Chen (2015). While sustainability is valued, affordability remains a priority, with participants indicating a willingness to consider sustainable options if the price difference is reasonable. The following subsections will delve into the five novel factors discussing the critical aspects that shape passengers' behaviours and attitudes toward sustainability in air travel.

#### 5.1.1 Importance of information availability

Our study underscores the crucial role of providing comprehensive and transparent information while using digital nudges to passengers. It was clear from our study that awareness and knowledge about carbon offset programs, or any other sustainability initiative impacts the decision of individuals to spend time to understand, trust the initiative without any confusion. This complements with the study by Kaiser et al. (1999) who claim that knowledge regarding environmental issues is an essential prerequisite of the intention to perform sustainable action. The participants expressed confusion and uncertainty regarding the effectiveness of carbon offset programs and they emphasised on availability of information like effectiveness scale, value for money that individuals pay, the environmental impact of paying for carbon offset programs, and the practical implementation of sustainable aviation fuel options.

Our research study also reflects on the information available in different nudge types like framing and priming nudges. A participant expressed dissatisfaction with the information

contained in carbon emission labels of framing nudge that were denoted using “low”, “medium” and “high” as they seemed to be insufficiently informative (participant P1). This participant emphasised on understanding the scale clearly to compare with the price difference. At the same time, visual representation of information is used to help individuals make informed decisions without a cognitive overload (Willermark & Islind, 2022). Thus, our study suggests that digital nudge designs should be meticulously crafted to cater to different audiences, whether they possess awareness or knowledge of sustainable options. Such designs should strike a balance between avoiding cognitive overload while providing comprehensive information.

### *5.1.2 Motivation of seeing the impact of sustainable choices*

The motivation derived from witnessing the tangible impact of sustainable actions emerged as a significant theme in our study's findings. A participant in our study shared their experience of how participating in community clean-up events helped in realization of the effectiveness of sustainable actions. This shows the importance of individuals being able to directly observe the outcomes of their sustainable behaviours, as it reinforces their commitment and encourages further engagement in eco-friendly practices.

Another participant expressed confusion in understanding how much does paying 3 euros to a carbon offset program has an actual environmental impact. This observation provides us insights on designing the digital nudges with some analogies and comparison to help individuals understand the numbers and statistics used in them to make informed decisions. Sometimes, individuals might find it easy to be consistent in performing low cost sustainable actions like recycling with strong pro-environmental behaviour when compared to high-impact sustainable actions like paying for carbon offsets (Berger et al., 2022). Hence, the suggestion from our study is to incorporate individual efforts towards larger positive outcomes into the design of digital nudges aimed at promoting sustainable travel behaviour. This approach can enhance the effectiveness of nudges aimed at encouraging passengers to take high impact sustainable decisions like paying for carbon offsets while booking flight tickets.

### *5.1.3 Company reputation*

Trust in airline companies emerged as a significant factor influencing passengers' decision-making processes. A participant of our study compared between two airline companies with regards to its values and support for sustainable initiatives and expressed a lack of trust in company X due to its perceived profit-driven approach (participant P1). This participant expressed support for another company Y, a Latvian airline known for its proactive efforts to reduce carbon emissions (participant P1). This comparison highlights a novel insight to be added to the literature on how an airline's reputation for sustainability can positively influence consumer decisions to support airline companies that demonstrate a genuine commitment to environmental stewardship.

Another participant when asked about priming nudge explained that the effort taken by the airline seemed obvious to explain about biofuel option with some fun fact and encouraging wordings through nudges (participant P2). Cordes et al. (2023) acknowledges this fact that the information designed in an appealing manner might have a positive influence on an

individual's decisions. Airlines that prioritize sustainability and actively communicate their efforts stand to benefit from increased consumer trust and loyalty. Hence, our study recommends designing digital nudges that includes factual information or a design that showcases genuineness of a company's support to sustainable initiatives.

#### *5.1.4 Importance of additional services*

Two participants highlighted the significance of tangible benefits and incentives offered by airline companies to encourage the selection of sustainable options. A participant expressed the sense of trust in airline companies that offer bonus points for choosing sustainable options, indicating that such incentives enhance the perceived value of sustainable choices (participant P4). Individuals evaluate the effort taken and importance that the airlines provide to encourage sustainable behaviour. This highlights the need for airlines to demonstrate their commitment to sustainability initiatives, emphasizing that their initiatives are driven by genuine concern for the environment rather than solely for profit motives (participant P4).

A participant proposed incentivizing eco-friendly travel through cashback rewards, discounts, or loyalty schemes tailored for green travellers. Careful consideration is necessary as high discounts may not induce a shift in travel behaviour. Moreover, offering greater benefits could potentially trigger rebound effects, where individuals compensate for their actions by relying on cheaper offsets (Baumeister, 2020; Cordes et al., 2023). But reward programs that include perks such as free seat selection for frequent flyers, can be considered nudging travellers towards more sustainable options. Our study recommends it is crucial to exercise careful consideration and conduct further research in this area to fully understand the implications and effectiveness of such incentive programs.

#### *5.1.5 Design factors*

From our research findings, we present important design factors or nudge designs that had a positive influence in decision making process of our participants. Our participants also insisted on certain factors like time constraints and design conventions as their preference while presented with different digital nudges. These insights are collected from the interview codes "Preference for availability of multiple options", "Not spending too much time on the choice" and "Nudge placement and visual presentation" of the theme "Effectiveness" in our study.

Framing nudge design offered various impact levels, indicating a preference for decision with multiple alternatives (participants P1 and P4). The middle option nudge allowed for comparison between alternatives based on benefits, carbon offset options, and price difference, suggesting a preference for choices that strike a balance between sustainability benefits and price (participants P1, P2 and P5). This novel insight will be an addition to applications of rational-actor model on the significance of the availability of multiple options on how it helps individuals in understanding of the differences between each choice and encourage opting for sustainable options with maximum benefits (Antimova et al., 2012).

Booking an online flight ticket is always in a rushed situation. Two participants favoured default setting nudges, finding them convenient for avoiding extra steps (participants P1 and P2). In contrast, another participant expressed the need for extra time to understand

sustainable options and tended to deselect default setting nudges when in a hurry (participant P3). Similar negative sentiments were expressed for social norm nudge that it is time consuming to read and understand. Hence, designing digital nudges keeping time constraint factor in mind is important as people might tend to skip them if the digital content is time consuming.

The visual layout of nudges like labelling, font size, colour schemes and space occupied by nudges are important to be influencing in a positive way without disturbing the conventional architecture. A participant found the labelling of high and low values in the framing nudge misleading due to its deviation from the typical left-to-right convention (participant P5). This suggests the importance of adhering to conventional design principles. Visual cues like green signs for sustainable options were positively influencing the participant's decisions (participant P4). The device types like a mobile phone influenced participants' perceptions negatively as looking at extra information like nudges in smaller screen would take up space and feels annoying.

To summarize, our study recommends three important design considerations: providing multi options as nudging mechanism to influence individuals to choose one sustainable option, time and digital space constraints as important factors to consider while designing nudges, and finally retaining conventions in design to avoid confusions.

## 5.2 Sustainable behaviour in air travel

Usual travel behaviour can influence the effectiveness of digital nudging aiming to promote sustainable choices in air travel. Personal booking considerations (price, timing, and minimal transfers), the type of travel (for business or personal reasons) and factor of solo or group travel, can sometimes outweigh the desire to choose sustainable options.

As mentioned in the literature review, the willingness to pay for carbon offset programs in airline websites is also influenced by individuals' personal environmental responsibilities and awareness of environmental issues (Cordes et al., 2023; Jou & Chen 2015). However, demonstrating strong support for the environment and participating in low-cost environmentally friendly activities does not mean that the person will engage in higher-impact environmental behaviours like purchasing carbon offsets for air travel (Berger et al., 2022). Our findings also indicate that, despite participants engaging in sustainable actions in offline settings and rating themselves as somewhat environmentally aware, they did not respond entirely positively to digital nudge examples or the concept in general. This highlights the importance of additional factors we previously identified as crucial for the effectiveness of digital nudges, emphasizing the complexity of the decision-making process.

What's important to note is that not all participants were aware of these types of sustainability nudges on airline booking websites. If a passenger isn't interested in sustainable actions, they might even overlook this section of the website. Furthermore, the placement of the nudge plays a crucial role in its visibility and the likeliness of passengers noticing it.

Overall, it is evident that participants had mixed emotions about digital nudging. They acknowledged its potential value in raising awareness about environmental issues in air travel but had doubts due to unavailable information, lack of trust, as well as the inability to see

tangible results. One suggestion from the participants was for airline companies to directly deduct the carbon offset costs from their profits, as the digital nudging approach can make users feel like all the responsibility lies in their hands and their personal finances, while companies are just making profits. Despite the scepticism, there was also willingness to see how these initiatives evolve in the future. This indicates that participants might reconsider opting for sustainable options if initiatives become more trustworthy and produce tangible results. Furthermore, when presented with the digital nudging examples, all participants exhibited a positive attitude towards at least one of the designs and indicated that it would influence their decision to choose the more sustainable option, suggesting the potential effectiveness across diverse beliefs and perspectives.

Regarding ethical considerations, participants often described digital nudging in this context as a form of marketing and profit-seeking by companies. This suggests a belief that companies may be creating a false impression of working towards environmental responsibility, or that they may not be allocating all funds to the stated initiatives and instead profiting from paid offsets. Furthermore, some reflections indicated the feeling of persuasion, highlighting the fine line between an ethical digital nudge and one that is manipulative. According to the literature review, the risk of manipulation is influenced both by the lack of understanding user preferences and transparency (Meske & Amojó, 2020a). Transparency was also identified as a key requirement for users with the default option digital nudge raising the most concerns regarding transparency and freedom of choice. Lastly, the issue of personal data collection emerged, but it appears that participants' general perspectives on data privacy determine their concerns in this regard.

To summarise the discussion of results, our research identified eight factors influencing sustainable decision-making in digital contexts, with five being novel contributions to the literature. These novel factors are information availability, the motivation of seeing the impact of sustainable choices, airline reputation, additional services, and design factors. Comprehensive information and visual clarity were crucial for user trust and engagement with carbon offset programs. Motivation was enhanced when participants saw tangible impacts of their sustainable actions. Trust in airline sustainability efforts significantly influenced decisions, with company reputation playing a critical role. Incentives like bonus points or rewards for choosing sustainable options were also important. Design factors such as multiple options, time efficiency, and adherence to conventional design principles positively impacted decision-making. Despite the value participants saw in raising awareness about sustainability, there were concerns about the transparency and ethical implications of digital nudging, suggesting a need for careful design to balance persuasion and autonomy.

## 6 Conclusions

The purpose of this study was to investigate the potential of digital nudging to promote sustainable behaviour among air passengers in the context of booking online flight tickets. Hence, our aim was to answer the following research question.

*What are the perceptions and responses of passengers towards digital nudges aimed at promoting sustainability in air travel?*

In order to study this research question, our research primarily provides strong theoretical background beforehand on the concepts including potential of behavioural change, effectiveness of carbon offset programs along with willingness to pay factor, attitude-behaviour gap, digital nudging as a concept, its effectiveness in promoting sustainability and the ethical considerations.

A semi-structured interview was conducted with five participants with questions framed to understand about individual's awareness, attitudes towards sustainability, travel behaviour, their understanding of digital nudging and ethical implications. At the end of interview process, participants were showed different digital nudges in online flight booking web pages to understand its influence on their decision-making process.

Four large themes with more than five different codes were obtained from the interview transcription. Through a detailed analysis of research findings and comparison with existing literature and theories, several important insights have emerged. Firstly, our research identified novel factors influencing the effectiveness of digital nudges, including the importance of information availability, motivation derived from observing the impact of sustainable choices, trust on airline company's reputation, the significance of additional services, and design factors. These factors highlight the need for comprehensive and transparent information, tangible incentives, and meticulous design considerations to encourage sustainable decision-making in a digital context.

Furthermore, the study highlights the complex interplay of personal, environmental, and behavioural factors in influencing passengers' willingness to engage with sustainable options. While sustainability is valued, affordability and convenience remain key considerations, indicating the need for innovative approaches to strike a balance between environmental concerns and practical constraints.

Ethical considerations surrounding digital nudging in the context of air travel also emerged, with participants expressing concerns about transparency, manipulation, and data privacy. Addressing these concerns is crucial to ensure the ethical implementation of digital nudges and promote trust among air passengers.

Overall, while participants exhibited mixed emotions towards digital nudging, there was a willingness to explore its potential effectiveness and evolve towards more sustainable behaviours in the future. By addressing the identified factors and ethical considerations, airlines can leverage digital nudging as a powerful tool to promote sustainability and environmental responsibility in air travel.

## 6.1 Contributions of the study

This study expands existing knowledge of how digital nudges can promote sustainable behaviour in air travel by introducing qualitative insights into passengers' perceptions and responses. Five novel factors affecting the effectiveness of digital nudges were identified. Moreover, it also gives practical guidance for interface designers and airlines to develop more effective digital nudges, enhancing user experience and helping reach broader sustainability goals in aviation.

## 6.2 Future work

Digital nudging is an emerging topic in IS research, and particularly the context of air travel and sustainability holds potential for further exploration. While our study extends the current literature by examining qualitative perspectives of digital nudges from a passenger viewpoint, there is a need for a deeper understanding of the ethical considerations and the design process in this context. Previous research on digital nudging in promoting sustainable choices in air travel has primarily focused on their effectiveness, but as highlighted in the theoretical background, the design and ethical aspects are equally important areas for study. Moreover, interdisciplinary research, particularly with psychology, could provide valuable insights, given the connection between IS and psychology within the theme of digital nudging. Overall, future research efforts in this area hold significant potential for exploring the use digital nudging to influence positive environmental changes in the aviation industry.

## Appendix 1: Consent form

**Lund University Master's Programme in Information Systems Master's Thesis: Digital nudging in air travel: An exploration of its impact on passenger sustainable behaviours**

Thank you for participating in our master's thesis, which investigates the effects of digital nudging on the adoption of sustainable behaviours among air travel passengers.

The purpose of this study is to explore the perceptions and reflections of passengers towards digital nudges in airline interfaces aimed at promoting sustainability. Since previous research has not qualitatively examined this aspect, we will be conducting semi-structured interviews to extend the existing research from a qualitative perspective.

The interview data will be analysed by the students mentioned below, supervised by the supervisor mentioned below, and the completed thesis will be assessed and graded by an examiner at the end of the course.

We ask for your approval to interview you and use the data for the study. Participation in this study is voluntary and you have the possibility to withdraw from participation at any time without motivating why.

The interview will be recorded and subsequently transcribed. All collected data will be protected, securely stored, and will not be disclosed to unauthorized individuals. The transcribed text will be further coded and analysed, and the findings will be presented in an anonymous manner. You may request the transcript to be sent to you until the end of the research (May 20, 2024). Once the research deadline has passed, all original data collected will be destroyed.

The results of the study will be presented in the thesis in a manner that protects the confidentiality of participants. Our research adheres to established guidelines on research ethics and applicable laws. Please contact us if you need any additional information.

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Supervisor: Avijit Chowdhury  
Email: [avijit.chowdhury@ics.lu.se](mailto:avijit.chowdhury@ics.lu.se)

If you agree to the information provided above, please sign this consent form.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

## Appendix 2: Background information on interview topic

### What is nudging and digital nudging?

Nudging is like giving someone a gentle push in the right direction without taking away their freedom of choice. It is a way to influence people's decisions by changing the way choices are presented to them. For example, putting healthy snacks at eye level in a cafeteria nudges people to choose them over less healthy options.

Now, digital nudging takes this concept into the online world. Just like how a store arranges its shelves to encourage certain purchases, websites and apps use design elements and features to guide our online behaviour. For instance, when you're booking a flight online and the website highlights a limited-time offer, that's a form of digital nudging to encourage you to make a decision quickly.

### What is sustainability in the air travel industry?

Sustainability in air travel means finding ways to reduce the negative impact of flying on the environment. Airplanes emit greenhouse gases like carbon dioxide, which contribute to climate change [Fact: Worldwide, aviation contributes approximately 2% to global greenhouse gas emissions!]. To make air travel more sustainable, airlines and airports are looking for ways to lower emissions, use energy more efficiently, and reduce waste.

For example, some airlines are investing in newer, more fuel-efficient planes, while others are offering carbon offset programs where passengers can pay extra to fund environmental projects that reduce emissions.

### What is carbon offset program?

Carbon offset programs provide a way for people to take responsibility for their carbon footprint.

For example, if you take a flight and want to offset the carbon emissions generated by that flight, you can calculate the estimated emissions based on factors like the distance travelled and the type of aircraft used. Then, you can purchase carbon offsets equivalent to the amount of emissions. The funds from your purchase support projects that reduce emissions elsewhere, effectively neutralizing the environmental impact of your flight.

### Digital nudging in online flight booking – few examples

- Visual cues like green leaf icons or symbols next to flights with lower environmental impact, making it easier for you to identify sustainable choices.
- Social norm nudge by showing messages like "90% of travellers choose eco-friendly options" to encourage you to follow the same.

## Appendix 3: Interview Guide

### Personal details.

1. Age
2. Gender
3. Country/place where you've lived longest part of your life
4. Education level
5. Professional status

### Introduction to our study.

The purpose of this study is to explore the perceptions and reflections of passengers towards digital nudges in airline interfaces aimed at promoting sustainability.

**Introduction questions: To understand the participants' attitudes towards environmental sustainability and awareness of pro-environmental behaviour, as well as to identify their travel behaviour.**

1. Have you participated in any sustainability-related programs, supported such initiatives through volunteering or providing monetary support, or adopted a sustainable lifestyle by making changes in your life in response to environmental issues? For example, sorting garbage waste after learning about the impact of plastic pollution on global warming.
2. On a scale from 1 to 10, how would you rate yourself in terms of awareness and responsibility regarding environmental issues, with 1 being the lowest and 10 being the highest?
3. Can you describe your air travel behaviour in terms of frequency of air travel, and whether it is usually long haul or short haul flight?
4. What are the main factors that you consider while booking online flight tickets? Can you prioritize them?

### Questions regarding overall attitude of the use of digital nudges for promoting sustainability in air travel.

1. Have you ever noticed that online air travel booking platforms aim to influence your decisions regarding sustainability by using digital nudges?
2. What are your overall reflections on the use of digital nudges for promoting sustainability in air travel?

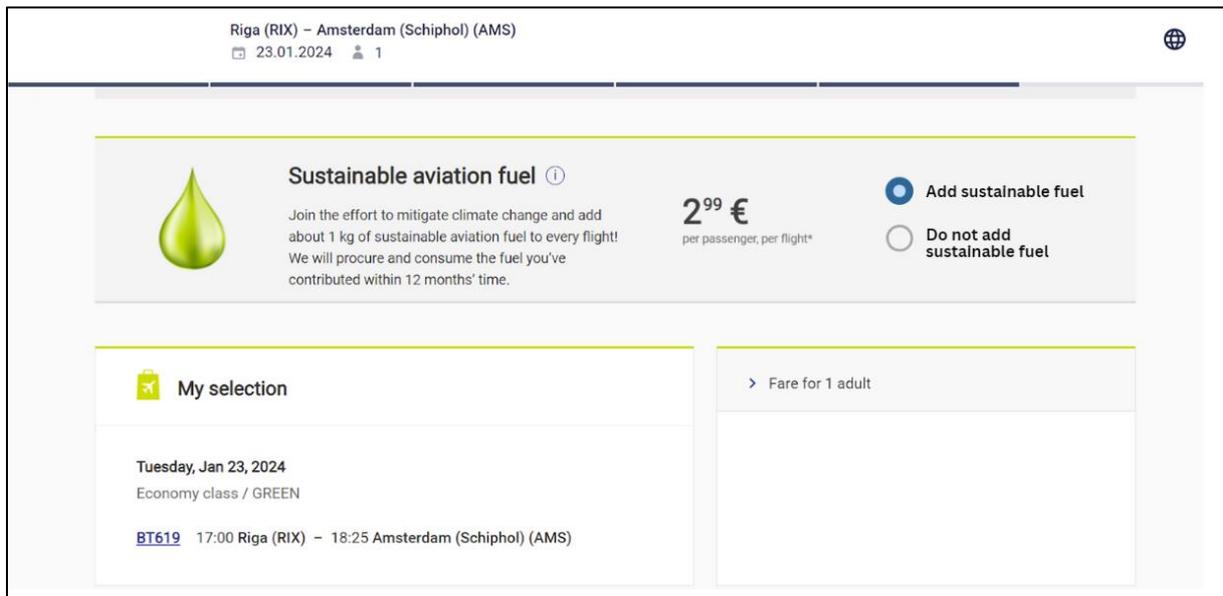
### Questions regarding ethical implications of using digital nudges for promoting sustainability in air travel.

3. What are your thoughts on the ethical implications of using digital nudges to influence passengers' behaviours towards sustainability in air travel?
4. How important do you think it is for digital nudges to be transparent in their intentions and methods when aiming to promote sustainable behaviours?

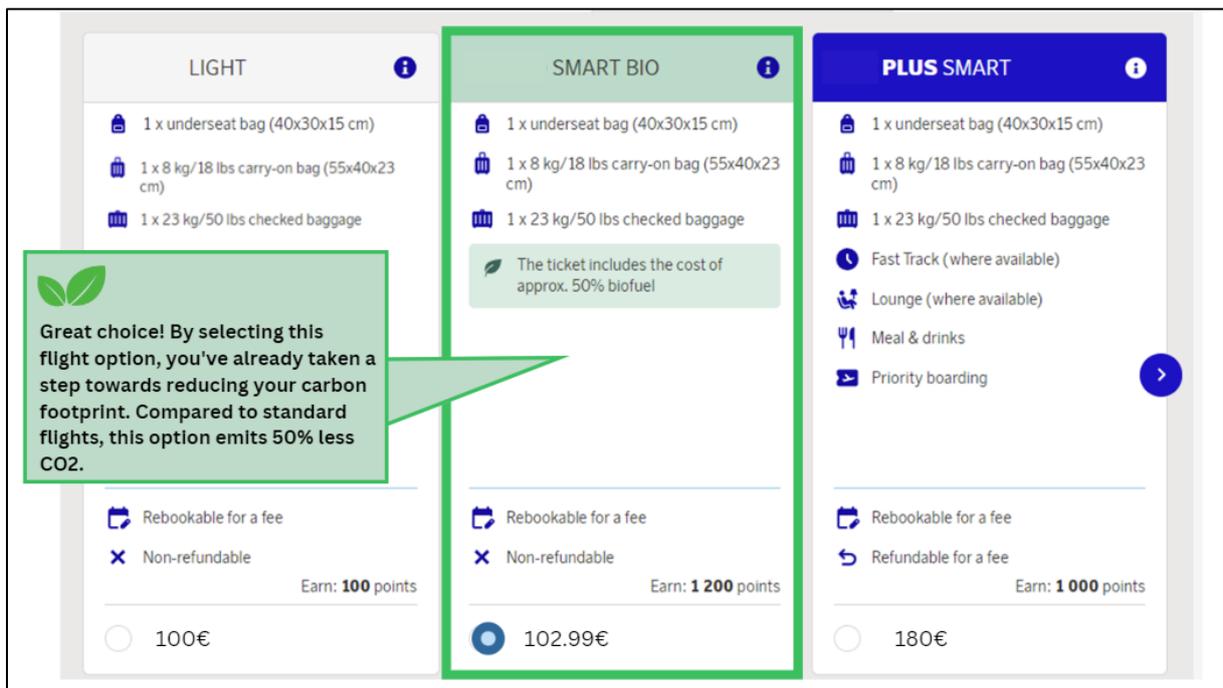
**Questions regarding the design elements of digital nudges to understand interviewee’s perceptions of them and the influence on their decision-making process.**

We will show a few pictures of digital nudges in the context of online flight ticket booking process.

1. Describe your thoughts on these nudges, how you feel about the nudging technique.
2. Would it influence your decision on flight ticket booking or not?



**Figure A:** Use of default settings (adapted from AirBaltic, n.d.)



**Figure B:** Feedback on emissions after selecting sustainable choice (adapted from SAS, n.d.)

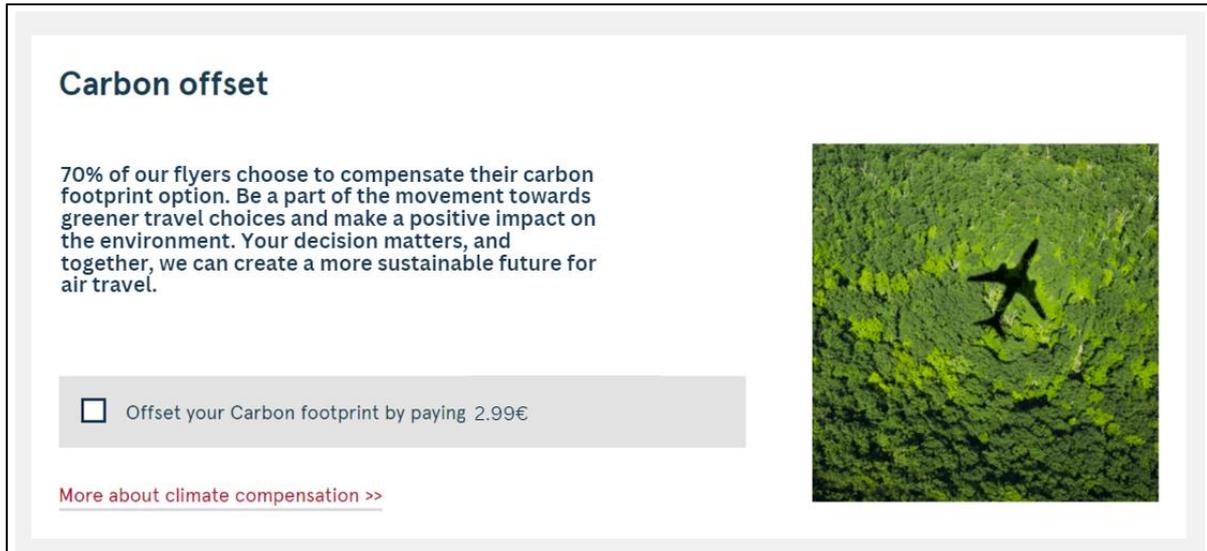


Figure C: Social norms (adapted from Norwegian, n.d.)

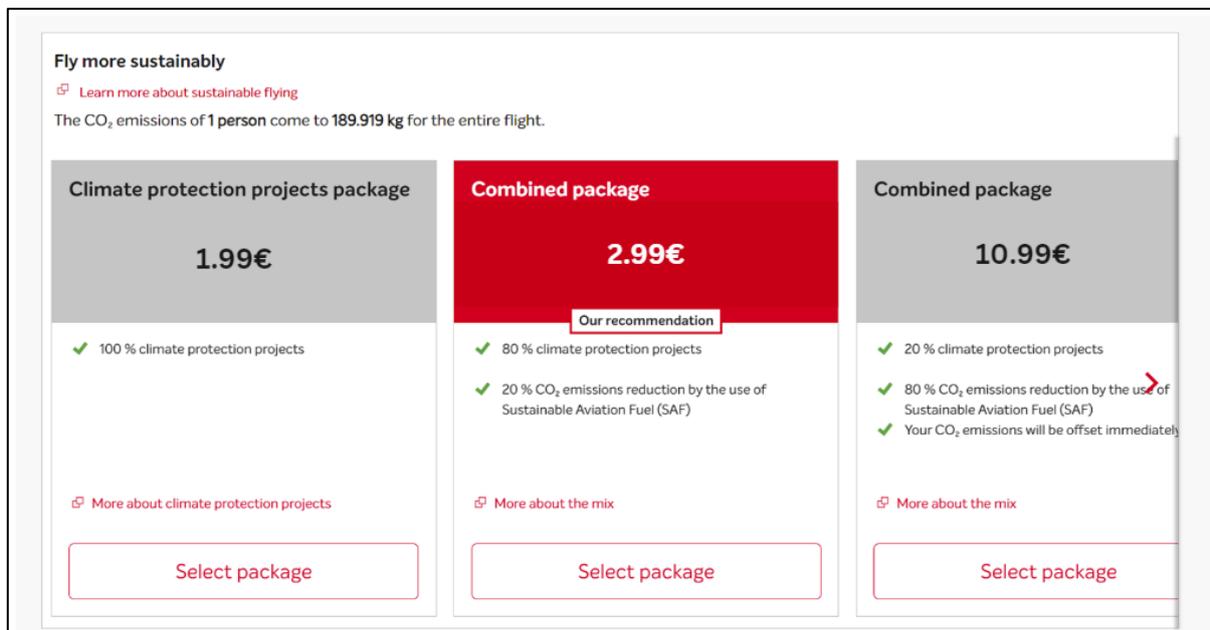


Figure D: Middle option (adapted from Brussels Airlines, n.d.)



Figure E: Framing: visually emphasizing the eco-friendly option

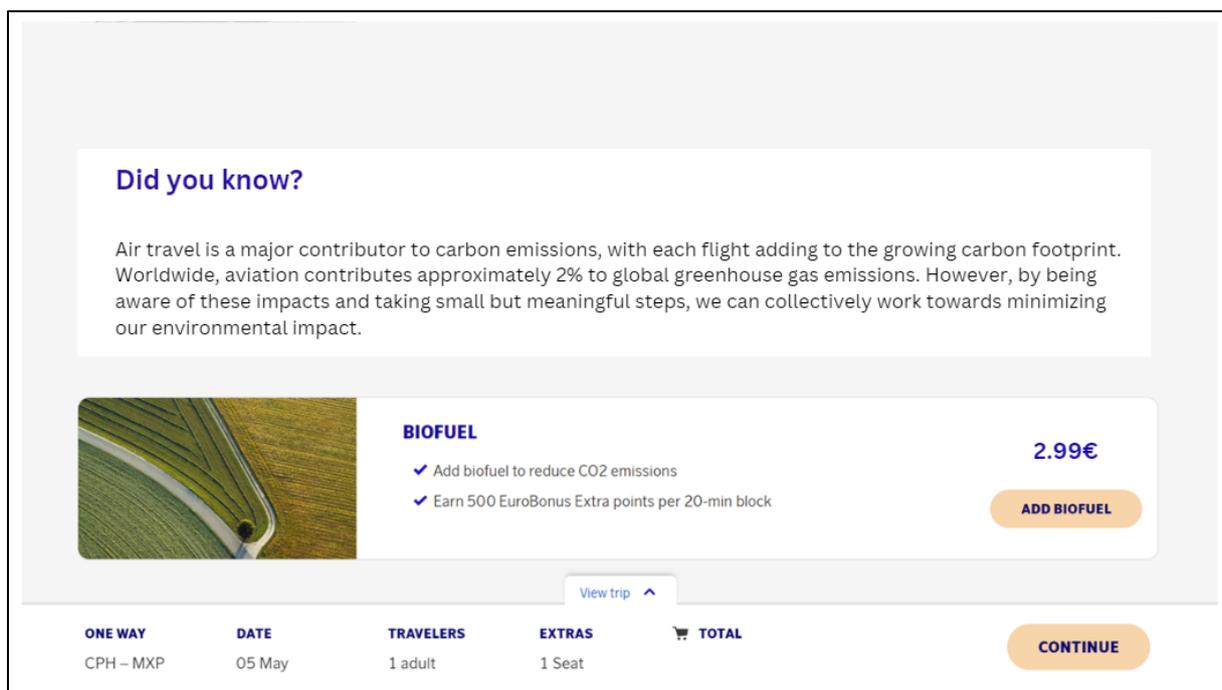


Figure F: Priming: introducing information beforehand (adapted from SAS, n.d.)

3. Which of the nudges do you believe would be the most suitable in this context to promote sustainable behaviour in air travel?

## Appendix 4: Themes and codes from Interview transcription

We found four main themes with more than five codes under each theme from the interview transcription for analysis of findings.

Theme	Code	Count
Ethical implications	Personal data collection	2
	Concerns regarding company profit/marketing	9
	Importance of transparency	6
	Questioning the ethical implications of default option digital nudge	4
	Persuasion	5
Behavioural influences	Importance of price	16
	Importance of flight time and minimal transfer	7
	Effects of travel type on flight behaviour	4
	Usual flight frequency	6
	Usual flight distance	4
	Factor of solo vs. group travel	2
Effectiveness	Preference for the availability of multiple options	9
	Nudge placement and visual representation	6
	Importance of information availability	26
	Importance of company reputation	5
	Motivation of seeing the impact of sustainable choices	15
	Not spending too much time on the choice	9
	Importance of personal booking considerations	14
	Importance of additional services	7

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Sustainability factors	Taking initiative and participating in sustainable activities	11
	Sustainability awareness and responsibility rating	6
	Awareness of digital nudging to promote sustainability in air travel	4
	Attitude towards digital nudging to promote sustainable behavior in air travel	5
	Suggestion for companies to take direct action for sustainability	4
	Raising awareness about sustainability among passengers	3

## Appendix 5: AI Contribution Statement

In the completion of this Master's Thesis, AI-based tools were utilized to a limited extent, primarily for specific tasks such as language refinement and data transcription.

1. **Tools:** ChatGPT, and Whisper AI.
2. **Degree of use:** ChatGPT was employed to generate alternative phrases and improve the clarity of the text, offering suggestions for sentence structure and word choice. It was also used to format the document like adding section breaks, setting page numbers, and adding captions for tables and figures. Whisper AI was utilized for interview transcription, converting recorded interviews into text for analysis.

We recognize that extensive reliance on AI tools can influence the originality and credibility of our submission. Therefore, we affirm that our entire thesis work maintains integrity and is entirely devoid of any unethical practices or inappropriate use of AI technology.

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