Fiscaoeconomia

E-ISSN: 2564-7504
2024, Volume 8, Issue 3, 1335-1365
https://dergipark.org.tr/tr/pub/fsecon

Submitted/Geliş: 03.04.2024
Accepted/Kabul: 23.07.2024
Doi: 10.25295/fsecon.1464126

Research Article/Araştırma Makalesi

From Theory to Action: Evaluating How (Digital) Nudges Influence Pro-Environmental Behaviors

Teoriden Eyleme: (Dijital) Dürtmelerin Çevre Yanlısı Davranışları Nasıl Etkilediğinin Değerlendirilmesi

Havva SERİM TORO[1], Seda AKSÜMER[2]

Abstract

Everyday actions of people across various settings can lead to environmental issues. These automatically performed actions are overlooked in the traditional economics. Therefore, it is crucial to identify and understand pro-environmental behaviors. On the other hand, behavioral economics offers insights into cognitive constraints affecting these kinds of behaviors and develops nudges that take human beings' limited rationality into account. Therefore the study underscores the significance of nudges as empirical tools in behavioral economics for building a sustainable world and laying the foundation for pro-environmental behaviors. In this context, it examines the emerging significance of nudges in digital settings, analyzing their applications in this domain. Conducting an extensive literature review, this study categorizes pro-environmental behaviors as energy conservation, waste reduction & recycling, and sustainable consumption. Sustainable consumption is divided into grocery shopping, travel decisions, fashion & makeup choices. The research makes the importance of behavioral economics apparent by acknowledging the automatic nature of many pro-environmental behaviors and addressing the pervasive attitude-behavior gap. Consequently, by investigating the impact of both physical and digital nudges, this article offers a practical response to empirical evidence on promoting pro-environmental behavior responsible actions.

Jel Codes: *D9, Q5, J18*
Keywords: *Pro-environmental behavior, (Digital) Nudges, Policy Review, Sustainability, Literature Review.*

[1] Assist. Prof., Ankara Haci Bayram Veli University, Department of Economics, havva.serim@hbv.edu.tr. ORCID: https://orcid.org/0000-0003-4222-4670.
[2] Phd Candidate, Ankara Haci Bayram Veli University, Department of Economics, seda.aksumer@hbv.edu.tr. ORCID: https://orcid.org/0000-0001-9516-1226.

Citation/Atıf: Serim Toro, H. & Aksümer, S. (2024). From Theory to Action: Evaluating How (Digital) Nudges Influence Pro-Environmental Behaviors. *Fiscaoeconomia, 8*(3), 1335-1365. Doi: 10.25295/fsecon.1464126

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Öz

İnsanların çeşitli ortamlardaki gündelik eylemleri çevresel sorunlara yol açabilmektedir. Otomatik olarak gerçekleştirilen bu eylemler, geleneksel iktisatta göz ardı edilmektedir. Bu nedenle, çevre yanlısı davranışları tespit etmek ve anlamak çok önemlidir. Öte yandan, davranışsal iktisat bu tür davranışları etkileyen bilişsel kısıtlamalara ilişkin içgörüler sunmakta ve insanların sınırlı rasyonelliğini dikkate alan dürtmeler geliştirmektedir. Bu nedenle çalışmada, davranışsal iktisattaki dürtmelerin sürdürülebilir bir dünya inşa etme ve çevre dostu davranışların temelini atma konusundaki önemi vurgulanmaktadır. Bu bağlamda dürtmelerin dijital ortamlarda ortaya çıkan önemi incelenerek bu alandaki uygulamaları analiz edilmiştir. Kapsamlı bir literatür taraması yapılan bu çalışmada, çevre yanlısı davranışlar enerji tasarrufu, atık azaltma, geri dönüşüm ve sürdürülebilir tüketim olarak kategorize edilmektedir. Sürdürülebilir tüketim ise market alışverişi, seyahat kararları, moda ve makyaj tercihleri olarak ayrılmaktadır. Araştırma, birçok çevre yanlısı davranışın otomatik doğasını kabul ederek ve yaygın tutum-davranış farkını ele alarak, davranışsal iktisatın önemini belirgin hale getirmektedir. Sonuç olarak, hem geleneksel hem de dijital dürtmelerin etkisini araştıran bu çalışma, çevre yanlısı davranışların teşvik edilmesine ilişkin ampirik kanıtlara pratik bir yanıt sunmaktadır.

Jel Kodları: *D9, Q5, J18*
Anahtar Kelimeler: *Çevre Yanlısı Davranışlar, (Dijital) Dürtmeler, Politika İncelemesi, Sürdürülebilirlik, Literatür Taraması.*

Serim Toro, H. & Aksümer, S. (2024). From Theory to Action: Evaluating How (Digital) Nudges Influence Pro-Environmental Behaviors. *Fiscaoeconomia, 8*(3), 1335-1365.
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1. Introduction

Encouraging consumers to adopt sustainable behaviors is critical to protecting the environment and maintaining the planet's limited resources. The understanding that our natural resources are finite is at the core of this necessity. The Earth's limited resources, including raw materials, electricity, and water, are becoming more and more stressed as a result of rising population density and changing consumer habits (Chu & Karr, 2017). Reducing waste, conserving energy, and engaging in responsible consumption are examples of sustainable habits that are essential to easing these pressures. Through conscientious decision-making in their everyday lives, consumers can minimize resource depletion, minimize ecological footprints, and mitigate environmental deterioration. Furthermore, sustainable development is also promoted by sustainable consumer practices (Yildirim, 2020). In essence, the collective adoption of sustainable behaviors by consumers represents a crucial step towards ensuring a balanced and resilient future for generations to come.

However, conscientious decision-making in our daily lives proves challenging from a behavioral economics perspective due to the prevalence of automatic behaviors and the existence of an attitude-behavior gap. Behavioral economics posits that individuals often rely on heuristics and cognitive shortcuts, leading to the automatic execution of routine actions without deliberate thought. This automaticity is rooted in the human tendency to conserve cognitive resources, and as a result, individuals may default to familiar, less pro-environmental behaviors. Additionally, the attitude-behavior gap, a phenomenon where individuals' intentions and beliefs do not consistently translate into corresponding actions, further complicates conscientious decision-making (Wintschnig, 2021). While people generally have strong attitudes towards sustainability, they have difficulty translating their intentions into action because of automatic habits or external factors that influence their decisions.

Therefore, in the modern environment, the combination of nudge theory and behavioral economics is particularly important for encouraging pro-environmental habits. Behavioral economics, which is based on an understanding of how people make decisions, offers a perspective through which (non-price) interventions, or "nudges," can be created to favorably affect outcomes. Whether they take the shape of digital or traditional nudges, they operate as low-cost strategies to encourage activities that are environmentally friendly (Newell & Siiamaki, 2014; Weinmann et al., 2016; Schneider et al., 2018; Gillingham & Tsvetanov, 2018; Grebitus et al., 2020). In this manner, these key research questions (R.Q.) guide our exploration:

R.Q.1. What is the current understanding of the use of nudges and digital nudges to bring about changes in pro-environmental behavior?

R.Q.2. How do traditional and digital nudges influence pro-environmental behavior, and what are the differences in effectiveness between traditional and digital nudges in promoting pro-environmental behavior?

To answer these questions, we conducted an extensive literature review, drawing on reputable databases such as Scopus, Web of Science, AIS eLibrary, EconLit, and other electronic databases, as well as relevant journals and citations referenced in included papers.

Although our primary focus is on studies published in peer-reviewed journals, we also included studies and conference papers from active researchers in the field. We limited our examination to studies utilizing experimental designs to establish relationships between interventions and behavioral outcomes on pro-environmental behavior with the categorisation of energy conservation, waste reduction and recycling, and sustainable consumption. Our review adhered to three specific criteria: 1) inclusion of experiments, 2) emphasis on pro-environmental behavior changes, 3) relevance to our three specified domains. We also categorized sustainable consumption into three behaviors: grocery shopping habits, travel decisions, and fashion & make-up choices based on the literature. To provide a comprehensive survey across multiple domains and interventions, we imposed certain constraints on our review such as we opted not to report study effect sizes or weigh them by quality due to variations in behavioral outcomes. Despite these constraints, we believe that our analysis provides a precious insight into the current state of evidence.

Our research extends the scope of earlier reviews, which concentrated solely on either energy conservation (Andor & Fels, 2018; Buckley, 2020; Chatzigeorgiou & Andreou, 2021), or other related pro-environmental behaviors (Lehner et al., 2016; Varotto & Spagnolli, 2017; Barker et al., 2021). There are studies that specifically examine traditional nudges (Osbaldiston & Schott, 2012; Byerly et al., 2018; Wee et al., 2021; van Valkengoed et al., 2022) or digital nudges (Zimmermann et al., 2021; Berger et al., 2022; Beermann et al., 2022; Zawieska et al., 2022) within this domain as a policy comparison and analysis. Hence, our research endeavors to analyze nudges and digital nudges, aligning them with distinct pro-environmental behaviors, allowing us to assess their efficacy in promoting sustainable actions within each behavior category.

It is essential to recognize that, although core principles of nudging remain consistent across physical and digital platforms, the changes in choice architecture and subsequent effects can vary significantly. For example, bringing nudging principles into the digital space, such as featuring sustainable products prominently in online stores, introduces complexities that require separate evaluation. The work of Meske & Amojo (2019) highlights the complications of this shift, emphasizing the need to examine the effects of digital nudges independently from their offline counterparts. Therefore, we analyzed related nudges separately by providing foremost examples. By exploring the details of nudging mechanisms and their implications in both traditional and digital settings, this study aims to contribute valuable insights to the ongoing academic discussions on environmentally friendly behavior.

The rest of this article is arranged as follows. Section 2 summarized the theoretical background of nudge theory and its relation to pro-environmental behavior. Section 3 provides the prominent traditional and digital nudges applications for energy conservation, recycling & waste reduction, and sustainable consumption behavior. Section 4 presents discussions and concludes the study.

2. Theoretical Background

2.1. Behavioral Economics and Nudge

As Richard H. Thaler (2016), winner of the 2017 Nobel Prize in Economics and one of the pioneers of the adoption and popularization of (modern) behavioral economics in the economics literature, emphasizes, calling economics behavioral is not about the opposition that it is a non-behavioral discipline: Both neoclassical and behavioral economics are about understanding and investigating economic behavior. The contrast stems mainly from the differences in the assumptions that these two approaches make about human behavior. While neoclassical economics models humans as homo economicus, behavioral economics seeks to understand and describe homo sapiens.

Homo economicus models a human being who acts 100% in his/her own self-interest, makes decisions 100% isolated from his/her environment, is 100% rational, has 100% willpower, temporal coherence and foresight. However, when these assumptions are stretched, in other words, when it is assumed that human beings possess these qualities with less than 100% probability, the structure of economic analysis diversifies and changes (Rabin 2002). In this regard, behavioral economics study human behavior without priori assumptions, accepting that a human being might display bounded rationality, bounded self-control and bounded self-interest depending on the context (Mullainathan & Thaler, 2001). That way, behavioral economics brings those main insights together by drawing on psychology, cognitive sciences and other related social sciences. Accordingly, behavioral economics' policies, or nudges, are a set of interventions based on these insights. So, how can we define a "nudge"? The presence of various explanations for a behavior complicates the design of interventions for behavior change. Additionally, differences in decision environments and contexts across studies make it challenging to agree on a clear definition of what qualifies as a nudge. Nevertheless, Thaler & Sunstein's (2008:6) definition provides a general framework for nudging: Nudging is the use of a choice architecture that aims to change individuals' behavior in a predictable way, without prohibiting any choice or drastically altering economic incentives. From this perspective, nudges directly target individuals' decision-making mechanisms, unlike neoclassical economics' policies that only intervene in market failures.

The reason for the effectiveness of nudges, which have been successfully applied in many economic areas in recent years, is basically the fact that, as the mind uses System 1 to save time and energy, choices and behaviors are often made automatically, without thought. This often leads to suboptimal "errors". Note that behavioral economics models the "dual way of thinking" of the mind: The way of thinking represented by System 1 is fast, intuitive, emotional and therefore automatic, while the way of thinking represented by System 2 is slow, cautious, analytical and therefore conscious (Stanovich & West, 2000). In other words, nudges are successful because they are designed taking into account that behavior is the result of the interaction of two systems, but mostly with System 1. For sustainability research, one of the results of dual way of thinking is that attitude-behavior gap which represents the discrepancy of willingness to support pro-environmental behaviors and actual purchasing or adopting behaviors (Terlau & Hirsch, 2015). In this manner, nudges help individuals or businesses to adopt sustainable behaviors by steering them towards what's best for them and the

environment without changing financial incentives significantly but preserving the autonomy of decision-making. Accordingly, digital nudges are defined as choice architecture to influence decision making in digital settings, especially in online buying behavior (Weinmann et al., 2016; Schneider et al., 2018). When we consider the rapid growth of online shopping, digital nudges seem to be doing as good as other nudges for desired behaviors such as sustainable grocery & apparels shopping and travel decisions (Berger et al., 2020; Roozen et al. 2021; Meske et al., 2022).

2. 2. Pro-environmental Behavior (PEB) and Nudge

The ecosystem, encompassing the shared living space for all organisms, is characterized as the biological, physical, social, economic, and cultural environment where living entities interact. In this interconnected web of relationships, addressing environmental challenges involves collective endeavors to enhance pro-environmental behaviors (PEB) (Environment Law, 1983). The day-to-day actions of individuals play a pivotal role in shaping the current state and future trajectory of the environment. Consequently, it is asserted that individual consumption patterns significantly contribute to climate change, biodiversity decline, and water resource depletion. With the human population on Earth expected to keep growing, these impacts are anticipated to worsen. Therefore, encouraging improved pro-environmental behavior is essential to preventing environmental disasters (Byerly, 2018: 159) and it's essential to assess pro-environmental behaviors using a conceptual framework by exploring the definition of pro-environmental behavior, considering its sustainable and behavioral aspects from various perspectives in different disciplines.

Investigating individuals' environmental behavior has been a significant focus in psychology and sociology. A central question in this exploration is: "why do some people engage in pro-environmental behavior while others do not?" To address this, we must first understand the definitions of pro-environmental behavior. PEB involves actions that minimize the impact of human activities on nature (Kollmuss & Agyeman, 2002: 240). These behaviors fall into categories such as non-activist behaviors in the public space, environmental activism, and individual environmentalism (Stern, 2000), tied to altruistic, biospheric, and pro-social behavior patterns. Such factors, influencing individuals' PEB, contribute to heightened environmental concerns and awareness (Steg & Vlek, 2009: 311; Groot & Steg, 2008). On the other hand, Kennedy et al., (2009) define pro-environmental behaviors as supportive actions for the environment, such as green consumption habits, public transportation use, recycling, and conscious use of energy and water. These behaviors result from individuals' personal efforts in both public and private life (Li et al., 2019: 29). According to Ramus & Killmer (2007), pro-environmental behavior includes ecological actions that benefit society or overall welfare.

For this reason scholars generally agree on the definition of PEB, emphasizing actions that minimize one's negative impact on the environment, with some extending it to include behaviors that benefit the environment and society. The focus is on improving environmental conditions while reducing harmful impacts like greenhouse gas emissions and resource waste. Various terms, such as "ecological behavior", "sustainable behavior," and “green behavior”

are used interchangeably, sharing common ground in specific actions and influences (Tian & Liu, 2022).

Enhancing and improving these behaviors requires identifying the cognitive biases that play a determining role in individuals' behavior patterns. Consequently, this discussion will delve into assessing the obstacles to pro-environmental behavior through the lens of behavioral economics. Broadly, the key determinants of this behavior, a significant domain in economics and psychology, can be categorized into four factors (Blankenberg & Alhusen, 2019: 1):

- Socio-demographic factors (personal capabilities)
- Contextual factors (individual, social, and institutional)
- Attitudinal (psychological) factors
- Habits

The interplay of individual and social factors is critical in shaping pro-environmental behavior. On the other hand, cognitive biases and heuristics pose barriers to PEB, diminishing environmental awareness. Cognitive biases hindering pro-environmental behavior include the difficulty in perceiving environmental problems, the slow pace of ecological changes, and the inherent complexity of environmental issues. Many individuals are unaware of the severity of problems like nuclear radiation, the ozone hole, and greenhouse gas emissions, as well as the potential devastating consequences they may have in the future (Kollmuss & Agyeman, 2002: 253-254).

One of the cognitive biases linked to PEB is loss aversion which relates to how people assess possibilities in loss and gains domains (Kahneman and Tversky, 1979). Many studies support the idea that humans tend to react more strongly to negative feelings associated with losses than positive feelings from gains (Levy, 1996: 181). Recognizing the significance of loss aversion as a cognitive bias, efforts have been made to understand and improve barriers to pro-environmental behavior. Research demonstrated that using loss framing, rather than gain framing, positively influenced individuals' pro-environmental decisions (Homar & Cvelbar, 2021). This finding was supported by a quasi-experiment measuring household energy consumption, where a decrease was observed with the use of loss framing intervention (Gonzales et al., 1988). Field experiments exploring the impact of loss- and gain-framed messages on behavior concluded that loss-framed messages positively influence behavior (Lord, 1994; White et al., 2011; Grazzini et al., 2018).

Another cognitive bias influencing PEB is the status quo bias. This bias makes people less inclined to change their current situation due to the belief that the present state is certain and involves fewer risks (Kahneman et al., 1991: 197-198). The inclination to stick with the status quo and face social dilemmas is one reason for resistance to environmentally friendly changes (Johnsen, 2016: 406). For example, Frederiks et al., (2015) argue that automatic and habitual behaviors in household energy consumption contribute to maintaining the status quo, but they suggest that appropriate nudges can change individuals' energy consumption behavior.

Finally, it's important to highlight the present bias as a potential source of cognitive biases. The present bias denotes individuals' inclination to assign greater significance to rewards occurring in the near future when assessing trade-offs between two future instances (O'Donoghue & Rabin, 1999). This also may lead to gaps between intention and action, and a tendency to procrastinate. This bias helps explain some current behaviors (Kremer et al., 2019: 380). For instance, a study in India found that individuals who are more patient and have lower present bias are more likely to invest in energy-saving devices, addressing the gap between energy-saving intentions and actions (Fuerst & Singh, 2018). That's because sustainable behaviors are usually linked to future benefits, representing abstract and uncertain processes in the human mind. Similarly, when deciding on environmentally friendly purchases, people often prefer outcomes closer to the present (Trudel, 2019: 88). These kinds of cognitive biases create challenges to individuals' PEB. Therefore, recognizing and understanding these biases is crucial for bridging the gap between intention and behavior. In the following section, we will assess the impact of appropriate choice architectures and behavioral interventions on PEB from a nudge perspective which takes these biases into consideration.

3. Action: Nudges & Digital Nudges for PEB

3.1. Energy Conservation

In the realm of energy conservation behavior, denoting the deliberate reduction of energy consumption within households, commonly used policies for influence include the strategic deployment of social norms, informational nudges, default options, framing effect, and goal-setting mechanisms. So, energy conserving behavior implies mainly two ways that households can save energy: first, by altering how much energy they consume, such as by using less light. Second, they can invest in energy efficiency and change the way they acquire things, like getting a really effective washing machine (Andor & Fels, 2018).

Numerous experimental approaches employing social norm nudges have demonstrated the capacity to effectuate changes in energy-saving attitudes and behaviors (Gillingham & Tsvetanov, 2018: 305). Social norms are significantly influenced by the social group in which the individual resides and are defined as a persuasive tool for improving behavior (Sherif, 1937; Cialdini & Goldstein 2004). Therefore, a message such as "A majority of your neighbors have adopted energy-efficient lighting" or "Your current energy consumption is above the neighborhood average" has the potential to motivate individuals to align their behavior with perceived communal standards.

The effectiveness of the social norm intervention used in field experiments aiming to improve the energy saving behavior of households was measured by energy consumption in electricity meters. The common finding of the studies is that interventions using social norms significantly encourage energy saving behavior of individuals (Schultz et al., 2007; Nolan et al., 2008; Alcott, 2011; Edirneligil, 2021). On the other hand, studies investigating the role of social norms on energy consumption behavior were conducted with university students. It was discovered that when the phrase "other university students save more energy" was applied to voluntary thermostat use within the context of social norms, behaviors improved (Liu, et

al., 2016). Interventions with feedback messages within the scope of social norms have been implemented in university campuses in South Korea, New Zealand, the USA and Thailand. These studies revealed that interventions employing social norms resulted in a significant improvement of students' energy consumption behavior (Petersen et al., 2007; Bekker et al., 2010; Delmas & Lessem, 2014; Anderson et al., 2017; Chongwilaikasae & Ayaragarnchanakul, 2023).

In this field, the effectiveness of nudges goes beyond social norms to include the influence of informational nudges and default options. For example, Cardella et al., (2022) investigated the extent to which informational nudges influence participants' choice preferences. This study investigated whether providing information about the efficiency, cost and environmental impacts of different energy sources influences consumers' voluntary choice of green energy plans. The results from two different samples show that informational nudges significantly influence participants' choice of plan. Showing pro-green choices as the default increased individuals' choice by 6%-8% according to this plan. The results showed the potential for information nudges to be a more understandable and less costly mechanism to increase the adoption of voluntary green energy plans. In another study similar to these findings, Ghesla et al., (2020) observed that the tendency towards green preferences increased when the informational nudge was presented as the default option in a field experiment with households.

Default options can be defined as rules that are valid and may persist in situations where individuals do not take any steps to change their current behavior. The green energy category presented as a default option makes the environmental and economic consequences of energy sources visible for individuals. Individuals are expected to take these factors into account when making choices (Sunstein & Reisch, 2020: 144). One of the important studies in this field is the study by Pichert et al., (2008), which investigated the tendency of individuals towards default green options by conducting 2 field and 2 laboratory experiments. In the laboratory experiment, the decision-making behaviors of individuals encountering different electricity usage options were examined. As a result of the study, it was determined that 68% of the participants changed their preferences in this direction when green energy was presented as the default option despite its higher pricing. The defaulted green energy programme was as follows: EcoEnergy company sells clean electricity generated from renewable energy sources. Contribute to climate protection and environmental protection!. In the field experiment, electricity consumption in households was measured with the assistance of an electricity meter, and green energy plans were presented as default options to individuals. The green (water energy) tariff is used by default. 4.3% of customers decided to switch to the economic tariff, less than 1% switched to the premium-priced green tariff, and 0.7% reacted by switching to a different supplier. Around 94% of customers stayed with the default option.

Apart from the evidence supporting the impact of nudges on behavior change, there are studies indicating their limited effectiveness. Research on the ineffectiveness of nudges in energy saving behavior emphasizes that in practical applications, dense text formats, legal statements, and information with multiple messages do not sufficiently support individual

efforts (Ölander & Thøgersen, 2014). Similar results were observed in field experiments investigating the effects of informational and social norm nudges on household energy savings (Ata & Erdogan, 2020). The experiments revealed that nudges, delivered through feedback and visual information, either had minimal effects on energy conservation in households or failed to bring about significant changes (Bittle et al., 1970; Hayes & Cone, 1981; Abrahamse et al., 2005; Nilsson et al., 2014). The delayed response of individuals and the difficulty in understanding savings strategies lead to a limited impact of these nudges on behavior change.

On the other hand, new smart home-connected energy-efficient technologies are emerging more frequently and have the potential to significantly impact consumer decisions. Therefore, it appears that behavioral interventions such as digital nudging will have an impact on behavior. Although the use of nudging to encourage energy conservation behavior has been studied in a number of settings, little is known about how effective it is in digital choice environments that encourage everyday energy conservation behavior, particularly when it comes to mobile applications. In this manner, Berger et al., (2022) tested the framing and default nudges, as well as their combination, with an online survey of 231 private household participants. The authors found that framing and default nudges in a smart home app can significantly influence energy conservation behavior. This is in line with the potential of feedback technology to change energy consumption behavior, as outlined by Froehlich (2009). Schweizer et al., (2015) further supports this by discussing the use of consumer behavior data and machine learning to reduce energy consumption in smart homes. Jahn (2010) emphasizes the importance of integrating energy efficiency features in smart home systems, including transparent and intuitive user interfaces. These findings highlight the potential of digital nudging and smart home technology in promoting energy conservation behavior. In this manner, goal-setting is also a promising strategy, however the research on this digital nudging mechanism produced inconsistent outcomes (Zimmermann et al., 2021). Goal-setting nudges for energy-saving behavior could involve encouraging individuals to set specific and achievable energy conservation targets such as sending personalized messages suggesting that residents set a goal to reduce their monthly energy consumption by a certain percentage over the next three months. According to Loock et al., (2013), default goal settings significantly influence the promotion of energy saving on residents' energy use. In contrast, goal-setting techniques have been studied by Brandsma and Blasch (2019) to lower energy and water consumption, their results were mixed, with the exception of when they produced more financial incentives. Lastly, according to Han et al., goal-setting processes did not appear to have a significantly beneficial effect on energy savings. (2013).

3.2. Recycling and Waste Reduction

In our pursuit of sustainability, it is necessary to distinguish between waste reduction and recycling. Both behavior patterns are related to each other but differ in some aspects. Waste reduction behavior refers to a complex process as part of people's daily life practice and is considered as an output of individual consumption. Recycling behavior relates to the separation of waste into different categories (Milford et al., 2015: 3). The experimental literature on recycling behavior dates back to the 1980s. These studies, which initially

approached recycling behavior from a sociological perspective, later became more concerned with identifying and improving individual behavior (Gould et al., 2016: 269). It should be noted here that nudges are seen as crucial interventions to enhance recycling behavior. Experimental studies showing behavior changes related to recycling and waste reduction, typically provide clear evidence of informational (mostly visual), social norm, social comparison& feedback, and framing effect interventions.

Field experiments with households in different countries have examined recycling and waste reduction behavior. The common aim of these studies was whether informational nudges change behavior. In these experiments, households in the treatment groups were given information about recycling or waste reduction, while the control group received no information. In the field experiment phase of the studies, households' own waste sorting data, narratives highlighting the benefits of recycling, and information such as *"if you recycle, you will benefit the ecosystem in this way"* were employed. After the nudges, it was tested whether the waste in the bins changed by measuring. The common finding of the studies is that informational nudges are effective in improving recycling and waste reduction behavior in households (Milford et al., 2015; Linder et al., 2018; Zhang and Wang, 2020). Another field experiment testing the effects of nudges on dietary change and food waste reduction observed the actual behavior of 481 participants. In the experimental group where the social cost of food waste was presented as information (*In the United States, an estimated 40% of all food produced is wasted*), vegetable preference increased by 50% and food waste decreased significantly (Qi et al., 2022).

In addition to process-related informational nudges, visual information nudges are also commonly used in these studies. Visual nudges, which incorporate graphics, highlights, or callouts are applied to prompt individuals to exhibit desired behaviors and are characterized as simple reminders (Chui et al., 2015). Some studies in this field show that visual prompts can be effective in increasing recycling behavior (Arbuthnot et al., 1976; Spaccarelli et al., 1989). For example, Sussman et al., (2013) investigated the effects of two different visual stimuli on individuals' solid waste sorting behavior. In the standard visual stimulus brochure, waste was categorized and visualized, while in the second type of brochure prepared with the behavioral intervention method, messages such as *"Please Compost Your Leftovers"* were used with real information. As a result of the field experiment, it was found that informative visual stimuli significantly changed solid waste sorting behavior. In a study testing similar hypotheses, a randomized field trial with households in the UK investigated the effectiveness of visual nudges to encourage the correct sorting of food waste. For the experimental groups, posters were placed over bins with the messages *"PLEASE NO FOOD WASTE" and "Remember to use the food recycling bin"*. The results revealed a behavioral change of 20.74% in the experimental group compared to the control group. Additionally, in a field experiment with students on a university campus, it was investigated whether visual stimuli change recycling behavior. A pair of human eye posters placed on recycling bins were used as visual stimuli. Accordingly, it was concluded that waste sorting behavior increased significantly in the experimental group where information and visual stimuli were used together (Shearer et al., 2017; Lotti et al., 2023).

On the other hand, a review of field experiments using descriptive (indicating what the majority does) and prescriptive (indicating what the majority approves of) social norms reveals the importance of norms in driving behavior change (Cialdini et al., 1990; Cialdini & Goldstein, 2004). For instance, Schultz (1999) conducted a 17-week field experiment with households, suggesting that appropriate norms could enhance recycling behavior. The use of descriptive norms, delivered through group feedback in the experimental groups, resulted in a noteworthy increase in overall recycling behavior. On the other hand, Cosic et al., (2018) explored the impact of social norm nudges on recycling behavior in a field experiment conducted on a university campus in Italy. Employing the descriptive norm approach, they crafted a message stating, *"Almost 70% of Harvard students RECYCLE. Do you want to be left behind?"* The study revealed a significant increase in recycling behavior within the experimental group exposed to the descriptive norm message. Dupre & Meineri (2016) investigated the effects of social comparative feedback, group feedback and persuasive communication nudges on recycling behavior in field experiments conducted on university campuses in France. For the experimental group in which social comparative feedback nudge was used, a graph showing the three-week recycling data of the students in the other cafe was prepared as a poster. In addition, the message *"nothing is lost, working together and everything is transformed"* was given. According to the empirical analyses conducted before and after the experiment, it was found that the recycling rate in the group in which social comparative feedback was used increased more than the other nudges. Despite the strong influence of social norms, some research argues that these nudges may not sustainably alter behavior in the long term. An investigation into the impact of social norm messages on waste prevention in Chinese households, aligned with existing literature, found that individuals did not show sustained improvement in behavior after the intervention (Ling et al., 2023). Therefore, the ongoing effectiveness of social norm nudges post-treatment remains a debated issue, with some scholars, such as Constantino et al., (2022), questioning whether their effects endure.

It can be expressed that social norms have a significant impact on reducing food waste in public settings such as restaurants where people's behavior is visible to others. In this context, Kallbekken & Sælen (2013) conducted a field study on the extent to which normative-based messages *("Welcome back! Again! And again! Visit our buffet many times. That's better than taking a lot once.")* are effective on customers' food waste in a hotel restaurant. It was concluded that the use of these normative message prompts reduced customers' food waste by 20% (Kallbekken & Sælen, 2013; Templeton et al., 2016). Geislar (2017), investigated the effect of nudges on individuals' food waste sorting behavior in a field experiment conducted in households in Southern California. The results of the study revealed that the explanatory social norm messages used *("75% of households in Costa Mesa sorted all food waste this week")* were able to change food waste sorting behavior for longer than the control group and the other treatment group. Kameke & Ficher (2018) analyzed the possible effects of nudges on reducing household food waste. The results of a survey of 101 consumers in Germany show that feedback, social interaction, and advice on meal planning can often change intentions towards food waste.

Chakravartya & Mishrab (2019), in a different field of study with three different companies in India, tested whether the social norm drive changes the behavior of office workers towards paper waste. As a result of the study, it was found that the injunctive social norm *(reduce-reuse-recycle and use less paper)* messages significantly changed the paper consumption behavior of office workers, but the behavior did not change in the control group where no nudge was applied.

Numerous studies have explored the impact of framing on inducing desired behaviors (Spence & Pidgeon, 2010; Kim & Kim, 2014). While both positive and negative framing can be effective, prevailing literature suggests a tendency for negatively framed messages to have a stronger influence (Cialdini et al., 2006). This efficacy is often attributed to loss aversion, wherein negative frames are perceived as more compelling due to the emphasis on potential losses. White et al., (2011) observed the superiority of negatively framed messages in influencing consumers' recycling behavior. Similarly, a field experiment by Poortinga and Whitaker (2018) involving 12 universities and business cafe sites demonstrated that framing options as losses *(3 billion takeaway cups go to landfill every year in the UK and fight the waste*), increasing individual's preference for disposable cups. While the literature mostly provides experimental evidence supporting the potential of the framing effect to induce behavior change, Nelson et al., (2021) found no significant difference between negative and positive framed messages on the use of plastic bags in supermarkets. Conversely, Zheng et al., (2023) discovered nuances in the effectiveness of framing combined with different behavioral norms. Their survey study on food waste reduction revealed that negatively framed messages are more impactful when paired with injunctive norms, whereas positively framed messages are more effective alongside descriptive norms. Notably, negative descriptive norms were found to increase food waste tendencies in individuals.

While the related literature on traditional nudges is extensive, there are few prominent examples that employing digital nudging in the contexts of food waste reduction (Ong et al., 2023), paper waste reduction (Egebark & Ekström 2016; Degirmenci & Recker, 2018), and sustainable packaging (Wensing et al., 2020)[3]. In Ong et al.'s (2023) investigation on digital nudging and waste reduction, positive reinforcement through digital tent cards is found to effectively modify food waste behavior. Notably, the study demonstrates that digital nudging is three times more effective in reducing food waste compared to a control group without nudging, with positive messaging proving more influential than negative counterparts. Gentle reminders, framing individuals as "warriors" or "heroes" against global food waste, significantly enhanced altruistic motivation. The studies by Egebark & Ekström (2016) and Degirmenci & Recker (2018) find out digital interventions (via email campaigns and

[3] While academic studies exploring the use of digital nudges to encourage recycling behavior are currently limited, notable technological solutions offered by companies like Routeware Inc have demonstrated practical applications. For instance, Routeware Inc has developed waste sorting games for items such as batteries and plastic straws, as well as conveying recycling notifications. These technological interventions have proven effective in enhancing the efficiency and effectiveness of the recycling value chain, contributing to the management of approximately 90 million tons of materials.

informative platforms) are effective for promoting double-sided printing. Wensing et al. 's (2020) study addresses consumer willingness to pay (WTP) for bio-based packaging as an alternative to plastic. Integrating environmental psychology and behavioral economics, the research tests four green nudging strategies: providing nature images, reflection questions, information on bio-based plastics, and normative information. Results from a study of 1019 German consumers show that the effectiveness of nudge strategies depends on consumers' cognitive styles. For instance, nature pictures increase WTP for bio-base packaging for emotionally driven decisions, while strategies providing normative information are more effective for consumers who engage in cognitive deliberation.

3.3. Sustainable Consumption

The conceptual definition of sustainable consumption includes the criteria for fulfilling the social and environmental needs of sustainable development (WCED, 1987). The concept of sustainable consumption generally encompasses goals such as equity, resource efficiency, waste minimization, quality of life, consumer health, and safety. Therefore, it can be stated that individual actions have a critical importance in the concept of sustainable consumption in terms of improving lifestyles and consumption habits (Monts & Plepys, 2008). Here, we categorized sustainable consumption into three subcategories in order to assess the (digital) nudges since the concept is notably broad.

Grocery Shopping Habits

The environmental sustainability of a product depends on the production methods and origins of its components (Meybeck & Gitz 2017). Regional production, with its shorter transport distances and reduced storage, cooling, and packing requirements, tends to result in lower pollutant emissions and energy consumption. As reflected in the European organic label, organic farming emphasizes a holistic approach to soil, animals and plants, providing benefits such as reduced nitrate pollution, soil erosion and greenhouse gas emissions, while making regional products more preferable to conventional products (Schlich & Fleissner 2005). Therefore, as Berger et al., (2022) emphasizes, more sustainable practices are possible with the pressure from demand side and this is possible with the help of (digital) nudges among other critical efforts[4].

Accordingly, the literature on grocery shopping habits reveals a growing interest in employing digital nudges to promote sustainable behaviors. Berger et al. (2020) carried out a study

[4] The literature focusing on sustainable grocery shopping through field or lab experiments is limited, but it highlights the effectiveness of social norm nudges in promoting plant-based diets that are healthier and more sustainable. For example, placing social norm messages inside shopping baskets or carts has been shown to increase customers' purchasing behavior towards fruits and vegetables by over 10% (Niculescu et al., 2016; Wansink et al., 2017; Bauer et al., 2022; McGrath, 2023). Additionally, experiments comparing environmental informational nudges to economic messages found that environmental messaging led to decreased meat consumption compared to economic messaging (Fredholm & Karlsson, 2020).

examining the effectiveness of three digital nudges (simplification, default options, and social norms) on 291 participants in an online grocery store. The findings demonstrated that the simplification nudge appealed to environmentally conscious consumers, default options were effective for a widespread segment of consumers, and social norms did not have a significant impact. De Bauw et al., (2022) conducted two successive user studies, focusing on highlighting, defaults, social information, and warnings in online users' decision-making processes. Their hybrid nudge, incorporating social information and setting a default, significantly increased the probability of item selection without negatively impacting decision time, confidence, or satisfaction. In another study by Valenčič et al., (2022), analysis of fifteen documents revealed four common nudging techniques in the grocery domain: utilizing alternative labels, suggesting healthier swaps, employing default choices, and raising salience. Despite nudging's positive association with improved nutritional outcomes, the studies often lacked detailed descriptions of the visual user interface features, hindering the understanding of factors influencing consumer behavior. This gap in knowledge underscores the need for insights into unsuccessful nudging techniques to inform the design of online platforms for sustainable and healthier food selection. Furthermore, researchers emphasize the importance of integrating digital environments into theoretical frameworks guiding nudging actions in the grocery domain. Overall, these studies collectively contribute to the understanding of digital nudges in shaping sustainable grocery shopping habits, emphasizing the need for tailored approaches and consideration of the digital context in designing effective interventions.

Sustainable Travel Decisions

Websites that book flights online allow users to compare prices, convenience, and other features that are important to them. Despite the fact that aircraft is the most emission-intensive form of transportation, environmental issues are usually ignored. In this manner, Meske et al., (2022) illustrates how digital nudges could help users of online travel booking platforms make more ecologically friendly decisions. Using a digital nudge design approach, the authors implemented two different nudge interventions in an experimental setting on a hypothetical flight reservation website. First, an understanding mapping displayed as an emission converter and second, an informative warning displayed as an emission label were implemented as nudges. The paper concludes that while emission labels are a more successful means of promoting sustainable booking behavior, both digital nudges are helpful treatments in online choice environments.

On the other hand, the majority of mobility-related issues are brought on by regular usage of private vehicles for transportation, such as commuting. Using digital nudging in the form of trip suggestions to encourage commuters to use public transit is one strategy to alter their patterns of mobility. Therefore, Zimmermann et al. (2022) conducted a choice-based conjoint analysis to investigate the impact of recommendations. With this study, they aimed to reveal how often the participants preferred the recommended travel option and to what extent this had an impact on their public transportation preferences. Based on commuters' trip times and usage of mobility apps, their results revealed differences. Commuters who typically do not utilize mobility apps and have short transit times experienced significant beneficial results. Those results are compatible with the findings of both Anagnostopoulou (2020) and Gabrielli

(2013) who discovered that tailored interventions, such goal-setting and persuasive messaging, can significantly raise the adoption of sustainable transportation options. According to Anagnostopoulou (2020), these treatments worked especially well when customized to the mobility type and personality of the users via applications on smartphones.

Sustainable Fashion and Make-up Choices

It should be noted that sustainable fashion refers to clothing that is: (1) sourced in a way that helps to decrease poverty and improve labor conditions; and (2) made with eco-friendly materials and produced with little harm to the environment (Garg, 2020). Similarly, sustainable make-up products are the ones produced by biodegradable, organic ingredients, and recyclable materials and prioritizing fair trade and ethical conditions.

A literature review shows that there are a number of promising studies conducted to date related to digital nudging for sustainable fashion products. Additionally, despite the fact that each study's methodology and digital nudges were different, the majority of this research concentrated on T-shirt purchase decisions. For instance, Amatulli et al., (2019) discovered that negative framing increased the likelihood of buying organic cotton t-shirts relative to positive or neutral framing in four experimental studies about the effects of message framing on sustainable consumer behavior. Lee et al., (2020) used neuromarketing approaches to find that a simplifying nudge framed in green colors, which stand for organic cotton, enhanced brain activity. This helped with decision-making and improved the possibility that the consumer would choose the product with the green logo. Roozen et al., (2021) looked into how information and visual priming nudges affected people's decisions to buy sustainable clothing. They found that both nudge types were successful, with the information-based nudge having a greater impact because it provided more positive environmental impact information. However, Mirbabaie et al., (2021) discovered negligible results when using social norm and digital default nudges to encourage green fashion in online shopping. Lastly, by taking into account subsequent sustainable behavior, Schürmann et al., (2023) investigated the impacts of simplification and social norm nudges to promote sustainable t-shirt decisions against conventional ones. The results show that the simplification nudge increases the selection of sustainable items.

Antonides & Welvaarts (2020) looked into whether choosing a default option and presenting items lateral to one another—that is, from left to right or left to left—influenced consumers' decisions on sustainable makeup options. Subsequently, 330 Dutch women participated in an online quantitative experiment where they selected 1094 hypothetical makeup products. More sustainable decisions were made when the default was set to a sustainable option rather than an unsustainable one. The presentation of products in a left-right or right-left orientation did not significantly affect the decisions made by customers. Moreover, consumers with greater levels of education and those who value sustainability were more likely to select sustainable makeup. People who wear makeup regularly and those who consider cost to be a factor in purchasing decisions frequently select non-sustainable makeup. According to the results of their experiment, choosing sustainable products by default increases the likelihood of making a sustainable decision by roughly 8%. The authors suggested that even though 14%

of the participants buy their make-up products online, since online purchasing will become more common in the future, digital nudging in this domain will gain importance, as well.

4. Discussion and Conclusion

The study aimed to assess the influence of both traditional and digital nudges in promoting pro-environmental behaviors (PEB), specifically focusing on energy conservation, recycling & waste reduction, and sustainable consumption practices, including grocery shopping, travel choices, and fashion/makeup choices. Utilizing a comprehensive review of relevant literature, the research examined the impact of nudges on PEB by each behavior category, considering shared and distinct characteristics employed in traditional and digital contexts. Now, we are prepared to offer insights into the questions that originally sparked our research and motivated our study.

R.Q.1. What is the current understanding of the use of nudges and digital nudges to bring about changes in pro-environmental behavior?

Regarding our first research question, findings indicate that both traditional and digital nudges demonstrate effectiveness in encouraging pro-environmental behaviors across the studied categories, although with mixed or insignificant results in certain cases. In energy conservation, whether it is physical or digital settings, the most commonly employed nudges include social norms and social comparison& feedback, followed by informational nudges (Schultz et al., 2007; Nolan et al., 2008; Alcott, 2011; Anderson et al., 2017; Edirneligil, 2021; Chongwilaikasae & Ayaragarnchanakul, 2023). However, some complexities arise, with certain approaches showing mixed or insignificant results. While informational nudges positively influence preferences for green power plans and default options sustainably increase green energy adoption (Pichert et al., 2008; Ghesla et al., 2020; Cardella et al., 2022), challenges persist in comprehending saving strategies, leading to limited impacts on behavior (Abrahamse et al., 2005; Ölander & John Thøgersen, 2014; Nilsson et al., 2014; Ata & Erdogan, 2020). Emerging smart home technologies offer promising avenues (Schweizer et al. 2015; Berger et al., 2022), with framing and default nudges showing potential in influencing energy conservation behavior. Yet, inconsistencies exist in the effectiveness of goal-setting mechanisms.

In recycling and waste reduction, various nudges, including informational, social norms, social comparison, and framing interventions play critical roles. Informational nudges, especially visual reminders, effectively enhance recycling behavior (Sussman, et al., 2013; Milford et al., 2015; Linder et al., 2018; Zhang & Wang, 2020; Lotti et al., 2023) while social norms and framing strategies also contribute positively (Cialdini et al.,1990; Cialdini and Goldstein, 2004; Cosic et al., 2018; Poortinga & Whitaker, 2018; Chakravartya & Mishrab, 2019), though debates persist regarding their long-term sustainability (Constantino et al., 2022). Despite conflicting findings, digital nudges hold promise, although research in this area remains limited, particularly in food, paper, and package waste reduction contexts.

In grocery shopping, digital nudges demonstrate efficacy, with default options and simplification nudges catering to different consumer segments (Berger et al., 2020). Hybrid nudges incorporating social information and defaults show effectiveness in online decision-making processes (De Bauw et al., 2022). However, a lack of detailed interface descriptions prevents understanding, highlighting the need for insights into unsuccessful techniques. Integrating digital environments into theoretical frameworks is crucial for designing effective interventions in promoting sustainable food selection. In transportation, digital nudges like trip suggestions effectively encourage public transit use, especially for commuters not accustomed to mobility apps (Meske et al., 2022; Zimmermann et al., 2022). Tailored interventions based on users' mobility types and personalities through smartphone applications significantly boost the adoption of sustainable transportation options (Gabrielli, 2013; Anagnostopoulou, 2020). In sustainable fashion, digital nudges influence purchase decisions, with negative framing and informational & simplification nudges showing promise (Amatulli et al., 2019; Roozen et al., 2021; Schürmann et al., 2023). Setting sustainable options as defaults increases the likelihood of making sustainable decisions, particularly in online makeup markets (Antonides & Welvaarts, 2020).

While the literature predominantly reports significant effects of nudges and digital nudges on pro-environmental behavior, it's essential to acknowledge the potential presence of publication bias. Studies with insignificant results may often remain unpublished, potentially skewing the overall perception of the effectiveness of these interventions. Therefore, future research should consider addressing this bias to provide a more comprehensive understanding of the true impact of nudges and digital nudges in promoting pro-environmental behavior.

R. Q. 2. How do traditional and digital nudges influence pro-environmental behavior, and what are the differences in effectiveness between traditional and digital nudges in promoting pro-environmental behavior?

Before delving into our R.Q. 2 regarding how nudges influence PEB, we should note that, we purposely skipped explaining the intricate psychology behind nudges, except briefly explaining the background theory at the beginning. Because human behavior is complex, and there are various reasons for behavior change. Therefore, we chose to look at the types of nudges instead of the psychological mechanisms. This decision was because nudges hold design information that makes replication easier, unlike psychological mechanisms. For example, as Beermann et al., (2022) states the status quo bias can be a default nudge or countered by a feedback nudge at different contexts.

(Digital) nudges exert influence on PEB through various mechanisms. Social norm and social comparison nudges (commonly employed with feedback), a prominent nudge, have shown significant efficacy in shaping energy-saving, recycling & waste reduction behaviors. Messages conveying information about neighbors adopting energy-efficient lighting, individuals exceeding the neighborhood's average energy consumption or students making recycling have proven motivational, aligning behavior with perceived social norms (Cialdini & Goldstein, 2004; Alcott, 2011; Liu et al., 2016; Anderson et al., 2017; Cosic et al., 2018; Chongwilaikasae

& Ayaragarnchanakul, 2023). Because individuals often look to others in their social groups as a reference point for appropriate behavior.

On the other hand, informational nudges play a critical role in promoting pro-environmental behavior across various domains by providing individuals with relevant information about the benefits of sustainable actions. These nudges work by increasing awareness and understanding of environmental issues, highlighting the positive impacts of adopting green practices, and empowering individuals to make informed choices. Whether it's encouraging energy conservation (Geshla et al., 2020; Cardella et al., 2022), promoting recycling and waste reduction (Susmann et al., 2013; Milford et al., 2015; Linder et al., 2018; Zhang & Wang, 2020; Qi et al., 2022), or influencing sustainable consumption habits (Berger et al., 2020; Meske et al., 2022; Roozen et al., 2021; Schürmann et al., 2023), informational nudges effectively leverage knowledge to drive behavior change towards more environmentally friendly practices. Unlike conventional education, which often requires active engagement and conscious effort from individuals to absorb and apply the information provided, informational nudges work by embedding key messages within the environment or decision-making process, making them more salient and likely to influence behavior without demanding significant cognitive resources. Similarly, default options seem to be a powerful tool across various behavior categories by leveraging inertia and guiding individuals towards more sustainable choices without requiring active decision-making. For instance, presenting green energy options as default choices significantly influences consumers' preferences, as observed in studies examining energy plan selections (Pichert et al., 2008; Loock et al., 2013; Sunstein & Reisch, 2020; Ghesla et al., 2020; Berger et al., 2022) or making sustainable consumption default increases the selection of them (Berger et al., 2020; Antonides & Welvaarts (2020). Likewise, loss- and gain-framed of the information often results in desired behavior change depending on the context. Especially for recycling& waste reduction behavior, most of the studies highlight the effectiveness of negative framing (Cialdini et al., 2006; White et al., 2011; Poortinga & Whitaker, 2018). For sustainable consumption, as Amatulli et al., (2019) showed, information in terms of negative frames (if you buy this conventional t-shirt, you actively will contribute to the collapse of the environment) stimulates PEB by evoking negative emotions like guilt or shame. However, the utilization of negatively framed messages for social or green marketing purposes should be approached with caution, as it carries the risk of inducing avoidance behaviors or causing psychological reactance, both of which could undermine the intended effectiveness of the message.

While the effectiveness of goal-setting nudges may vary, they are particularly successful when tailored to individual preferences and accompanied by personalized feedback, particularly for energy conservation (Loock et al., 2013; Brandsma & Blasch, 2019) and sustainable travel choices (Gabrielli, 2013; Anagnostopoulou, 2020).

As it is obvious, the effectiveness of traditional nudges and digital nudges on PEB can vary based on several factors. One of the factors is related to its setting. Traditional nudges, such as physical cues and incentives (placing visual prompts on recycling bins) may excel in contexts where tangible, immediate prompts are necessary, leveraging real-world visibility and direct impact on the senses. On the other hand, digital nudges, which often utilize online platforms

and personalized feedback, may offer advantages in terms of accessibility, scalability, and real-time information delivery. As decision-making processes have increased, nudges and Information Systems have become more frequently used in digital environments. Used in apps, online stores or web pages, digital nudges include user interface elements to guide online behavior. While digital nudging mechanisms have similar characteristics to traditional nudges, there are differences in terms of choice architectures and effects. For instance, grocery stores can adjust their nudge strategy to the digital environment by ranking sustainable products first. However, the effects of similar measures in offline and online spaces may not be the same in all cases. Therefore, the impacts of digital nudges should be evaluated separately from traditional nudges, with personalized feedback and goal-setting mechanisms showing immediate impact by leveraging big data and smart applications (Beerman et al., 2022; Berger et al., 2022).

Last but not least, the impact of nudges differs depending on the context and timing of the behavior. Certain nudges are better suited for instilling new behaviors, whereas others excel at modifying existing ones. For example, while providing social comparison and feedback seems more effective for altering existing behaviors, default nudges are often used to form new behaviors such as contract with a green energy program (Beermann et al., 2022). Additionally, it's essential to evaluate nudges based on their timing, whether they are implemented before, during, after, or throughout the action (Zimmermann et al., 2021; Berger et al., 2022).

In conclusion, the article highlights the varying effectiveness of traditional and digital nudges in promoting pro-environmental behavior, with energy conservation being the most researched area. In waste reduction and sustainable consumption, grocery and food choices are the research area that become prominent. However, there remains a notable gap in experimental research for underrepresented areas such as electronic products, sustainable fashion, and personal care products. Despite the adoption of digital nudges by recycling firms, academic research in this domain is limited, suggesting a need for further exploration. Moreover, for already represented areas, digital nudges like gamification hold promise for evoking pro-environmental behaviors, indicating a potential direction for future research and practical applications in promoting sustainability.

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Çıkar Beyanı: Yazarlar arasında çıkar çatışması yoktur.
Etik Beyanı: Bu çalışmanın tüm hazırlanma süreçlerinde etik kurallara uyulduğunu yazarlar beyan eder. Aksi bir durumun tespiti halinde Fiscaoeconomia Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazarlarına aittir.
Yazar Katkısı: Yazarların katkısı aşağıdaki gibidir;
Giriş: 1. yazar
Literatür: 2. yazar
Metodoloji: 1. yazar
Sonuç: 2. yazar
1. yazarın katkı oranı: %. 50, 2. yazarın katkı oranı: % 50.
Conflict of Interest: The authors declare that they have no competing interests.
Ethical Approval: The authors declare that ethical rules are followed in all preparation processes of this study. In the case of a contrary situation, Fiscaoeconomia has no responsibility, and all responsibility belongs to the study's authors.
Author Contributions: author contributions are below;
Introduction: 1. author
Literature: 2. author
Methodology: 1. author
Conclusion: 2. author
1st author's contribution rate: % 50, 2nd author's contribution rate: % 50.