

Choose sustainable! How digital nudging architectures shape sustainable choices and consumer perceptions

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Abstract

Purpose – This study aims to investigate the effectiveness of different digital nudging architectures in promoting sustainable consumer behaviour during the shopping experience. This research addresses a critical research gap by providing the first empirical comparison of theoretically grounded digital nudging models specifically designed to foster conscious shopping decisions.

Design/methodology/approach – A between-subjects experimental design involving 195 participants was implemented to compare the impact of three digital nudging architectures – make together, in-sourcing and crowd-sourcing – on multiple consumer outcomes. These outcomes include engagement, perceived usefulness, willingness to pay a premium price, trust in the retailer, retailer credibility and commitment to charitable initiatives.

Findings – All three digital nudging architectures elicited generally positive consumer evaluations, although with differentiated outcome profiles. The only statistically significant difference concerned the perceived relevance of the initiative, which was higher in the crowd-sourcing condition than in the make together condition. Descriptive patterns further suggest that crowd-sourcing is associated with stronger relational and engagement-oriented responses, in-sourcing with higher perceived usefulness and retailer credibility and make together with stronger purchase-related responses such as intention to buy and willingness to pay a premium.

Research limitations/implications – Managerial implications are provided for designing engaging, ethically responsible digital nudges and sustainability campaigns in retail environments.

Originality/value – To the best of the authors' knowledge, this is the first empirical study to compare distinct digital nudging architectures in a sustainability context, offering a structured, theory-driven evaluation. The study advances knowledge in behavioural marketing and digital retailing by (1) offering a structured comparison of nudging architectures for sustainability goals, (2) evaluating how such interventions influence cognitive, emotional and behavioural consumer outcomes, (3) emphasising the strategic role of retailers in digital sustainability communication and (4) addressing the ethical acceptability of nudging in preserving consumer autonomy.

Keywords Digital nudging, Sustainability, Consumer behaviour, Choice architecture, Conscious shopping, Sustainable consumption

Paper type Research paper

1. Introduction

Sustainability has become a pivotal challenge of the 21st century (Kemper and Ballantine, 2019; Fischer *et al.*, 2023), leading to a deep reflection on how to promote more sustainable behaviours (Buerke *et al.*, 2017). Although the relevance of sustainability has become one of the main goals pursued by the United Nations with the establishment of the sustainable development goals (United Nations, 2023), the efforts made to achieve these goals are insufficient with substantial gaps remaining between sustainability commitments and actual progress (Bharti and Suneja, 2025). In this scenario, the retail industry plays a twofold role as both an intermediary and a driver of consumer behaviour. Research has demonstrated that retailers can influence sustainability outcomes not only through their own operations and supply chains, but also by shaping

purchasing environments, communicating sustainability values and nudging consumers towards more responsible choices (Trewern *et al.*, 2021; Smith, 2023; Leung *et al.*, 2025).

At the same time, the role of consumers remains essential. While institutional actors such as retailers can shape the choice environment, the impact is ultimately influenced by consumers' behavioural responses. As Sheth *et al.* (2011) and Lee *et al.* (2025) emphasise, responsible behaviour at the individual level is a significant driver of sustainable development, particularly when aligned with effective retail and policy structures. Consumer behaviour is widely recognised as a critical factor in achieving sustainability targets. However, despite consumers

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expressing interest in companies that align with their personal values and demonstrate sustainability commitments, actual purchasing behaviour often does not reflect these intentions (Munro *et al.*, 2023; Bellini *et al.*, 2025; Bharti and Suneja, 2025). This misalignment between intention and action, commonly referred to as the “say–do gap” (Munro *et al.*, 2023; Bellini *et al.*, 2025; Bharti and Suneja, 2025), is driven by several factors, including price–quality trade-offs when adopting more sustainable choices, perceived inconvenience, scepticism about corporate actions, cognitive overload, as well as the lack of immediate and tangible benefits from sustainable choices (White *et al.*, 2019; Lehner *et al.*, 2016). Over the past decade, several strategies have been implemented to face this gap – such as informational campaigns, eco-labelling, CSR communication, ethical branding and sustainability certification (see Shah and Oppenheimer, 2008; Gond *et al.*, 2017). Nevertheless, while these tools have raised awareness among retailers, practitioners and policymakers, their effectiveness in changing behaviour has remained limited. One possible reason is that, as shown in recent research, overcoming the sustainable attitude–behaviour gap requires communication strategies that speak directly to consumers’ own concerns and motivations. Specifically, Chakraborty and Sadachar (2022) demonstrate that user-centric persuasive messages highlighting personal benefits (e.g. affordability, style, self-expression) are more effective than purely environmental appeals in evoking stronger affective responses and stimulating interest in sustainable consumption.

This scenario presents an opportunity for the implementation of behavioural interventions such as nudging to bridge the gap between sustainable intentions and actions. A nudging approach, as described by Thaler and Sunstein (2009), operates by leveraging cognitive heuristics, emotional responses and framing effects which are particularly relevant in everyday consumption decisions, including those related to sustainability. In this regard, the promotion of sustainable behaviours has emerged as a primary domain for the application of nudging and, in particular, digital nudging (Bergram *et al.*, 2022).

The effectiveness of nudging has been proven in a range of domains, including health, finance and increasingly, sustainability to guide individuals towards better decisions without restricting their freedom of choice. The application of nudging in the context of sustainability is a growing field of research, as evidenced by the increasing volume of literature on the subject (see Mont *et al.*, 2014; Lehner *et al.*, 2016; Trewern *et al.*, 2021; Mirbabaie *et al.*, 2022). The utilisation of nudges has garnered increased attention as a promising strategy to promote sustainable societal behaviours. Whilst acknowledging the limitations, the efficacy of nudges appears to exceed that of conventional marketing methodologies (Gonçalves *et al.*, 2021).

As consumer decision-making increasingly takes place in digital environments, the concept of nudging has been expanded into the online sphere, giving rise to the concept of digital nudging, defined by Mirsch *et al.* (2018) as the use of digital tools and interface design elements to nudge user behaviour online. By leveraging personalisation, real-time feedback and adaptive architectures, digital nudges can guide consumers towards more sustainable choices by offering a cost-effective, scalable and personalised approach (Weinmann *et al.*, 2016; Schneider *et al.*, 2018; Jesse and Jannach, 2021;

Mele *et al.*, 2021). In this way, digital nudging enables the design of choice architectures that make sustainability personally meaningful to consumers. Digital nudges, therefore, have the potential to address the limitations of traditional sustainability communication by activating user-centric motivations in digital environments (Chakraborty and Sadachar, 2022). These types of nudges, as suggested by Chakraborty and Sadachar (2022) offer a persuasive approach capable of bridging the say–do gap by making sustainable choices easier, more relevant and more consistent with users’ values.

This technological shift gives rise to new possibilities for influencing behaviour at scale, facilitated by the ubiquity and flexibility of digital devices, particularly in sectors such as retail where digital interaction is frequent and impactful.

Despite the growing interest in digital nudging as a behavioural intervention, its application to sustainable consumption remains underdeveloped (Henkel *et al.*, 2019). While early studies (e.g. Weinmann *et al.*, 2016; Schneider *et al.*, 2018) defined the theoretical foundations of digital nudging, empirical evidence in the field of sustainability is still limited and often inconsistent. Recent systematic reviews (Bergram *et al.*, 2022; Stieglitz *et al.*, 2023) reveal a clear tendency for studies to concentrate on attitudinal outcomes, such as message acceptance or perceived usefulness, rather than on actual behavioural intentions or actions. Furthermore, the majority of interventions that have been evaluated use a single nudging tactic, such as defaults, social norms or framing, without considering the potential outcomes that may be produced by diverse architectural models of nudging strategies.

Moreover, existing research tends to overlook the role of the retailer as an active agent in designing and implementing nudging interventions. For instance, Henkel *et al.* (2019) addressed nudging in digital contexts such as e-commerce or public policy platforms, but very few explore the role of the retailers, particularly in the food or fast-moving consumer goods sectors, as credible intermediaries of sustainability communication. In this perspective, the relational and trust-based dimension of retail nudging has not been thoroughly investigated.

In this context, to the best of our knowledge, this study provides the first empirical comparison of different digital nudging architectures within a retail setting aimed at promoting sustainable consumption. Despite the growing literature on digital nudging and sustainable consumption, existing research has mainly examined isolated nudging mechanisms, single-nudge designs or public-sector interventions, with limited attention to how broader participatory architectures structure consumer responses in digital retail environments. Specifically, this study addresses this gap by comparing three distinct digital nudging architectures – make together, in-sourcing and crowd-sourcing – originally proposed by Pellegrini *et al.* (2022), as alternative ways of promoting consumer participation in sustainability-oriented initiatives. In this way the paper contributes to the literature by showing that these architectures should not be treated as interchangeable variants of the same digital nudge, but as distinct participatory configurations that differ in how sustainability action is framed and that shape consumer responses in different ways. More specifically, our study aims to fill four key gaps in the literature:

- 1 it compares the effectiveness of the three digital nudging architectures originally proposed by [Pellegrini et al. \(2022\)](#);
- 2 it measures multiple consumer outcomes, including attitudes towards the initiative, engagement, intention to purchase sustainable products and willingness to pay a premium price for sustainable products;
- 3 it explores how the different architectures affect consumers' perception of retailer trustworthiness, credibility and charitable commitment, thereby highlighting the retailer's role as a sustainability ambassador in digital nudging processes; and
- 4 it assesses whether these digital nudging messages are perceived as persuasive yet non-coercive, in line with the normative principles of nudging.

2. Theoretical background

2.1 Nudging and sustainable decision-making

Nudging, as introduced by [Thaler and Sunstein \(2009\)](#), refers to “any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives”.

Dual process theories by [Kahneman \(2011\)](#) explain how individuals rely on two cognitive systems: one intuitive and automatic (System 1) and one deliberative and effortful (System 2). Nudging primarily targets the former, helping individuals make decisions that may otherwise appear irrational ([Mele et al., 2021](#)). This finding is consistent with behavioural economics theories on limited rationality ([Simon, 1957](#)) and the innate human tendency to minimise cognitive effort. Research suggests that up to 95% of daily decisions are not driven by conscious deliberation and rational processes, but rather by situational stimuli processed through automatic cognitive mechanisms and supported by mental shortcuts known as heuristics which have the effect of reducing the effort required for information processing ([Bargh et al., 2001](#); [Shah and Oppenheimer, 2008](#); [Caraban et al., 2019](#)). [Hansen \(2019\)](#) argued that nudges are effective when operating on the specific cognitive boundaries, biases, routines and habits that prevent individuals from acting in accordance with their own intentions. Each nudge is designed to rely on distinct psychological mechanisms and its effectiveness depends on the degree to which these mechanisms align with the underlying cognitive processes that shape behaviour ([Hansen, 2019](#)). Consequently, nudging interventions should be theoretically grounded to ensure both effectiveness and ethical soundness (i.e. organ donation by [Hansen, 2019](#)).

In this context, nudges do not replace heuristics but are designed to work in harmony with them, subtly guiding decisions by shaping the environment in which choices are made ([Mele et al., 2021](#)). It is precisely the structure of the decision environment that plays a crucial role in influencing behaviour and as evidenced by [Mele et al. \(2021\)](#), what people choose often depends on how the available options are presented.

Despite an increase in consumer concern for environmental issues ([White et al., 2019](#); [Garske et al., 2020](#)), a considerable gap remains between sustainable intentions and actual purchasing behaviour ([Bharti and Suneja, 2025](#); [Munro et al., 2023](#); [Bellini et al., 2025](#)), particularly in domains such as food consumption, energy use and product disposal ([Brand and](#)

[Augustin, 2021](#)). This phenomenon widely referred to as the intention–behaviour gap or say–do gap ([Munro et al., 2023](#); [Bellini et al., 2025](#); [Bharti and Suneja, 2025](#)).

The concept of the say–do gap has been a subject of considerable interest in recent years ([Bellini et al., 2025](#)) and nudging has emerged as a promising behavioural approach with the potential to bridge this misalignment. Indeed, nudging offers a way to reshape the choice architecture to gently guiding consumers towards more sustainable purchasing decisions without restricting their freedom of choice ([Trewern et al., 2021](#); [Gonçalves et al., 2021](#)).

However, nudging effectiveness cannot be assumed. As demonstrated by [Hansen \(2019\)](#) in the context of organ donation defaults, superficially similar nudges may operate through different cognitive mechanisms, such as inattention, perceived recommendation, loss aversion or cognitive avoidance, leading to substantially different behavioural outcomes and ethical implications. Consequently, sustainability-oriented nudging strategies should be evaluated not only in terms of their observable effects, but also with respect to the specific cognitive mechanisms they activate, as neglecting these mechanisms may result in ineffective or even problematic interventions.

Building on this perspective, recent literature has explored various nudging mechanisms applicable to sustainability ([Trewern et al., 2021](#); [Mirbabaie et al., 2022](#); [Leung et al., 2025](#)). Common nudging strategies in the sustainability domain include default green options, feedback mechanisms, social comparison and social norm activation and visual salience cues. Among these, social norms have proven effective in positively influencing sustainable behaviours by leveraging individuals' desire for conformity and reputational concerns ([Chakravarty and Mishra, 2019](#)).

Nudges for sustainability are considered as useful tools in promoting sustainable behaviour within society. They can be applied both as stand-alone interventions or as complements to existing communication strategies. Compared to conventional marketing techniques, nudges appear to offer broader and more sustained impact, particularly when addressing cognitive barriers such as effort aversion and limited attention ([Gonçalves et al., 2021](#)).

While traditional nudges operate within physical environments, recent developments have extended these mechanisms to digital interfaces. The rise of digital environments has offered new opportunities to implement and enhance these behavioural interventions. The transition to digital environments has enabled these nudges to be scaled, personalised and delivered in real time, thereby amplifying their potential impact. This shift gives rise to important ethical questions, as increasingly adaptive and personalised choice architectures may blur the boundary between guidance and manipulation, with the potential to undermine user autonomy and generate disparate outcomes among individuals. Accordingly, scholars have emphasised the importance of transparency, freedom of choice and the necessity for careful consideration of potential ethical and distributional implications when applying nudging principles, particularly in digital contexts ([Hansen, 2019](#); [Susser et al., 2019](#); [Sunstein, 2022](#)).

2.2 Digital nudging in interactive environments

Because the decision-making process has been enriched with digital touchpoints, several authors have begun to transfer the

concept of nudging from the offline context to the online one giving rise to what is termed digital nudging (Weinmann *et al.*, 2016; Mirsch *et al.*, 2018; Jesse and Jannach, 2021; Mele *et al.*, 2021). Digital nudging is defined as:

[...] an attempt to influence decision-making, judgment or behaviour in a predictable way by counteracting the cognitive boundaries, biases, routines and habits that hinder individuals from acting to their own benefit in the digital sphere. Digital nudging does not forbid or add any rational choice option, change incentives significantly or provide rational argumentation (Mirsch *et al.*, 2018).

In other words, digital nudging refers to the practice of using interface design elements in digital environments to influence user behaviour in a predictable manner, without restricting options or significantly altering economic incentives (Weinmann *et al.*, 2016; Mirsch *et al.*, 2018).

In the digital context, the nudge is effective when it modifies the architecture of the choice (Schneider *et al.*, 2018). Those who work on designing the digital user interfaces have become choice architects, who unconsciously or consciously influence the decisions of users (Weinmann *et al.*, 2016). From a design perspective, research in human–computer interaction further shows that digital nudging encompasses a wide range of distinct mechanisms that differ in terms of cognitive engagement, transparency and behavioural leverage. Caraban *et al.* (2019), for instance, identified 23 technology-mediated nudging mechanisms, illustrating how interface design choices systematically shape the effectiveness and functional role of digital nudges by leveraging different cognitive biases and interaction patterns.

Compared to physical environments, digital environments and the tools of digital nudging offer opportunities to influence consumer decisions that are cost-effective, scalable and personalised, whilst enabling real-time monitoring and behavioural analysis (Schneider *et al.*, 2018).

These advantages are further enhanced by mobile connectivity, ubiquitous access to digital platforms and the ability to integrate decision support tools directly into websites and mobile applications (Mele *et al.*, 2021). New digital technologies enable real-time monitoring and analysis of user behaviour, while also allowing the dynamic customisation of digital interfaces. This facilitates the optimisation of the effectiveness of nudges and the collection of rich behavioural and contextual data, particularly through mobile apps.

Recent research has explored how the potential of digital nudges can be amplified through the integration of artificial intelligence (AI) tools into various digital platforms, including websites, mobile apps, cloud services, chatbots (Seo and Yoon, 2025) and the Internet of Things (Mele *et al.*, 2021). More broadly, unlike its offline counterpart, digital nudging in online environments operates within choice architectures that can become increasingly personalised, interconnected and data-driven (Bergram *et al.*, 2022; Panwar *et al.*, 2025). In such settings, algorithmic systems such as recommender systems and adaptive personalisation tools can dynamically adjust nudges to align with the states, preferences and behavioural histories of users (Chiam *et al.*, 2024). In the context of sustainable e-commerce, these platform-mediated and algorithmically shaped choice environments often rely on personalised recommendations, default options and social-proof cues, while also raising concerns related to transparency, fairness and consumer autonomy (Panwar *et al.*, 2025). At the

same time, the increasing adaptivity and personalisation of digital choice architectures has raised concerns regarding the potential blurring of the boundary between legitimate nudging and manipulation, particularly when influence operates in ways that are difficult to observe or comprehend (Susser *et al.*, 2019).

Furthermore, because the process of digitalisation has been found to facilitate market democratisation by reducing entry barriers for small medium enterprise and enabling more inclusive participation in sustainable innovation processes (Maslach, 2016), digital nudging can be understood as a micro-level design mechanism supporting digital transformation by guiding user behaviour within interactive digital systems (Meske *et al.*, 2019). In particular, Meske *et al.* (2019) show that digital nudges embedded in interfaces can facilitate technology adoption, enhance value creation and support structural change, thereby extending the relevance of digital nudging beyond purely consumer-facing applications.

2.3 Digital nudging for sustainability

While nudging has been extensively studied in physical environments (Hummel and Maedche, 2019; Trewern *et al.*, 2021), its effectiveness in promoting sustainable behaviour through digital channels remains underexplored (Henkel *et al.*, 2019).

Several studies have highlighted the effectiveness of digital nudging in shaping individuals' decisions in different contexts. For example, Bammert *et al.* (2020) focused on sustainability and conscious behaviour in corporate settings, Henkel *et al.* (2019) on end-user behaviour, Lehner *et al.* (2016) on public policy and Lembecke *et al.* (2019) on the ethical issues raised by the implementation of digital nudging mechanisms. Michels *et al.* (2022) further confirmed that digital nudging can effectively guide consumer choices towards more sustainable alternatives in online settings, highlighting its role in advancing sustainability within the digital economy.

The literature on digital nudging for sustainability suggests at least four cognitive-motivational, structural, temporal and informational barriers that digital nudging can help address.

Firstly, traditional sustainability interventions often fail because they do not activate user-centric motivations (*motivational barrier*). Prior research suggests that motivations underlying sustainable behaviour are not uniform across contexts. In socially embedded environments such as digital and social platforms, sustainable actions are strongly shaped by cultural orientation, normative expectations and identification motives, which vary across contexts and media (Minton *et al.*, 2012). Moreover, research shows that overcoming the attitude–behaviour gap requires messages that resonate with consumers' own concerns (Chakraborty and Sadachar, 2022). However, conventional (and non-digital) nudges and informational campaigns have limited capacity to tailor messages dynamically to users' motivations or to make sustainability personally relevant. Digital nudging, by contrast, can leverage real-time data, personalisation, adaptive interfaces and interactive to make sustainable choices more relevant and more aligned with users' values and preferences by activating intrinsic motivations.

Secondly, sustainability choices are not easy to implement because often they entail a misalignment between individual effort and collective benefit (*structural barrier*). This asymmetry

reduces the effectiveness of traditional communication strategies, which typically underestimate cognitive constraints. Digital tools can help overcome this barrier by enabling new forms of relations between businesses and citizens, as well as social feedback mechanisms and transparency, thereby encouraging a closer alignment between individual and collective objectives.

Thirdly, many sustainable behaviours involve intertemporal trade-offs – immediate effort or cost for delayed, uncertain benefits (*temporal barrier*). For this reason, traditional marketing levers are ineffective due to their incompatibility with the limited nature of human willpower. Digital nudges, through framing, gamification, reward mechanisms or innovative calls to action, can be effective in mitigating the uncertainty of the benefits, favouring forms of emotional gratification and values.

Fourth, sustainable actions often lack immediate and observable feedback, making it difficult for individuals to measure the results of their decisions and to perceive the consequences of their choices (*informational barrier*). Digital solutions can address this through forms of measurement and traceability, such as real-time progress indicators, aimed at reassuring the individual by providing immediate and recurrent feedback (Mele *et al.*, 2021).

Figure 1 graphically represents the conceptual foundations of digital nudging that emerges at the intersection of the three domains of nudging, sustainability and digital technologies, each contributing specific barriers, challenges or affordances. Their intersection highlights digital nudging as an integrative approach that leverages digital affordances to overcome behavioural barriers and support sustainable consumer behaviour.

2.4 Digital nudging architectures for sustainable behaviour

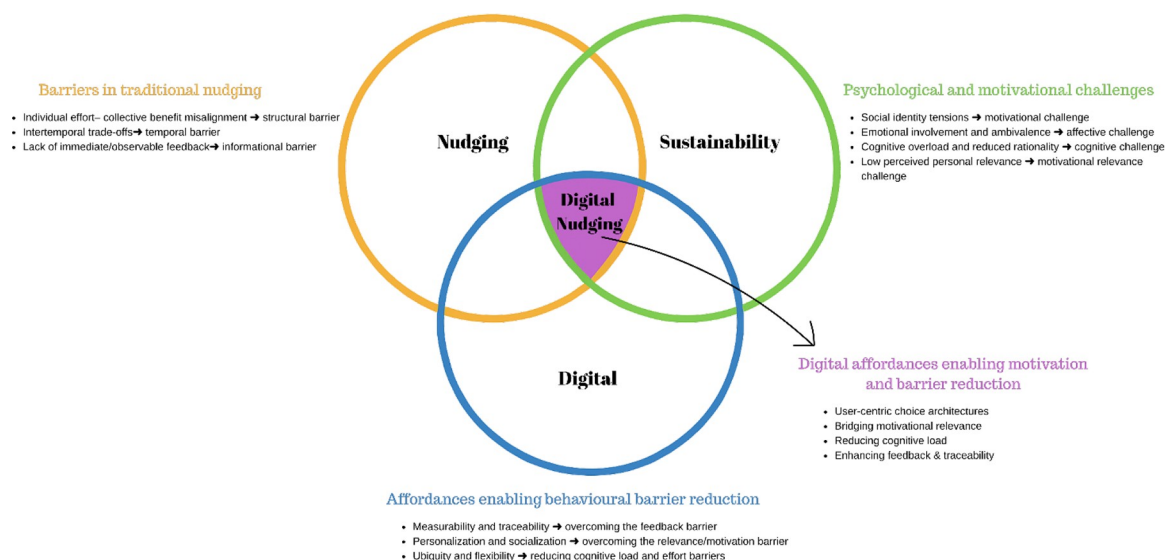
Following the logic of digital choice architecture by Thaler and Sunstein (2009), Pellegrini *et al.* (2022) identified three

configurations of digital nudging whose structures differ in the level of consumer involvement and cognitive load (see Figure 2). The three digital nudging architectures should be interpreted as different ways of structuring consumer participation in sustainability initiatives, thereby activating different consumer evaluations and behavioural responses. Specifically, rather than representing minor variations of the same digital nudge, these architectures differ in how participation is organised, in the role assigned to the consumer and in the type of engagement they activate.

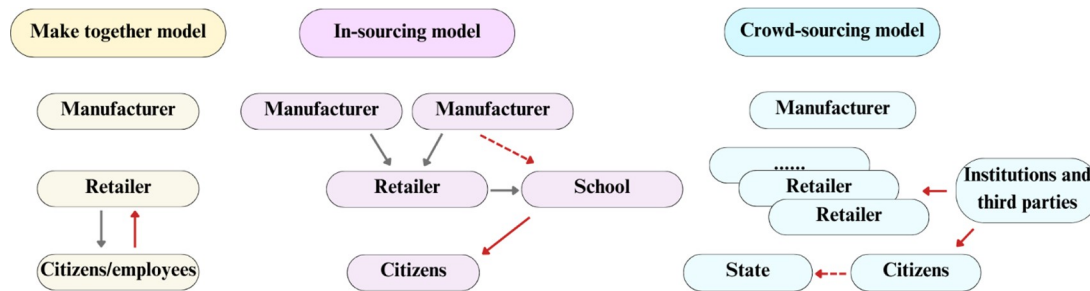
The first, “make together”, represents a collaborative effort between the retailer and the consumer, a collaborative logic whereby purchasing decisions contribute directly to a sustainability initiative. This architecture engages consumers through minimal effort and leverages cognitive mechanisms such as perceived impact and loss aversion. Despite the fact that the consumer’s role is operationally passive, the initiative is structured as a co-created action, thereby stimulating identification through symbolic collaboration. This architecture includes numerous cases where sustainable actions are triggered by the act of purchasing a product and the recipients in most cases are citizens but also employees and collaborators. For instance, a retailer may donate 1% of sales revenue to an environmental cause for each unit purchased, thereby reinforcing the sense of shared value creation (e.g. “If you buy this product we dedicate the 1% of the value in favour of this action...”).

The second architecture, “in-sourcing”, requires higher consumer effort. The retailer organises and communicates a sustainability initiative through a digital call-to-action and the consumer must actively perform a behaviour to benefit from it. This model activates mechanisms such as commitment, effort justification and perceived agency. In this model, the process – from communication to implementation – is managed internally, ensuring coherence in digital nudging design and execution. For example, a loyalty program may reward customers with points when they engage in sustainable behaviours such as donating to

Figure 1 Digital nudging at the intersection of nudging, sustainability challenges and digital affordances



Source: Authors' elaboration from Pellegrini *et al.* (2022)

Figure 2 Digital nudging architectures by Pellegrini *et al.* (2022)

Source: Authors' elaboration from Pellegrini *et al.* (2022)

environmental projects or participating in green initiatives (e.g. “earn loyalty points for donating to a green initiative”).

The third architecture, “crowd-sourcing”, fosters collective consumer engagement in sustainable actions, encouraging community-driven initiatives. It leverages social proof, normative influence and the identity effects of participating in group-based sustainable actions. The success of this initiative depends on spontaneous and large-scale consumer participation, whereby the “crowd” serves as both the target and the driver of impact. The absence of the crowd would render the sustainable process unable to take off. A typical example is a bottle return program, wherein users collectively contribute to a shared recycling initiative through repeated individual contributions (e.g. “return used bottles to support a community recycling program”).

Overall, these three architectures embody distinct applications of digital choice architecture, which vary in required cognitive effort, motivational framing and social dynamics, thereby potentially activating different behavioural responses. The objective of this research is to empirically evaluate the effectiveness of these mechanisms in influencing and promoting sustainable consumer behaviour.

3. Research objectives

This research aims to clarify how digital technologies can promote sustainable consumption by supporting novel business models grounded in nudging principles, particularly within the context of collaborative and non-competitive (pre-competitive) retail environments. Consumers are expected to adopt a more active role when exposed to digitally enabled incentive mechanisms, such as personalised feedback, social comparison or gamified engagement, with the aim of promoting conscious shopping.

Building on these considerations, this study investigates whether and how digital technologies can support sustainability through the implementation of the organisational architectures proposed by Pellegrini *et al.* (2022).

Specifically, the study investigates how the different nudging architectures influence consumer responses in terms of persuasive impact, engagement with sustainability messages and behavioural intentions. Particular attention is devoted to consumers' willingness to purchase sustainable products and to pay a price premium for them.

In addition, the research explores how these interventions shape consumers' perceptions of retailers as credible

sustainability actors. The study investigates the extent to which consumers trust the retailer's commitment to sustainability, especially when this commitment is expressed through charitable actions or community-oriented initiatives. These perceptions are analysed as potential signals of authenticity in a context characterised by information overload and growing consumer scepticism.

Furthermore, the research explores how consumers evaluate the credibility of the retailer's sustainability commitment based on the nature and framing of the three proposed initiatives by distinguishing between altruistic and profit-driven motivations. Particular attention is given to how the specific design stimuli used in a charitable initiative may positively influence corporate image, thereby enhancing or undermining perceptions of authenticity and trustworthiness.

The research also investigates whether sustainable nudging strategies preserve individuals' sense of autonomy and perceived freedom of choice, a key criterion in ethical evaluations of behavioural interventions consistent with the definition of nudging.

In line with the conceptual framework and research aims outlined above, the following research questions are proposed:

- RQ1. To what extent do digital nudging strategies influence consumers' attitudes towards the sustainability initiative and their behavioural intentions, including willingness to purchase sustainable products and willingness to pay a price premium?
- RQ2. How do consumers perceive the retailer's credibility and trust when exposed to different digital nudging architectures?
- RQ3. Which of the three digital nudging architectures is most effective in fostering sustainable consumption?

By addressing these questions, the research contributes to advance the academic discourse on behavioural marketing, sustainability and digital nudging, while offering practical implications for retailers aiming to design more effective and credible engagement strategies.

4. Methodology

This study adopts a between-subjects experimental design based on an online structured questionnaire, with the aim of comparing

the effectiveness of three digital nudging architectures in supporting conscious shopping and sustainable consumption.

This method aligns with prior research (Adelaar *et al.*, 2003; Sharma *et al.*, 2010; Mohan *et al.*, 2013; Aiolfi, 2023), which has determined the effectiveness of both techniques in capturing consumers' perceptions and attitudes towards marketing communications.

Specifically, in the context of the present research, which is grounded in the domain of marketing and consumer behaviour, experimental designs provide a robust framework for examining the effects of digital nudges on decision-making processes and communication effectiveness. The employment of experimental techniques is intended to establish causal relationships and evaluate interventions in controlled settings (Kahneman, 2011).

Each participant was assigned to one experimental condition and was exposed to a single version of the message, without being influenced by the other two groups. This enables independent comparisons between groups, a key requirement of the between-subjects design (Charness *et al.*, 2012). Participants were quasi-randomly assigned to one of three groups, each exposed to a different digital nudging stimulus, based on their last name initial. Specifically, participants with surnames A to D were exposed to make together, participants with surnames E to L were exposed to in-sourcing and participants with surnames M to Z were exposed to crowd-sourcing. This assignment procedure was adopted for operational feasibility, but it should not be interpreted as equivalent to full random assignment. To assess the comparability of the three groups on observed characteristics, manipulation check and chi-square balance tests (see Table 3) were conducted for age, gender and education. No statistically significant differences emerged across conditions, suggesting that the groups were comparable on these socio-demographic variables. The absence of significant sociodemographic imbalances among the groups does not fully substitute for true randomisation but it facilitates the isolation of variables and enables a thorough comprehension of the precise impact of distinct digital nudging tactics on consumer responses and communication outcomes.

As illustrated in Figure 3, the three communications of digital nudging for conscious shopping have been developed for the

implementation of digital nudging for conscious consumption by an Italian retailer. The objective of this initiative is to communicate to its potential customers a sustainable initiative that will benefit the environment and society. Specifically, each group was exposed to a standardised marketing message featuring the same graphics (pictures of turtles and plastic waste and hands joining together), slogan ("make a sustainable choice") and visual layout, with only the call-to-action differing depending on the target architecture and the resulting level of customer engagement required (see Table 1). This manipulation enabled researchers to isolate the effect of the engagement architecture, while ensuring that visual and semantic elements remain constant across conditions to control for confounding perceptual effects.

The make together architecture is characterised by the consumer purchasing a certain product with a minimal involvement in charitable activity, as it is directly managed by the retailer. Conversely, the in-sourcing architecture involves medium consumer involvement, whereby individuals donate a share of their points through the purchase of the product. This donation is non-monetary and non-material in nature. Consequently, the level of involvement is lower than in the third architecture of crowd-sourcing. The latter model involves consumers purchasing the product and supporting the community by returning it at the point of sale, thereby resulting in high levels of consumer involvement. In this particular case, the objectives of charity and environmental protection are aligned, facilitated by the power of crowdsourcing and collective action. Consequently, the system exhibits the potential to evolve towards sustainability. This operationalisation enabled the manipulation of consumer effort and perceived autonomy, which are key levers in digital nudging strategies.

A total of 195 Italian participants were recruited online via mailing lists and social networks and no exclusion criteria were applied. Italy represents a relevant and dynamic retail context in which sustainability communication and digital customer journeys are increasingly central. However, the actual implementation of nudging and particularly digital nudging, remains underexplored. For this reason, an Italian consumer sample provides a theoretically meaningful and contextually appropriate setting for a preliminary evaluation of the three digital nudging architectures, which may be subsequently

Figure 3 Experimental stimuli



Source: Authors' elaboration

Table 1 Call to action and customer engagement

Architecture	Call to action	Responsibility	Level of customer engagement
Make together	Buy this product: 1% of sales proceeds will be donated to the "BEST Together" association	The consumer purchases and the retailer donates	Low
In-sourcing	Buy this product: the loyalty points accumulated will be donated to the "BEST Together" association	The consumer purchases and donates loyalty points	Medium
Crowd-sourcing	Buy this product: return the empty bottle to the supermarket to support the "BEST Together" association	The consumer purchases and actively returns the product in store	High

Source(s): Authors' elaboration

implemented by an Italian retailer involved in this pre-experimental phase.

The online administration of the questionnaire was considered suitable for consumers who frequently engage with the Internet as it is likely to align with their familiarity with digital communications (Aiolfi, 2023). The online platform was deliberately selected for its high degree of suitability in emulating the digital environments in which these nudges are predominantly used. It is acknowledged that online interactions are ubiquitous and that digital nudges can be easily embedded within these contexts; therefore, the online questionnaire was considered an appropriate medium through which to measure participants' responses to these specific behavioural interventions.

To ensure participant attentiveness, before disclosing the communication stimulus, participants were exposed to an instructional attentiveness phase. Furthermore, to ensure that the participants actually paid attention to the stimuli, a response-time screening was performed at the conclusion of the experiment to exclude implausibly fast completions and no cases met the exclusion criteria.

The number of participants in each group was constant for all three architectures: make together ($n = 65$), in-sourcing ($n = 65$) and crowd-sourcing ($n = 65$). Following their exposure to the communication stimulus, participants completed a structured questionnaire aimed at assessing a range of psychological and behavioural responses. These included the perceived usefulness and relevance of the initiative, attitudes towards the advertising message, feelings of persuasive pressure, intention to purchase sustainable products and willingness to pay a premium price. Moreover, the study examined perceptions of the retailer's credibility, trustworthiness and charitable engagement in the context of the proposed sustainable initiative through digital nudging mechanisms.

To avoid response bias and ensure consistency with prior human response studies, a specific protocol and guidelines were used to design the survey (e.g. Evan and Miller, 2006; Kountur, 2011). All the questionnaire items were administered in Italian and the original English scales were translated and adapted by bilingual researchers and through the use of the AI-tool DeepL following recommended guidelines for survey-based research (Evan and Miller, 2006; Kountur, 2011). All scales, translated into Italian, were adapted to the experimental context through minor wording adjustments, with no items being removed, deleted or reframed in a way that altered their conceptual meaning. A pre-test was conducted to validate the clarity and comprehensibility of each message

confirming the conceptual equivalence between the original and translated items.

Moreover, all measurement items were based on five-point Likert scales derived from established literature and Table 2 summarises the constructs, number of items, sources, reliability and validity indices. Specifically, perceived usefulness was measured using a five-item scale from Altsech (1996), while relevance of the initiative was assessed with four items adapted from Chen et al. (2016). Attitudes towards the advertisement were measured using a five-item scale adapted from Cleveland et al. (2005) and the perception of persuasive pressure were captured through three items adapted from Chang (2017). The intention to purchase sustainable products was assessed with a three-item scale adapted from White et al. (2016) and the willingness to pay a premium price with two items adapted from Netemeyer et al. (2004). The perceived importance of the company's charitable contributions was measured using a five-item scale from Hildebrand et al. (2017), while retailer credibility and trust were evaluated using scales from Gupta et al. (2009) and Darke et al. (2016), respectively.

Prior to the analysis of differences between the three groups, the data reliability was assessed using Cronbach's alpha, with all values exceeding the minimum acceptable threshold of 0.70 (Santos, 1999), thus confirming the internal consistency of the scales (Table 2). Moreover, convergent and discriminant validity were assessed using Hair et al. (2010) and Fornell and Larcker (1981) criteria (Table 2): all factor loadings exceeded the recommended 0.50 threshold, supporting indicator reliability; average variance extracted (AVE) values ranged from 0.573 to 0.828 and composite reliability (CR) values ranged from 0.729 to 0.950, all exceeding the conventional thresholds of 0.50 and 0.70, respectively, results confirm strong convergent validity across all constructs. Discriminant validity was also supported, as the square root of each construct's AVE was greater than its correlations with the other constructs, in line with the Fornell-Larcker criterion.

In addition, to verify that participants correctly processed the experimental manipulation and to ensure the comparability of the three conditions, we conducted both a manipulation check and demographic balance tests through analysis of variance (ANOVA) and chi-square tests. Because the manipulation involved a subtle change limited to the call-to-action of each nudging architecture while all other visual and textual elements of the stimuli (layout, images, claim and message structure) were held constant, Fayant et al. (2017) recommend the use of a conceptually aligned psychological measure when no explicit recall item is available. In light of this, we considered the validated scale of "perception of

Table 2 Scales summary

Variables	N. Item	Cronbach's		Mean	AVE	CR	√AVE
		alpha					
Perceived usefulness (adapted from Altsech, 1996)	5	0.88		2.81	0.613	0.887	0.783
1. The advertising message is perceived as credible							
2. The advertising message provides relevant information							
3. The advertising message effectively conveys the benefits of the initiative							
4. The advertising message provides a positive image of the initiative							
5. The advertising message provides practical information							
Relevance of the initiative (adapted from Chen et al., 2016)	4	0.91		3.26	0.709	0.907	0.842
1. The initiative promoted by the supermarket is of great significance							
2. The initiative is consistent with my concerns about the environment							
3. The initiative responds well to my needs							
4. The initiative is important to me							
Attitudes toward the advertising message (adapted from Cleveland et al., 2005)	5	0.91		2.60	0.665	0.908	0.816
1. After seeing this advertisement I will talk about the initiative with my family and friends							
2. Seeing this advertisement makes me think that what it promotes is important							
3. Seeing this advertising message makes me more willing to devote my time to the initiative							
4. Seeing this advertising message, I feel like being an active part of the initiative							
5. Seeing this advertising message makes me want to devote money to the initiative							
Perception of persuasive pressure (adapted from Chang, 2017)	3	0.81		2.64	0.593	0.813	0.771
1. When faced with the message, it was difficult not to be persuaded by what it communicated							
2. While viewing the advertisement, I had difficulty finding arguments against the proposed initiative							
3. I was easily influenced by the advertisement for the initiative							
Intention to purchase sustainable products (adapted from White et al., 2016)	3	0.91		2.97	0.780	0.913	0.883
Referring to the initiative proposed by the supermarket, indicate how much you agree with the following statements							
1. Very unlikely to buy/very likely to buy							
2. I am not at all willing to buy / I am very willing to buy							
3. I am not at all inclined to buy / I am very inclined to buy							
Willingness to pay a premium price (adapted from Netemeyer et al., 2004)	2	0.73		2.77	0.573	0.729	0.756
1. I am willing to pay a higher price for a sustainable product							
2. I am willing to pay much more for a sustainable product							
Corporate charitable contribution (adapted from Hildebrand et al., 2017)	5	0.88		3.40	0.600	0.881	0.775
The initiative promoted by the retailer:							
1. Requires effort on the part of the retailer							
2. It is charitable							
3. It is human							
4. It is sincere							
5. It is useful							
Credibility of the retailer (adapted from Gupta et al., 2009)	5	0.94		2.96	0.760	0.940	0.872
1. The retailer seems reliable to me							
2. I think the retailer will also be reliable in the future							
3. I think the retailer keeps its promises							
4. I think the supermarket is open to interacting with me							
5. I think the supermarket is transparent							
Trust in the retailer (adapted from Darke et al., 2016)	4	0.95		3.01	0.828	0.950	0.910
1. I think I can trust the retailer							
2. I think I can rely on this supermarket							
3. I think I can trust the supermarket to do what it says it will do							
4. The supermarket has a high level of moral integrity							

Source(s): Authors' elaboration

persuasive pressure” (Chang, 2017) underlying the structural differences (the degree of consumer involvement and perceived persuasive pressure) among the three digital nudging architectures, as the manipulation check. The ANOVA shows that the perceived persuasive pressure did not significantly differ across the three conditions (p -value = 0.547). This finding suggests that the participants processed the messages in a consistent manner and that the manipulation did not compromise their perceived autonomy, an essential component of ethical nudging. Furthermore, to further strengthen internal validity, chi-square balance tests were conducted on key socio-demographic variables. No significant differences were found across groups in terms of age, gender and education, thereby confirming that the surname-based quasi-random assignment produced statistically equivalent and comparable groups (Table 3) as supported by prior validated procedures in experimental research (e.g. Barabas and Jerit, 2010).

Finally, a comparative analysis was conducted using ANOVA with IBM SPSS 25.0 statistical software to examine the differences in means across the three experimental conditions of digital nudging architecture for each variable measured. In addition to mean differences, effect sizes and post-hoc comparisons were calculated to identify the strength and direction of the observed effects (Bellini and Aiolfi, 2020).

5. Findings and discussion

The sample is composed of 195 subjects (65 per each of the three groups), 66.7% women and 30.3% men (3% prefer not to say), with the majority of respondents (55.4%) under 25 years old. Participants were primarily university students in Italy, reflecting a digitally literate consumer base that is aligned with the aims of the research. A detailed overview of the demographics of the sample is reported in Table 4.

Overall, participants across all experimental groups reported a positive attitude towards the sustainable initiatives. The nudges were perceived as useful and relevant, with average or above-average scores (Table 5). Although participants reported a certain perception of persuasive pressure, these scores remained moderate. This finding suggests that digital nudges can guide behaviour while preserving perceived freedom of choice, which is consistent with the non-coercive logic of nudging and the principles of libertarian paternalism (Thaler and Sunstein, 2009). Taken together, these positive evaluations indicate that the proposed architectures were generally acceptable to respondents and may support willingness to participate in the sustainability initiative, thereby addressing RQ1.

Analyses indicate a generally positive intention to participate in the initiative by purchasing sustainable products, although these responses did not differ significantly across architectures.

Table 4 Characteristics of the sample

		%		
Features	Overall sample	In-sourcing	Make together	Crowd-sourcing
<i>Gender</i>				
Men	30.3	21.5	38.5	30.8
Women	66.7	75.4	58.5	66.2
Not stated	3.1	3.1	3.1	3.1
<i>Age</i>				
Under 25	55.4	60.0	44.6	61.5
26–40	33.8	27.7	41.5	32.3
41–60	9.7	12.3	10.8	6.2
61–79	1.0	–	3.1	–
Over 80	–	–	–	–
<i>Education</i>				
Secondary school	2.1	3.1	–	3.1
Diploma	13.3	9.2	23.1	7.7
Bachelor's degree	41.5	43.1	32.3	49.2
Master's degree	40.5	40.0	44.6	36.9
Other	2.6	4.6	–	3.1

Source(s): Authors' elaboration

However, the values of willingness to pay a premium price for the sustainable product promoted through the three architectures are lower (RQ1). This result is consistent with existing literature on sustainable consumption, which highlights several barriers to price acceptance, including cost sensitivity and effort avoidance, scepticism towards green claims and the perception that environmental benefits are intangible or delayed, all of which contribute to the say–do gap (White et al., 2019; Munro et al., 2023; Bellini et al., 2025; Bharti and Suneja, 2025).

The present study investigated, in a preliminary way, the potential role of retailers in promoting digital nudging mechanisms for sustainability (RQ2). Participants reported high levels of trust and perceived credibility towards the retailers, although these did not statistically differ across architectures. However, these perceptions offer preliminary indications of the potential role of retailers as sustainability facilitators. Similarly, the variable with the highest values, regardless of the proposed architecture, is the level of appreciation by customers about a company's charitable commitments. The findings of this study serve to reinforce the notion that corporate social responsibility (CSR) initiatives and cause-related marketing campaigns can have a positive impact on corporate image, strengthen consumer–brand relationships and influence consumer behaviour (Hildebrand et al., 2017).

Table 3 Manipulation check (ANOVA) and demographic balance tests (chi-square)

Test/variable	Statistic	Df	p-value	Result
Manipulation check – <i>perception of persuasive pressure</i>	$F = 0.605$	2,192	0.547	No significant differences; manipulation perceived coherently
Age	$\chi^2 = 9.33$	6	0.156	Groups equivalent
Gender	$\chi^2 = 4.49$	4	0.344	Groups equivalent
Education	$\chi^2 = 14.58$	8	0.068	Groups equivalent

Source(s): Authors' elaboration

Table 5 ANOVA test

Variables for each group		Mean	SD	SE	ANOVA
Perceived usefulness	Make together	2.588	0.945	0.117	Test of homogeneity of variance: Levene $F(2, 192) = 0.037$ (p. 0.963); ANOVA test: $F = 2.774$ (p. 0.065) – no significant differences
	In-sourcing	2.975	1.012	0.126	
	Crowd-sourcing	2.877	0.969	0.120	
Relevance of the initiative	Make together	3.108	1.027	0.127	Test of homogeneity of variance: Levene $F(2, 192) = 0.617$ (p. 0.540); ANOVA test: $F = 3.166$ (p. 0.044); Post Hoc HSD Tukey: $\text{Make together} < \text{Crowd-sourcing}$ (mean difference = -0.4039 ; p. < 0.05)
	In-sourcing	3.165	0.992	0.123	
	Crowd-sourcing	3.512	0.948	0.118	
Attitude toward the advertising message	Make together	2.505	0.925	0.115	Test of homogeneity of variance: Levene $F(2, 192) = 0.903$ (p. 0.407); ANOVA test: $F = 1.085$ (p. 0.340) – no significant differences
	In-sourcing	2.560	0.962	0.119	
	Crowd-sourcing	2.748	1.065	0.132	
Perception of persuasive pressure	Make together	2.682	0.978	0.121	Test of homogeneity of variance: Levene $F(2, 192) = 0.165$ (p. 0.848); ANOVA test: $F = 0.605$ (p. 0.547) – no significant differences
	In-sourcing	2.523	1.036	0.128	
	Crowd-sourcing	2.703	1.042	0.129	
Intention to purchase sustainable products	Make together	3.025	0.945	0.117	Test of homogeneity of variance: Levene $F(2, 192) = 0.494$ (p. 0.611); ANOVA test: $F = 0.188$ (p. 0.829) – no significant differences
	In-sourcing	2.923	0.995	0.123	
	Crowd-sourcing	2.959	0.946	0.117	
Willingness to pay a premium price	Make together	2.854	0.814	0.101	Test of homogeneity of variance: Levene $F(2, 192) = 2.084$ (p. 0.127); ANOVA test: $F = 0.666$ (p. 0.515) – no significant differences
	In-sourcing	2.785	0.944	0.117	
	Crowd-sourcing	2.669	0.997	0.124	
Corporate charitable contribution	Make together	3.286	0.971	0.120	Test of homogeneity of variance: Levene $F(2, 192) = 1.415$ (p. 0.245); ANOVA test: $F = 1.169$ (p. 0.313) – no significant differences
	In-sourcing	3.375	0.864	0.107	
	Crowd-sourcing	3.523	0.837	0.104	
Credibility of the retailer	Make together	2.849	0.875	0.109	Test of homogeneity of variance: Levene $F(2, 192) = 0.428$ (p. 0.652); ANOVA test: $F = 0.611$ (p. 0.544) – no significant differences
	In-sourcing	3.009	0.962	0.119	
	Crowd-sourcing	3.006	0.989	0.123	
Trust in the retailer	Make together	2.792	0.958	0.119	Test of homogeneity of variance: Levene $F(2, 192) = 0.414$ (p. 0.662); ANOVA test: $F = 2.286$ (p. 0.104) – no significant differences
	In-sourcing	3.100	0.958	0.119	
	Crowd-sourcing	3.127	1.055	0.131	

Source(s): Authors' elaboration

To facilitate a comparison of the variables analysed and the behaviour of the respondents, the three groups were compared based on the architectures identified in the study undertaken by Pellegrini *et al.* (2022) (RQ3). Differences across the three digital nudging architectures were assessed using ANOVA (Bellini and Aiolfi, 2020). As reported in Table 5, the only statistically significant difference concerned the perceived relevance of the initiative (p-value < 0.05). To complement the ANOVA results, we computed effect sizes (partial η^2) and their 95% confidence intervals to assess the magnitude and reliability of the observed effects.

As shown in Table 6, the effect sizes were, in general, negligible to small across the non-significant outcomes, ranging from 0.002 for intention to purchase sustainable products to 0.028 for perceived usefulness, whereas the only statistically significant outcome (relevance of the initiative) showed a comparatively larger, albeit still modest, effect size (partial $\eta^2 = 0.032$). Trust in the retailer also showed a small but non-significant effect size (partial $\eta^2 = 0.023$), suggesting limited differentiation in perceived relational outcomes, although this was below conventional significance thresholds. Overall, these findings suggest that the structure of the engagement architecture may play a meaningful role in shaping consumers' perceptions of the initiative's importance. Specifically, post-hoc HSD Tukey comparisons reported in Table 5 revealed that perceived relevance was significantly higher in the crowd-

sourcing condition (Mean = 3.512) than in the make together condition (Mean = 3.108, p-value < 0.05), whereas the difference between crowd-sourcing and in-sourcing was not statistically significant. This result suggests that the higher level of active participation embedded in the crowd-sourcing architecture may enhance the perceived importance of the initiative. Although both crowd-sourcing and make together involve retailer–consumer interaction, the difference may lie in the more active role required of consumers in the crowd-sourcing condition, which could make the initiative appear more meaningful and engaging. This interpretation is consistent with behavioural and psychological theories (Tversky and Kahneman, 1974), although it should be treated with caution given the limited number of statistically significant differences across outcomes.

Although only one between-architecture difference reached statistical significance, the descriptive mean patterns suggest that the three architectures may be associated with different response profiles. Crowd-sourcing showed the highest mean scores for relevance of the initiative, attitude towards the advertising message, perception of persuasive pressure, trust in the retailer and perceived corporate charitable contribution. In-sourcing showed the highest mean levels of perceived usefulness and retailer credibility, suggesting that incentive-based and internally managed participation may support more instrumental

Table 6 Effect sizes (η^2) and CI 95%

Variable	Partial η^2	95% CI	Interpretation
Perceived usefulness	0.028	[0.000–0.082]	Small
Relevance of the initiative	0.032	[0.000–0.088]	Small–moderate (only significant)
Attitude toward the advertising message	0.011	[0.000–0.050]	Very small
Perception of persuasive pressure	0.006	[0.000–0.038]	Very small
Intention to purchase sustainable products	0.002	[0.000–0.021]	Negligible
Willingness to pay a premium price	0.007	[0.000–0.039]	Very small
Corporate charitable contribution	0.012	[0.000–0.052]	Very small
Credibility of the retailer	0.006	[0.000–0.038]	Very small
Trust in the retailer	0.023	[0.000–0.074]	Small

Source(s): Authors' elaboration

evaluations of the initiative. Conversely, make together exhibited the highest mean values for intention to purchase sustainable products and willingness to pay a premium price, suggesting that lower-effort participation may be more consistent with purchase-oriented responses. However, because the corresponding effect sizes were negligible to small and the mean differences were not statistically significant, these patterns should be interpreted as exploratory rather than confirmatory. Taken together, these differentiated patterns provide initial empirical grounding for Pellegrini *et al.*'s (2022) digital nudging architectures by suggesting that each approach may be associated with a distinct consumer response profile rather than a uniform effect across all outcome dimensions. At the same time, stronger conclusions will require further investigation in future studies, particularly with larger and more heterogeneous samples.

6. Conclusions and implications

The proposed research represents one of the first empirical attempts to frame and categorise the phenomenon of digital nudging for conscious shopping.

From a theoretical perspective, the research contributes to the existing literature on digital nudging and sustainability by extending and empirically testing, in a retail sustainability setting, the three conceptual digital nudging architectures proposed by Pellegrini *et al.* (2022). While Pellegrini *et al.* (2022) introduced the three nudging architectures as alternative ways of structuring consumer participation, our findings contribute to this framework by clarifying how the model should be interpreted empirically. Unlike prior studies, which examined single nudges or applied them within narrowly defined domains, our study integrates behavioural economics, consumer psychology and digital marketing to investigate how nudging strategies influence consumer decision-making. The study provides a foundation for the development of effective sustainability marketing campaigns by leveraging digital technologies and nudging theory. By evaluating the three distinct digital nudging architectures, the study highlights how different architectures are associated with different patterns of consumer responses across engagement, purchase intentions and willingness to pay.

Rather than indicating that one architecture is systematically more effective than the others, the results show that different architectures matter for different types of

consumer responses. Specifically, the results are broadly consistent with the model's premise that architectures differ in the type of consumer involvement they activate and may therefore be associated with distinct consumer evaluations. Taken together, these findings refine Pellegrini *et al.*'s (2022) model by showing that the three nudging architectures should not be interpreted as a ranking of effectiveness, but as qualitatively different participatory logics whose relevance depends on the specific evaluative or behavioural outcome considered.

The findings of this study highlight the potential of digital nudging in fostering conscious shopping and consumption, regardless of the specific architectural framework implemented. In the present online between-subjects experiment, the crowd-sourcing approach displayed the highest levels of perceived relevance and descriptively strong engagement-related evaluations. This result suggests that more participatory architectures may strengthen the perceived importance of the sustainability initiative, suggesting that consumers perceive greater value when directly involved in sustainable actions (Deci and Ryan, 2013). While no statistically significant differences were identified, the make together model showed the highest mean values for willingness to pay a premium price, likely due to the lower engagement required, which has been shown to reduce cognitive effort and enhance perceived simplicity.

The in-sourcing model, involving moderate consumer engagement through incentive-based actions, was perceived as both useful and credible. While it did not generate the highest levels of engagement or willingness to pay, it represents a valuable strategy for fostering consumer participation when aligned with personal benefits such as loyalty rewards. The higher level of perceived obligation associated with this model suggests a more structured form of engagement, which is likely to appeal to consumers who value tangible returns for their sustainable behaviour.

The present study is particularly relevant for retailers, whose role has been confirmed as essential in stimulating conscious and sustainable consumer behaviour (Smith, 2023). Specifically, all three nudging architectures were generally perceived as credible and persuasive, reinforcing the importance of brand reputation and trust in sustainability messaging. These results suggest the potential of digital nudging as a tool through which retailers may act as sustainability ambassadors, by delivering useful, relevant and trustworthy messages.

Beyond the managerial implications, the findings also suggest concrete ways in which retailers can operationalise digital nudging architectures in real-world settings. For instance, make together initiatives can be integrated into digital storefronts by automatically associating product purchases with tangible sustainability contributions (e.g. donations triggered at checkout), thereby reducing cognitive effort and facilitating acceptance of price premiums. In-sourcing initiatives can be implemented through loyalty programs, gamified sustainability challenges or personalised feedback dashboards, wherein consumers are rewarded with points or benefits for their active engagement in sustainable actions, reinforcing perceived usefulness. Crowd-sourcing initiatives are particularly suited for mobile applications and platform-based environments, where collective participation (e.g. community-based recycling incentives), progress tracking and social visibility can be leveraged to maximise engagement and perceived relevance. These examples are intended as architecture-specific applications that reflect the heterogeneous response profiles observed in the study.

Given the favourable perceptions held by consumers of companies' charitable commitments, retailers may consider partnerships with reputable social, environmental or charitable organisations to enhance the perceived credibility and meaningfulness of sustainability initiatives. In this sense, charitable collaborations may strengthen the communicative value of digital nudging strategies. For these reasons, retailers may consider allocating further resources to digital nudging strategies, provided that these are aligned with specific managerial objectives such as enhancing perceived relevance, reinforcing credibility or supporting lower-friction purchase-oriented responses and that they are implemented transparently and perceived as authentic.

Retailers can leverage these insights to design tailored digital nudging strategies by aligning each architecture with a specific managerial objective rather than assuming that one model is universally superior. Specifically, crowd-sourcing appears particularly suitable when the goal is to enhance perceived relevance and collective engagement; in-sourcing may be more appropriate when retailers aim to reinforce perceived usefulness and credibility through incentive-based participation such as loyalty points or exclusive offers; and make together may be better suited to lower-friction, purchase-oriented responses. However, given that only the relevance of the initiative differed significantly across architectures, these implications should be interpreted as evidence-informed but partly exploratory.

From a practical perspective, these architectures may also be further refined through AI-enabled personalisation. For instance, recommendation systems and adaptive interfaces could tailor the timing, visibility and format of participatory nudges to different consumer profiles and usage contexts. At the same time, across all architectures, such personalisation should be accompanied by transparent communication and ethical framing and be perceived as authentic, so that greater effectiveness does not come at the expense of consumer trust, autonomy or fairness (Smith, 2023). In this sense, the effectiveness of any architecture also depends on whether it is implemented in a way that is consistent with the

ethical principles of autonomy and non-coercion (Thaler and Sunstein, 2009).

At a broader organisational and policy level, ethical digital nudging may serve as a complementary strategy to retailers' CSR initiatives and sustainability communication. Specifically, it can facilitate voluntary and non-coercive consumer behaviour aligned with broader societal goals. Moreover, from a policy perspective, digital nudging architectures may represent a cost-effective instrument for supporting sustainability goals, particularly when embedded within existing retail ecosystems and guided by transparency, data protection and consumer autonomy principles (Hansen, 2019; Susser *et al.*, 2019; Sunstein, 2022).

Furthermore, the integration of educational components within nudging messages has been demonstrated to enhance consumers' comprehension and acknowledgement of the consequences of their decisions, thereby facilitating more informed and deliberate choices. The positive responses to the crowd-sourcing model suggest that retailers may benefit from investigating collaborative initiatives that involve consumers in decision-making processes. This enhances consumer engagement and fosters a sense of co-creation, which in turn strengthens brand loyalty and perceived impact, contributing to greater long-term commitment.

Finally, the differentiated patterns observed across the three architectures may be theoretically consistent with different underlying motivational dynamics (Deci and Ryan, 2013). In particular, architectures that encourage greater participation, such as crowd-sourcing, may be associated with stronger perceptions of involvement and collective action, whereas lower-effort or incentive-based architectures may activate different evaluation responses. However, because these mechanisms were not directly tested in the present study, they should be interpreted as theoretical possibilities rather than as confirmed explanatory processes. Future research should therefore examine these psychological dimensions of digital nudging effectiveness more explicitly.

Considering these findings, it is imperative for retailers to develop long-term strategies that integrate digital nudging into broader sustainability communication, thereby cultivating novel competencies and insights to promote future conscious behaviour, elevate their reputation and propel comprehensive business success. This necessitates a constant investment in the training of personnel. Employees who understand the principles and architectures of digital nudging have the potential to provide better support to consumers, thereby improving both the customer experience and the impact of sustainability initiatives.

Furthermore, retailers should invest in communication design to ensure nudging interventions are perceived as ethical, transparent and empowering. In particular, a critical challenge that retailers must address is that of ensuring security and data privacy. The use of digital nudging requires retailers to use clear communication and transparent practices. The protection of user data and adherence to privacy standards (e.g. GDPR) are essential to preserve consumer trust and ensure the legitimacy of behavioural interventions. This, in turn, is a key element in building credibility and ensuring the effectiveness of nudging initiatives.

7. Limitations and future research directions

While the present study provides relevant insights into the role of digital nudging in promoting sustainable consumer behaviour, it is essential to acknowledge its main limitations and outline directions for future research.

Building on the present findings, our results offer a future research agenda on digital nudging architectures, as outlined in Table 7, which summarises the main theoretical and methodological directions emerging from our study. In particular, the descriptive patterns across outcomes indicate that the three architectures are not merely alternative formats, but rather distinct models of participation that can activate different psychological pathways and, consequently, lead to different evaluative and behavioural responses. Future studies may develop this insight further by moving from the question of “whether” nudges work to the question of “when, why and for whom” a given participatory architecture is most effective, thereby strengthening the explanatory power of Pellegrini *et al.*'s (2022) framework in digital retail sustainability contexts.

Future research can advance the research agenda by theorising and testing the mediating mechanisms linking each architecture to specific consumer outcomes. For instance, crowd-sourcing may be facilitated by social proof, identity signalling and perceived collective efficacy, while make together may operate through reduced cognitive effort, perceived retailer responsibility and satisfaction. In contrast, in-sourcing may rely on perceived exchange fairness, extrinsic motivation and commitment. Testing these mechanisms would clarify why different architectures are associated with distinct response patterns.

In addition, future studies should explore the effectiveness of each architecture by considering boundary conditions. For instance, further analysis could consider the role of promising moderators encompassing individual differences, situational constraints and retailer-level characteristics. This would advance the field by identifying the conditions under which different levels of participation (low vs moderate vs high involvement) produce stronger outcomes (e.g. persuasion, engagement, willingness to pay).

From a methodological perspective, this study used an online survey-based experiment, a method that, whilst appropriate for digital nudging research, may not fully capture the complexity of real-world shopping, including contextual cues, time constraints and social influences. Future studies could incorporate field experiments, conducted in physical stores or e-commerce settings, to validate these findings in actual retail environments.

In addition, while the sample of 195 digitally literate Italian university students was sufficient for our preliminary statistical testing of the three digital nudging architectures, this limits the generalisability of the findings to this specific demographic and cultural context. Specifically, even though the sample is selected from a context of practical managerial interest and this specific population is relevant for an initial test of digital nudging architectures, it remains relatively homogeneous in terms of age, educational background and socio-cultural context (Italian students with digital skills). This calls for caution when generalising the results due to limitations in external validity.

To enhance the generalisability of the findings to broader and more diverse consumer populations, future research should

replicate the present study with more heterogeneous consumer segments and in different cultural settings. Specifically, it is recommended that future research investigate how cultural differences influence the perception and effectiveness of digital nudging strategies, given that attitudes towards sustainability, consumer autonomy and ethical sensitivity may vary across contexts. For instance, Hofstede's (2011) concept of cultural dimensions, including individualism–collectivism and uncertainty avoidance, may influence the interpretation of retailer-led sustainability initiatives by consumers and their response to different forms of participation. Consequently, comparative cross-country studies, grounded in cultural dimensions as moderators, could clarify how consumers interpret retailer-led sustainability initiatives and how they respond to different forms of participation.

At the same time, the exploration of ethical considerations, particularly with regard to consumer autonomy and the potential for manipulative effects, could provide valuable guidelines for retailers and practitioners seeking to implement digital nudging strategies in line with consumer psychology, engagement preferences and the principles of libertarian paternalism (Thaler and Sunstein, 2009).

Moreover, the self-reported nature of the data introduces the possibility of social desirability bias, where respondents may overstate their willingness to engage in sustainable behaviours thus contributing to the so-called “say–do gap” frequently observed in sustainability research (Bharti and Suneja, 2025). Because the study relies on self-reported evaluations and behavioural intentions rather than observed behaviour, the findings should be interpreted as evidence of perceived and intended responses, not as direct proof of actual sustainable behaviour in retail settings.

In this sense, future research could further investigate the psychological mechanisms underlying the effects of different digital nudging architectures. While the present study focused on outcome variables, further studies may use mediation/moderation analyses or structural equation modelling to investigate how psychological factors (e.g. perceived autonomy, trust in the retailer, engagement) influence consumers' responses to digital nudges. Those analyses could help clarify why certain architectures are perceived as more relevant or engaging than others, thereby providing deeper insight into the cognitive and motivational factors and effects of digital nudging strategies.

Moreover, complementary methods, such as behavioural tracking or observational studies, could mitigate this limitation. Specifically, future research should investigate behavioural or longitudinal measures such as clickstream data or simulated purchasing, because these factors can provide richer evidence of actual decision-making. Future research could also adopt neuroscientific tools, such as electroencephalography and eye-tracking, to gain deeper insights into users' cognitive responses to digital nudging stimuli.

Furthermore, this study is notable for its focus on the short-term impact of digital nudging interventions. Longitudinal studies are needed to assess whether digital nudging produces lasting behavioural changes in sustainable consumption.

In addition, while this study provides a solid basis for understanding digital choice architecture and consumer motivation, future research should explore how AI-driven

Table 7 Future research agenda

Research focus	Recommended next steps
Testing nudging effectiveness in real-world retail settings	Conduct field experiments in physical stores or e-commerce to validate nudging effects in real shopping contexts, enhancing ecological validity and robustness
Exploring longitudinal effects of nudging on sustainable behavior	Use longitudinal studies or repeated-measure designs (e.g. clickstream, simulated purchases) to examine whether digital nudging can produce long-lasting changes in consumer habits over time
Identify psychological processes underlying different nudging architectures	Investigate why different architectures lead to different consumer responses by examining the psychological processes activated by different levels of participation (e.g. engagement, perceived responsibility, effort, or motivation)
Investigating cross-cultural and demographic differences in nudging response and effectiveness	Compare nudging effectiveness across countries, age groups, or value orientations to improve segmentation and adapt nudging strategies to diverse consumer profiles (e.g. cross-country, multi-group research designs, cultural dimensions by Hofstede)
Using neuromarketing to analyze unconscious reactions to nudges	Apply tools such as EEG, eye-tracking or facial emotion recognition to explore non-conscious emotional and cognitive reactions to different nudging architectures
Considering AI-driven personalization of nudging architectures	Explore how emerging technologies (e.g. AI-driven personalization) can dynamically adapt digital nudging architectures to user characteristics and contexts, while assessing implications for autonomy, transparency and ethical acceptability
Assessing the ethical boundaries and consumer perceptions of digital nudging	Use mixed methods (surveys + in-depth interviews or focus groups) to investigate how consumers perceive the transparency and autonomy-preserving features and perceived manipulation of nudging interventions

Source(s): Authors' elaboration

personalisation or platform-mediated and algorithmically shaped choice environments may transform digital nudging architectures from relatively static participation formats into adaptive choice environments, thereby dynamically matching the form of participation to user characteristics and situational contexts (Seo and Yoon, 2025). In particular, future research could investigate whether personalised recommendation systems, dynamic defaults and context-sensitive participatory prompts enhance the effectiveness of sustainability-oriented nudges without undermining transparency, fairness and consumer autonomy. This would also help clarify whether ethical personalisation should be treated as a relevant boundary condition for the effectiveness of digital nudging.

Finally, future research may also revisit and refine the current categorisation of digital choice architectures, testing their applicability across various sustainable domains such as health, wellness and nutrition.

By addressing these methodological and contextual limitations, future studies (see Table 7) can further refine our understanding of how digital nudging architectures influence sustainable retail behaviours across diverse consumer populations.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT and DeepL to improve the English language and structure of some sentences. After using these tools, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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Further reading

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