IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Green Nudges At Checkout: A Conceptual Framework For Sustainability Messaging And Cart Abandonment In E-Commerce

[1] Dr. Nitu Sharma, [2] Ms. Garima Chhaparia

[1]Associate Professor, School of Commerce, Department of Post Graduate Studies, Mount Carmel College Autonomous, Bengaluru, India

[2]Post Graduate School of Commerce, Department of Post Graduate Studies, Mount Carmel College Autonomous, Bengaluru

Abstract

Cart abandonment remains a persistent challenge in e-commerce, constraining both conversion performance and the promotion of sustainable consumption. While digital platforms increasingly incorporate sustainability messaging, limited conceptual work has examined how environmentally framed interventions shape consumer decision-making, specifically at the checkout stage. This paper develops a conceptual framework to explain how green nudges embedded within e-commerce checkout environments can reduce cart abandonment while encouraging environmentally responsible purchasing behaviour.

Drawing on Nudge Theory, the Theory of Planned Behavior, and Cognitive Load Theory, the framework identifies key psychological mechanisms through which sustainability messaging influences checkout decisions-including environmental concern, perceived behavioural control, and guilt-related affect. Contextual conditions such as time pressure, cognitive load, and the intention–behaviour gap are also incorporated, as they characterize checkout environments and shape how consumers respond to nudging interventions. The study advances the literature by positioning the checkout stage as a critical intervention point for sustainable consumption in digital commerce. The proposed framework provides theoretical foundations for future empirical investigation. It offers practical guidance for e-commerce platforms seeking to design checkout environments that simultaneously support conversion outcomes and pro-environmental behaviour.

Keywords: *Green nudges; cart abandonment; sustainability messaging; e-commerce checkout; sustainable consumption; choice architecture*

JEL Classification: *D91, M31, Q50, L81, M14*

1. INTRODUCTION

The rapid expansion of e-commerce has transformed global consumer behaviour, yet digital retailers continue to face a persistent operational challenge: shopping cart abandonment. The phenomenon occurs when consumers add products to an online cart but exit the platform without completing the transaction. Empirical research consistently attributes this behavior to factors such as complex checkout interfaces, unexpected costs, and perceived purchase risk. (Chopra et al. 2024) Identify cart abandonment as a critical bottleneck in e-commerce conversion, particularly when consumers experience elevated cognitive load and decision fatigue at the final stage of the purchase process. Simultaneously, sustainability has become a defining strategic concern in digital commerce. Green nudging-a form of behavioural intervention designed to promote environmentally responsible choices without restricting consumer autonomy-has emerged as a tool for businesses to align commercial operations with environmental objectives. Research by (Michels et al. (2023) demonstrates that digital nudging strategies, including default settings, active-choice prompts, and social-norm messages, can encourage consumers to choose sustainable logistics and shipping options. However, a gap persists: few conceptual studies have examined how green nudges function specifically at the checkout stage, where the discrepancy between environmental intention and actual behaviour is typically greatest.

E-commerce checkout environments are characterised by heightened cognitive demands, competing decision stimuli, and time constraints. (Younusi and Li 2023) establish that cognitive load and information processing demands contribute substantially to cart abandonment in complex purchase contexts. (Goel et al.2024) further demonstrate that perceived inconvenience, price sensitivity, and product-related risk amplify hesitation at the point of purchase. These dynamics suggest that checkout interfaces are particularly susceptible to design-level interventions that can shape consumer decisions without adding friction. The psychological mechanisms through which green nudges exert their influence are equally important to understand. Environmental concern, anticipated guilt, and perceived behavioural effectiveness are well-established determinants of sustainable purchasing behaviour (Gruchmann et al., 2022). Nevertheless, the intention–behaviour gap in sustainable consumption remains persistent: consumers who express strong environmental attitudes do not reliably translate those attitudes into purchasing decisions (Wang et al., 2025). Targeted nudging strategies that incorporate message framing, social proof, and default settings may help bridge this gap by activating purchase intentions at a moment of heightened receptivity (Khalufi, 2025). The Theory of Planned Behavior provides a well-established theoretical lens for understanding how environmental information influences purchase intention through perceived behavioural control and subjective norms (Ajzen, 1991). Social norm communication has also been shown to shape sustainable

consumption (Pristl et al., 2020). In behavioural economics, default options can steer consumers towards environmentally responsible alternatives (Sattar et al., 2025), and emotions such as eco-guilt are recognised as significant motivators of pro-environmental behaviour (Nielsen et al., 2024).

This paper responds to these converging research streams by developing an integrated conceptual framework that positions the e-commerce checkout stage as a strategic intervention point for sustainable consumption. The framework draws on Nudge Theory, the Theory of Planned Behavior, and Cognitive Load Theory to explain how green nudges can simultaneously reduce cart abandonment and foster pro-environmental purchasing decisions. Three theoretically grounded hypotheses are proposed to guide future empirical inquiry. The study thereby advances both the sustainable consumption and digital commerce literatures by providing a theoretically coherent account of how checkout design can reconcile commercial performance with environmental responsibility.

2. LITERATURE REVIEW

2.1 Green Nudge Systems and Checkout Optimization

A growing body of research has examined the role of green nudges to pro-environmental consumer behavior in e-commerce contexts. In the literature, green nudging refers to design-level interventions embedded within digital environments that guide consumers towards environmentally responsible choices while preserving their freedom to act otherwise. Such interventions are relevant at the checkout stage, where final purchase decisions are made, and cart abandonment is most likely to occur. (Lohmann et al.2024) Conducted an observational analysis of pro-environmental behavioral interventions, finding that explicit calls to action generally outperform emotion-based appeals in encouraging environmentally compliant behavior.

The choice architecture literature similarly demonstrates that design elements-such as sustainable shipping defaults, environmental message framing, and social norm cues-can meaningfully steer consumer choices towards sustainability outcomes. (Hwang et al. 2024) applied the Extended Theory of Planned Behavior to confirm that subjective norms exert a significant effect on pro-environmental purchase intentions. When sustainable behavior is perceived as socially desirable, consumers are more likely to act accordingly. The integration of sustainability interventions into digital commerce settings nevertheless presents practical challenges. (Chopra et al.2024) observe that complex checkout interfaces increase cognitive overload and exacerbate cart abandonment, suggesting that sustainability nudges must be designed to be concise and minimally disruptive. (Schleicher and Töller 2024) Further show that combining multiple behavioral instruments can enhance the promotion of sustainable behavior. These findings collectively indicate that sustainability nudges can support both environmental and commercial goals when they are strategically embedded at checkout decision points.

2.2 Psychological Underpinnings of Sustainable Purchasing Behavior

The effectiveness of green nudges is substantially shaped by the psychological processes that govern consumer behavior. Several conceptual and empirical contributions have advanced understanding of how environmental attitudes, emotional responses, and social influences condition pro-environmental purchasing decisions. (Mandić et al. 2023) applied the Norm Activation Model to demonstrate that ecological awareness and guilt-related emotions are central drivers of pro-environmental action. (McCarthy 2024) extended the Theory of Planned Behavior to show that moral licensing can disrupt the relationship between perceived behavioral control and behavioral intention, revealing a layer of complexity in sustainability decision-making.

Habit formation also contributes to sustainable consumption: (Solekah et al., 2024) found that sustainable behaviours are shaped by both habitual patterns and interpersonal social influences. Value orientations further inform sustainable purchasing. (Mehdi et al. 2024) found that altruistic values are stronger predictors of organic food purchase intentions among Generation Z consumers than egoistic motivations. Social influence operates as an additional driver: (Alghamdi & Agag (2024) demonstrated that exposure to environmental content on social media reinforces both altruistic and egoistic motivations, thereby heightening environmental awareness more broadly. (Nguyen and Tran 2025) further established that pro-environmental behaviour mediates the relationship between environmental concern and green purchase intention, particularly in collectivist cultural settings. These findings collectively suggest that moral drivers, social influences, and value orientations interact to shape consumer sustainability behaviour.

2.3 The Intention–Behaviour Gap in Sustainable E-Commerce

A central and enduring challenge in sustainable consumption research is the intention–behaviour gap-the discrepancy between consumers stated environmental intentions and their actual purchasing behaviour. In digital commerce environments, time pressure, information overload, and decision fatigue compound this gap, making it difficult for sustainability intentions to manifest as completed purchases. (Hui et al. 2024) applied the Theory of Planned Behavior to examine consumers' willingness to pay a premium for eco-friendly products, identifying financial constraints and skepticism about sustainability claims as primary barriers to purchasing follow-through. Esfandiari Bahraseman et al. (2024) found that cooperative strategies for sustainability engagement are more effective than regulatory enforcement in shaping pro-environmental intentions, underscoring the relevance of non-coercive behavioural approaches in digital contexts.

Digital interactions also shape the intention–behaviour gap in distinctive ways. Šálková et al. (2023) observe that despite growing ethical consumption attitudes, actual purchasing behaviour for sustainable products remains disproportionately low. Trust emerges as a critical mediating factor: Molho et al. (2024) found that the persuasive impact of social-norm-based sustainability messages varies across cultural contexts and depends on the perceived credibility of the normative claim. This implies that sustainability interventions must be sensitive to trust, cultural context, and the perceived authenticity of environmental messaging.

3. RESEARCH GAP AND OBJECTIVES

3.1 Research Gap

Despite significant scholarly interest in sustainable consumption and digital nudging, the specific application of green nudges at the e-commerce checkout stage remains underexplored. Prior research has established that social norms and environmental concern influence pro-environmental purchase intentions (Hwang et al., 2024; Lohmann et al., 2024) and that checkout complexity is a primary driver of cart abandonment (Chopra et al., 2024). However, these streams of research have largely proceeded in isolation, with limited integration of how green nudges can simultaneously promote sustainable purchasing and reduce cart abandonment at the same intervention point.

The persistent intention–behaviour gap in sustainable consumption-documented by Wang et al. (2025) and others-highlights the need for targeted, context-specific interventions. Psychological factors, including moral licensing (McCarthy, 2024), social influence (Nguyen & Tran, 2025), and differential responses across consumer segments (Molho et al., 2024), have been identified in the literature. However, their combined operation in the digital checkout context has received limited direct attention. The present study addresses this gap by proposing an integrated conceptual framework that links green nudge design to checkout behaviour, incorporating the psychological processes and contextual conditions that shape consumer responses.

3.2 Research Objectives

Two primary objectives guide this study:

Objective 1: To develop a conceptual framework explaining how green nudges at the e-commerce checkout stage influence sustainable purchasing behaviour and reduce cart abandonment.

Objective 2: To identify the key psychological mechanisms and contextual conditions that link green nudge design to consumer purchase completion outcomes at checkout.

4. THEORETICAL FRAMEWORK

To explain how sustainability messaging at the e-commerce checkout stage influences consumer cognition and purchasing behaviour, this study draws on three established theoretical perspectives: Nudge Theory, the Theory of Planned Behavior (TPB), and Cognitive Load Theory (CLT). These theories are complementary and address different but overlapping dimensions of the consumer decision-making process at checkout, providing a multi-layered theoretical foundation for the proposed conceptual framework.

4.1 Nudge Theory

Nudge Theory, as articulated by Thaler and Sunstein (2008), holds that individuals' choices are systematically influenced by the design of the decision environment-termed choice architecture-without restricting freedom of choice or altering economic incentives. Rather than mandating specific behaviours, nudges subtly modify the context in which decisions are made, guiding individuals towards preferred outcomes while preserving autonomy. In digital commerce, checkout interfaces constitute a prominent form of choice architecture that can influence consumer behaviour through strategically positioned cues. Green nudges in e-commerce may take the form of sustainability labels, default selections for eco-friendly packaging or carbon-neutral delivery, or social-norm messages that signal a particular option is environmentally responsible.

These cues gently orient consumers towards pro-environmental decisions without imposing constraints. Crucially, the presence of sustainability information at checkout may also enhance the perceived value of completing the purchase, thereby reducing the probability of cart abandonment. Nudge Theory thus provides a foundational explanation for how checkout design features can support sustainable purchase completion.

4.2 Theory of Planned Behavior

The Theory of Planned Behavior (Ajzen, 1991) posits those behavioral intentions-the immediate antecedents of behavior-are determined by three components: attitudes towards the behavior, subjective norms, and perceived behavioral control. Attitudes reflect the individual's evaluation of the behavior as favorable or unfavorable; subjective norms capture perceived social expectations; and perceived behavioral control reflects the ease or difficulty of performing the behavior.

In e-commerce checkout contexts, sustainability messaging can positively shape consumer attitudes by framing eco-friendly options as responsible and socially valued choices. Social proof messages-such as notifications that a large proportion of customers selected a sustainable delivery option-activate subjective norms, making pro-environmental behaviour feel normatively appropriate. Offering clearly labeled, low-effort sustainable options at checkout also enhances perceived behavioral control by reducing the friction associated with sustainable choices. These three mechanisms, together, strengthen consumers' intentions to make environmentally responsible purchases and reduce the likelihood of cart abandonment.

4.3 Cognitive Load Theory

Cognitive Load Theory (Sweller, 1988) holds that the human cognitive system has finite processing capacity. When information complexity or the volume of decisions exceeds this capacity, cognitive overload occurs, impairing decision quality and increasing avoidance behavior. In e-commerce checkout environments, consumers simultaneously navigate payment options, delivery preferences, pricing details, and promotional offers. This combination substantially increases cognitive load and heightens the risk of cart abandonment. Well-designed sustainability nudges can function as decision-support cues that reduce

rather than increase this cognitive burden. When green messages are concise, clearly formatted, and strategically placed within the checkout flow, they provide clarity, reduce uncertainty, and facilitate faster decision-making.

The design and placement of sustainability messaging are therefore critical determinants of whether a nudge supports or impedes purchase completion. Cognitive Load Theory explains this relationship and informs practical recommendations for sustainable checkout interface design.

5. CONCEPTUAL FRAMEWORK

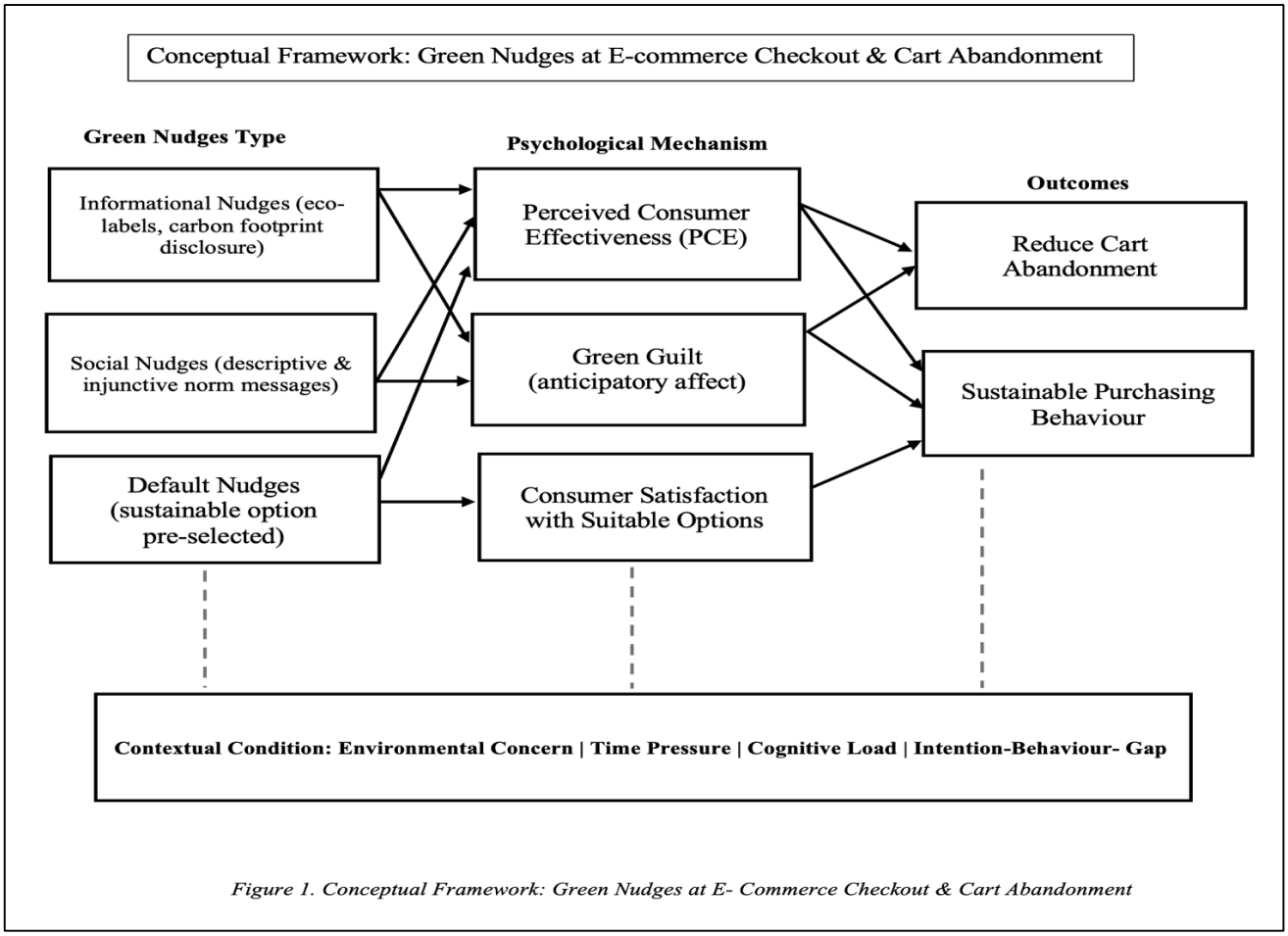

Figure 1. Conceptual Framework: Green Nudges at E- Commerce Checkout & Cart Abandonment

Source: Primary

5.1 Framework Overview

The proposed conceptual framework illustrates how green nudges embedded at the e-commerce checkout stage influence sustainable purchasing behaviour and cart abandonment. Rather than specifying mediation or moderation pathways in a statistical sense, the framework articulates the directional relationships between three categories of green nudge inputs, the psychological responses they activate, the contextual conditions

that shape those responses, and the behavioral outcomes of primary interest. Figure 1 presents the framework diagrammatically.

5.2 Green Nudge Types

The framework identifies three categories of green nudge as the primary inputs to the model, each operating through distinct mechanisms and grounded in the theoretical perspectives outlined above.

Informational nudges present consumers with factual environmental data at the point of purchase, including carbon footprint disclosures, eco-label certifications, and comparative environmental impact information. These nudges draw on the TPB by activating consumer attitudes and perceived behavioral control, making environmental consequences salient and enabling informed choice.

Social nudges communicate that other consumers have chosen sustainable options, leveraging descriptive and injunctive norm messages. For example, notifications such as 'Most shoppers in your area chose carbon-neutral delivery' activate subjective norms, aligning the sustainable choice with perceived social expectation and group behavior.

Default nudges set sustainable options as the default at checkout, requiring consumers to opt out rather than actively opt in. Grounded in Nudge Theory, this approach exploits the status quo bias to reduce the effort cost of sustainable choice and draws on Cognitive Load Theory by simplifying the decision environment.

5.3 Psychological Mechanisms Activated

Each green nudge category is expected to elicit distinct psychological responses in consumers at checkout. These responses are presented as the explanatory channel through which nudges influence behavior and are not operationalized as formal statistical mediators in this conceptual paper. Perceived consumer effectiveness (PCE) refers to consumers' beliefs that their individual purchase decisions contribute meaningfully to environmental outcomes. Informational nudges are particularly likely to activate PCE by making the environmental implications of purchasing decisions transparent and comprehensible. Consumers who believe their choices matter are more likely to proceed with a sustainable purchase rather than abandon the cart.

Green guilt captures the negative, anticipatory, or reactive affect experienced when consumers recognize a gap between their environmental values and their intended behavior. Social and informational nudges may elicit this emotional response, providing consumers with the motivation to resolve the discrepancy by selecting a sustainable option and completing the purchase. Consumer satisfaction with sustainable options reflects positive evaluations of eco-friendly alternatives presented at checkout. When sustainable options are framed as convenient, credible, and socially endorsed, consumers are more satisfied with the available choices and less likely to abandon their carts due to decision dissatisfaction.

5.4 Contextual Conditions

The framework acknowledges that the relationship between green nudges and consumer responses does not operate in isolation. Four contextual factors are identified as relevant to shaping the effectiveness of checkout-stage nudges across different consumer and platform contexts.

Environmental concern-the degree to which a consumer is aware of and troubled by environmental problems-is expected to amplify the impact of informational and social nudges. Consumers with greater environmental concern are more likely to attend to sustainability cues and act upon them. Time pressure and cognitive load, inherent to many checkout environments, may reduce the effectiveness of complex or text-heavy nudges while increasing the relative effectiveness of simple defaults. The intention–behaviour gap, as discussed in the literature review, represents the broader contextual challenge that checkout-stage green nudges are designed to help bridge.

5.5 Outcomes

The framework identifies two behavioral outcomes of central theoretical and practical relevance. Reduced cart abandonment is the probability that a consumer who would otherwise exit the checkout without purchasing is retained to complete the transaction after exposure to green nudges. This outcome is expected to result primarily from reduced decision uncertainty and increased satisfaction with available sustainable options. Sustainable purchasing behavior reflects the completed selection of an environmentally responsible product, delivery method, or packaging option at checkout. This outcome is expected to follow from the activation of PCE and green guilt, and from the internalization of social norms through nudge exposure. Taken together, these two outcomes reflect the dual commercial and environmental objectives that the framework seeks to address.

6. RESEARCH HYPOTHESES

Based on the proposed conceptual framework and the theoretical review presented above, this study advances three hypotheses to direct future empirical investigation. These hypotheses are conceptual and *intended to be examined using experimental or quantitative survey-based methodologies.*

H1: Green nudges at the e-commerce checkout stage-encompassing informational, social, and default nudge types-are positively associated with purchase completion, such that higher nudge exposure is associated with reduced cart abandonment.

H2: Checkout-stage green nudges are positively associated with sustainable purchasing behavior, such that informational and social nudges activate perceived consumer effectiveness and green guilt, and default nudges reduce the effort cost of selecting sustainable options.

H3: The effectiveness of checkout-stage green nudges on sustainable purchasing behavior is contingent on consumer environmental concern, such that consumers with higher levels of environmental concern respond more strongly to informational and social nudges.

In contrast, default nudges are comparatively more effective for consumers with lower environmental concern. These hypotheses are grounded in the theoretical relationships articulated in the framework. They are intended to be empirically evaluated through appropriate methodologies, including experimental manipulation designs, regression-based analysis, or cross-sectional survey approaches.

7. RESEARCH METHODOLOGY

This study adopts a qualitative conceptual research approach, drawing on secondary sources, including peer-reviewed articles from Scopus- and Web of Science-indexed journals in e-commerce, sustainability marketing, behavioral economics, and consumer psychology. This orientation is consistent with the study's objective of theory building rather than empirical hypothesis testing and is well established as a methodological approach in the conceptual paper tradition (Jaakkola, 2020). The literature review was conducted thematically across three domains: green nudge design and checkout optimization; the psychological underpinnings of sustainable purchasing behavior; and the intention–behaviour gap in digital commerce. Sources were selected based on their relevance, theoretical rigor, and recency, with priority given to work published within the preceding five years. The thematic synthesis informed the identification of key constructs, directional relationships, and contextual conditions within the proposed framework.

Consistent with the conventions of conceptual scholarship, the associations presented in the framework have not been empirically tested in the current study. The framework is therefore advanced as a theoretical foundation for future empirical inquiry, whether quantitative, qualitative, or mixed methods. The three proposed hypotheses are designed to guide the operationalization of the framework's constructs in subsequent primary research.

8. DISCUSSION

This paper develops a conceptual framework to understand how green nudges at the e-commerce checkout stage influence sustainable purchasing behavior and cart abandonment. The analysis integrates Nudge Theory, the Theory of Planned Behavior, and Cognitive Load Theory to offer a coherent account of the mechanisms and contextual conditions shaping consumer responses to checkout-stage sustainability interventions. A central contribution of the framework is its differentiation of green nudge types and their respective psychological pathways. Informational nudges are expected to activate perceived consumer effectiveness by rendering the environmental consequences of purchasing decisions salient (Ganesan et al.,

2025). Social nudges draw on subjective norms and social proof dynamics, making sustainable choices feel normatively congruent (Granato & Mugge, 2025). Default nudges reduce the cognitive effort required to select eco-friendly options, directly addressing the cognitive load barrier identified by Sweller (1988). This differentiation moves beyond treating sustainability messaging as a monolithic category and offers a more precise account of how distinct nudge designs elicit distinct consumer responses.

The framework's treatment of environmental concern as a contextual condition shaping nudge effectiveness reflects an important empirical nuance. Consumers with greater environmental concern are expected to respond more readily and consistently to informational and social nudges (Khalufi, 2025). In contrast, those with lower concern may rely on the lower-effort pathway offered by default nudges. This heterogeneity in consumer responses underscores the importance of personalized or segmented nudge strategies at checkout rather than one-size-fits-all sustainability communications. Green guilt, as a psychological response to sustainability nudges, presents both opportunities and risks for e-commerce platforms. Nielsen et al. (2024) demonstrate that eco-guilt can serve as a motivational state that prompts consumers to align their behavior with their values. However, if guilt-based appeals are perceived as excessive or manipulative, they may generate reactance and increase rather than reduce cart abandonment (Suroto, 2025). This tension points to the importance of calibrated, proportionate sustainability messaging that informs rather than pressures consumers.

The framework also explains why uniform nudging strategies often fail to yield consistent outcomes across diverse consumer populations (Molho et al., 2024). Consumer responses to sustainability interventions at checkout are contingent on environmental concern, cognitive capacity at the time of purchase, price sensitivity, and trust in sustainability claims. E-commerce platforms seeking to deploy green nudges effectively must therefore adopt differentiated designs that account for these contextual sources of variation (Estropia et al., 2025). Transparent and credible sustainability communication is additionally essential to prevent greenwashing perceptions that erode consumer trust. From a broader perspective, the framework contributes to the sustainable consumption and digital commerce literatures by integrating checkout optimization and sustainability intervention within a unified theoretical model. It positions the e-commerce checkout not merely as a commercial transaction endpoint but as a critical behavioral intervention point where the intention–behaviour gap in sustainable consumption can be systematically addressed.

9. IMPLICATIONS

9.1 Theoretical Implications

This study contributes to the theoretical literature on sustainable consumption and digital commerce in several respects. The integrated conceptual framework advances understanding of how green nudges function as differentiated interventions that operate through attitudinal, normative, and cognitive pathways. By situating the checkout stage as a critical decisional moment, the framework extends prior sustainability

intervention research, which has predominantly focused on pre-purchase stages, to the final phase of the online purchase journey.

The integration of Nudge Theory, TPB, and Cognitive Load Theory represents a theoretically coherent synthesis that addresses the limitations of single-theory accounts of sustainable purchasing behavior. In particular, the inclusion of cognitive load as a contextual condition for nudge effectiveness responds to a gap in the existing literature, which has generally treated sustainability messaging as cognitively neutral rather than as a potential contributor to decision fatigue. The framework's conceptual treatment of consumer heterogeneity-through the role of environmental concern-also extends prior work on sustainable consumption by identifying individual-level characteristics that condition the effectiveness of checkout-stage nudges.

9.2 Managerial Implications

The framework provides actionable guidance for e-commerce managers seeking to reduce cart abandonment while promoting sustainable purchasing behavior. As the final stage of the online purchase experience, the checkout interface represents a strategically high-value location for behaviourally informed sustainability interventions. Managers should design sustainability messages that are concise, credible, and sensitive to consumer values, avoiding communications that may be perceived as manipulative or as instances of greenwashing (Khalufi, 2025). Segmenting nudge types by consumer environmental concern levels can improve the precision and efficiency of checkout interventions. Conversion rates and cart abandonment metrics should be systematically monitored to evaluate the effectiveness of interventions. Transparency regarding the environmental basis of sustainability claims is also critical for building consumer trust upon which effective nudge strategies depend.

9.3 Practical Implications

Checkout-stage green nudges represent a low-cost, scalable behavioral intervention that does not require substantial structural changes to existing e-commerce systems. Given that approximately 70% of online carts are abandoned before purchase completion (Udaigiri, 2026), the commercial case for checkout optimization is compelling. Sustainability cues such as eco-labels, carbon footprint disclosures, and social norm messages can be integrated into current checkout workflows with relatively modest technical requirements. A/B testing methodologies allow e-commerce operators to identify iteratively which nudge formats are most effective across specific product categories, consumer segments, and platform contexts, providing an evidence base for continuous improvement of checkout design (Suroto, 2025). These experimental approaches support the development of evidence-based, ethically grounded checkout interventions aligned with both commercial and environmental goals.

9.4 Policy and Social Implications

At a societal level, the study highlights the significant role that e-commerce platforms can play in scaling sustainable consumption. Given the growing share of routine purchases conducted online, digital platform design has meaningful aggregate environmental implications. Embedding green nudges at checkout can contribute to societal transitions towards sustainable consumption in a voluntary, non-coercive, and respectful manner of consumer autonomy (Syahribulan et al., 2025).

For policymakers, the study underscores the need for clear, enforceable guidelines governing sustainability claims in digital retail environments. As environmental messaging proliferates across online platforms, transparent communication standards are necessary to protect consumers from misleading claims and to preserve the credibility of legitimate sustainability interventions (Mannoni, 2025). Policies that support the affordability and accessibility of sustainable product options would also strengthen the conditions under which checkout-stage nudges can be most effective.

10. CONCLUSION

This paper has developed an integrated conceptual framework to advance understanding of how green nudges at the e-commerce checkout stage can simultaneously reduce cart abandonment and promote sustainable purchasing behaviour. Grounded in Nudge Theory, the Theory of Planned Behavior, and Cognitive Load Theory, the framework identifies three categories of green nudge-informational, social, and default-and articulates the psychological processes through which these nudges operate, including perceived consumer effectiveness, green guilt, and consumer satisfaction with sustainable options. Contextual conditions, including environmental concern, time pressure, cognitive load, and the intention–behavior gap, are incorporated to reflect the complex environment in which checkout decisions are made.

Three theoretically grounded hypotheses are proposed to direct future empirical investigation into the relationships between checkout-stage nudge design and consumer purchasing outcomes. The study contributes to the sustainable consumption and digital commerce literatures by positioning the checkout interface as a critical behavioral intervention point at which the intention–behaviour gap in sustainable e-commerce can be systematically narrowed. Future empirical research-employing experimental designs, quantitative survey methodologies, or longitudinal approaches-is needed to test and refine the proposed relationships across diverse e-commerce contexts, product categories, and consumer populations.

11. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The primary limitation of this study is its conceptual orientation: the proposed framework's relationships have not been empirically tested, and its constructs require operationalization before the hypotheses can be formally evaluated. Future research should employ quantitative survey instruments or experimental methodologies to assess the causal relationships between green nudge types, psychological responses, and purchasing outcomes across samples of online shoppers.

Experimental designs manipulating nudge type, message framing, and checkout interface characteristics would be particularly well suited to establishing causal effects and testing the differential effectiveness of informational, social, and default nudges.

Cross-sectional surveys can provide breadth across consumer segments. At the same time, longitudinal designs would enable researchers to assess whether repeated exposure to green nudges produces durable changes in sustainable consumption behavior or whether habituation diminishes effectiveness over time. Comparative research across e-commerce platforms, product categories, and cultural contexts would help identify the boundary conditions of nudge effectiveness. Mixed-methods approaches combining quantitative surveys with qualitative interviews or think-aloud protocols may additionally illuminate consumers' subjective interpretations of sustainability messaging and their sensitivity to perceived manipulation. Such investigations will provide the empirical foundation for designing effective, ethical, and scalable sustainability interventions at the checkout stage.

REFERENCES

1. Alghamdi, O. A., & Agag, G. (2024). Understanding Factors Affecting Consumers' Conscious Green Purchasing Behavior. *Sustainability*, *16*(2), 705. https://doi.org/10.3390/su16020705
2. Ante Mandić, Walia, S., & S. Mostafa Rasoolimanesh. (2023). Gen Z and the flight shame movement: examining the intersection of emotions, biospheric values, and environmental travel behavior in an Eastern society. *Journal of Sustainable Tourism*, *32*(8), 1–23. https://doi.org/10.1080/09669582.2023.2254950
3. Chopra, I. P., Jebarajakirthy, C., Jain, T., & Haroon Iqbal Maseeh. (2024). Electronic shopping cart abandonment: What do we know and where should we be heading? *EM*, *34*(1). https://doi.org/10.1007/s12525-024-00697-0
4. Ganesan, Dr. A., Velanganni, Dr. R., Selvaraj, Dr. V., & Rajapriya, Dr. M. (2025). ANALYZING THE INFLUENCE OF BEHAVIORAL ECONOMICS ON CONSUMER DECISION-MAKING IN SUSTAINABLE PRODUCT MARKETS. *Archives for Technical Sciences*, *33*(2), 976–985. https://doi.org/10.70102/afts.2025.1833.976
5. Goel, P., Patti, S., Garg, A., & Sharma, A. (2024). The unfinished order: examining shopping cart abandonment in food delivery apps. *Journal of Foodservice Business Research*, 1–28. https://doi.org/10.1080/15378020.2024.2443698
6. Granato, G., & Mugge, R. (2025). Leveraging social norms for sustainable behavior. *Proceedings of the 6th Product Lifetimes and the Environment Conference (PLATE2025)*, *6*. https://doi.org/10.54337/plate2025-10293

7. Gruchmann, T., Maugeri, G., & Wagner, R. (2025). Do you feel guilty? A consumer-centric perspective on green nudging in last-mile deliveries. *International Journal of Physical Distribution & Logistics Management*. https://doi.org/10.1108/ijpdlm-07-2024-0286

8. Hwang, S., Lee, J., & Jang, D. (2024). Climate Change Awareness and Pro-Environmental Intentions in Sports Fans: Applying the Extended Theory of Planned Behavior Model for Sustainable Spectating. *Sustainability*, *16*(8), 3246. https://doi.org/10.3390/su16083246

9. Khalufi, A. M. (2025). Digital Nudges and Environmental Concern in Shaping Sustainable Consumer Behavior Aligned with SDGs 12 and 13. *Sustainability*, *17*(24), 11292–11292. https://doi.org/10.3390/su172411292

10. Kim, E. L., Cain, L., & Kim, E. J. (2025). Optimizing food delivery sustainability: the roles of nudging and choice architecture in promoting carbon-free delivery and reusable containers. *International Journal of Contemporary Hospitality Management*. https://doi.org/10.1108/ijchm-08-2024-1260

11. L. Estropia, D. F., C. Remoreras, Ma. C. E., & Campos, K. P. (2025). Green Marketing and Consumer Purchasing Behavior: A Systematic Literature Review through the Lens of Behavioral Economics. *Asian Journal of Economics, Business and Accounting*, *25*(12), 116–129. https://doi.org/10.9734/ajeba/2025/v25i122080

12. Lemken, D., Erhard, A., & Wahnschafft, S. (2024). A choice architect's guide to the (autonomous) galaxy: a systematic scoping review of nudge intrusiveness in food choices. *Humanities and Social Sciences Communications*, *11*(1). https://doi.org/10.1057/s41599-024-03555-8

13. Lohmann, P. M., Gsottbauer, E., van, & Kontoleon, A. (2024). Chilling results: how explicit warm-glow appeals fail to boost pro-environmental behavior. *Behavioral Public Policy*, 1–26. https://doi.org/10.1017/bpp.2024.4

14. Mannoni, E. (2025). "I'm worried, but": Unpacking the gap between environmental concern and pro-environmental behavior. *Swiss Political Science Review*. https://doi.org/10.1111/spsr.12660

15. McCarthy, B. (2024). Moral licensing and habits: Do solar households make negligent choices? *Renewable and Sustainable Energy Reviews*, *191*, 114213. https://doi.org/10.1016/j.rser.2023.114213

16. Mehdi, S. M., Rūtelionė, A., & Bhutto, M. Y. (2024). The Role of Environmental Values, Environmental Self-Identity, and Attitude in Generation Z's Purchase Intentions for Organic Food. *Environmental Research, Engineering and Management*, *80*(2), 75–87. https://doi.org/10.5755/j01.erem.80.2.36649

17. Molho, C., Francesca De Petrillo, G., Z. H., & Slewe, S. (2024). Cross-societal variation in norm enforcement systems. *Philosophical Transactions of the Royal Society B*, *379*(1897). https://doi.org/10.1098/rstb.2023.0034

18. Murooj Mohammad Sattar, Hussein Ajlan Hasan, Salah Hassan Maleh Akla, Mujahed Mutlaq Abdul Rahman, & Jassim Mohamed Brieg. (2025). Behavioral Economics in Promoting Sustainable Consumer Choices. *Environment and Social Psychology*, *10*(11). https://doi.org/10.59429/esp.v10i11.4002

19. Nguyen, K. H., & Tran, M. D. (2025). How Minimalism Drives Green Purchase Intention in Collectivist Cultures. *Sustainability*, *17*(1), 332. https://doi.org/10.3390/su17010332

20. Poch, M., Aldao, C., Godo-Pla, L., Monclús, H., Popartan, L. A., Comas, J., Cermerón-Romero, M., Puig, S., & Molinos-Senante, M. (2023). Increasing resilience through nudges in the urban water cycle: An integrative conceptual framework to support policy decision-making. *Chemosphere*, *317*, 137850. https://doi.org/10.1016/j.chemosphere.2023.137850

21. Ponce de León Solís, V. (2025). Nudging and Inequality: Examining the Heterogeneous Effects of Behavioral Interventions on Low Socio-economic Status Individuals. *Journal of Applied Philosophy*. https://doi.org/10.1111/japp.70015

22. Pristl, A., Kilian, S., & Mann, A. (2020). When does a social norm catch the worm? Disentangling social normative influences on sustainable consumption behavior. *Journal of Consumer Behavior*, *20*(3). https://doi.org/10.1002/cb.1890

23. Rikke Sigmer Nielsen, Gamborg, C., & Thomas Bøker Lund. (2024). Eco-guilt and eco-shame in everyday life: an exploratory study of the experiences, triggers, and reactions. *Frontiers in Sustainability*, *5*. https://doi.org/10.3389/frsus.2024.1357656

24. Sajan, V., & P S, R. (2024). Smart moves: Flipkart's name-personalized nudging techniques to combat cart abandonment. *Journal of Information Technology Teaching Cases*. https://doi.org/10.1177/20438869241301078

25. Šálková, D., Čábelková, I., & Hommerová, D. (2023). Ethical Consumption. What Makes People Buy "Ethical" Products? *Central European Business Review*, *13*(2). https://doi.org/10.18267/j.cebr.346

26. Sasan Esfandiari Bahraseman, Firoozzare, A., Tinoush Jamali Jaghdani, & Arash Dourandish. (2024). Intervention strategies for the safe use of semi-treated wastewater by Iranian farmers: An approach for safe food production in the circular economy. *NJAS Impact in Agricultural and Life Sciences*, *96*(1). https://doi.org/10.1080/27685241.2024.2335376

27. Schleicher, K., & Annette Elisabeth Töller. (2024). Dietary Behavior as a Target of Environmental Policy: Which Policy Instruments Are Adequate to Incentivize Plant-Based Diets? *Sustainability*, *16*(6), 2415–2415. https://doi.org/10.3390/su16062415

28. Solekah, N. A., Handriana, T., & Usman, I. (2024). Understanding Zillennials Consumer Green Behavior of Reducing Plastic Bag Use through the Theory of Planned and Interpersonal Behavior. *Journal of Consumer Sciences*, *9*(2), 206–225. https://doi.org/10.29244/jcs.9.2.206-225

29. Suroto. (2025). Digital Nudging Strategies, Applications, and Ethical Considerations: A Systematic Literature Review. *International Journal of Innovation in Enterprise System*, *9*(1), 61–77. https://doi.org/10.25124/ijies.v9i01.663

30. Syahribulan, E., E., & i Rosmiati. (2025). The Role of Social Media Influencers in Shaping Sustainable Purchasing Behavior: Genuine Consumer Interest or Impulsive Trends? *Journal of Production Operations Management and Economics*, *5*(51), 63–77. https://doi.org/10.55529/jpome.51.63.77

31. Tsz Hin Hui, Itani, N., & O'Connell, J. F. (2024). Examining Air Travellers' Willingness to Pay for Non-voluntary Environment-related Fees: The Case of SAF Surcharge and Carbon Taxes. *Highlights of Sustainability*, *3*(1), 61–75. https://doi.org/10.54175/hsustain3010005

32. Udaigiri, M. N. (2026). Green marketing and consumer behavior: A meta-analysis of sustainability-driven purchase decisions. *Arabian Journal of Business and Management Review (Kuwait Chapter)*, *15*(1), 21–25. https://doi.org/10.65453/ajbmr.v15i1.1404

33. Wang, X., Peng, M., Li, Y., Ren, M., Ma, T., Zhao, W., & Xu, J. (2025). How E-Commerce Product Environmental Information Influences Green Consumption: Intention–Behavior Gap Perspective. *Sustainability*, *17*(6), 2337–2337. https://doi.org/10.3390/su17062337

34. Younusi, A., & Li, L. (2025). The Impact of Filtering Experience on Shopping Cart Abandonment: A Study on the Chain Mediation of Cognition and Affect. *Transactions on Economics, Business and Management Research*, *15*, 176–182. https://doi.org/10.62051/qcghry04