Multicore Int. J. Multidiscip, Vol 2, No 1, May 2026
e-ISSN: 3108-933X

OPEN ACCESS

MIMP
Marasofi International Media and Publishing

The Effect of Personalization Algorithm-Based Dark Patterns on Consumer Decision Distortion: Integration of Business Ethics and Behavioral Economics Perspectives on E-Commerce Platforms

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Abstract— The rapid advancement of artificial intelligence (AI)-driven personalization in e-commerce has introduced algorithm-based dark patterns that subtly manipulate consumer behavior and potentially distort decision-making processes. This study aims to analyze the effect of personalization-based dark patterns on consumer decision distortion by integrating perspectives from behavioral economics and business ethics. A quantitative approach was employed using a scenario-based survey involving 212 active e-commerce users. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine both direct and indirect relationships among variables. The results indicate that personalization-based dark patterns have a positive and significant effect on consumer decision distortion. Additionally, cognitive biases, particularly loss aversion and anchoring effect, significantly mediate this relationship. Loss aversion is found to be the more dominant mediating factor, suggesting that consumers are more influenced by the fear of missing out than by reference-based judgments. These findings confirm that digital consumers are not fully rational, as their decisions are shaped by psychological biases exploited through system design. In conclusion, algorithm-based dark patterns significantly contribute to distorted consumer decisions through both direct influence and cognitive mechanisms. This study recommends the implementation of more transparent and ethical interface designs, as well as stronger regulatory frameworks to limit manipulative practices. The findings provide theoretical implications by integrating technological, behavioral, and ethical perspectives into a unified framework, and practical implications for developers and policymakers in promoting responsible and sustainable digital platforms.

Keywords: *Dark Pattern, Algorithmic Personalization, Behavioral Economics, Consumer Decision Distortion, Business Ethics.*

1. Introduction

The rapid advancement of digital technology has fundamentally transformed the contemporary business ecosystem, particularly within the e-commerce sector, which increasingly relies on artificial intelligence (AI) to enhance user experience through algorithm-based personalization [1], [2]. This capability enables platforms to deliver tailored content, product recommendations, and promotional offers in real time based on individual user preferences. However, alongside these advantages, a critical issue has emerged in the form of dark patterns, defined as interface designs intentionally created to manipulate user behavior toward decisions that primarily benefit the platform [3], [4]. When combined with personalization algorithms, these practices become more sophisticated and potentially exploitative, as they can target users' cognitive vulnerabilities and subtly influence decision-making processes without explicit awareness [5], [6], [7]. Such conditions raise concerns regarding the distortion of consumer decisions,

Received: 30 April 2026, Revised: 04 May 2026 , Accepted: 04 May 2026
https://doi.org/10.64123/mijm.v2.i1.5

which contradicts the rational decision-making assumptions in classical economic theory [8]. Moreover, the limited development of regulatory frameworks, particularly in developing countries, further exacerbates the risk of widespread exploitation in digital environments [9], [10].

More specifically, despite the efficiency offered by AI-driven personalization, significant concerns persist regarding transparency and fairness in consumer decision-making. Many users demonstrate limited awareness of the presence and operational mechanisms of dark patterns, leading to decisions that are not entirely rational [11]. At the same time, existing regulations remain insufficient to address the growing complexity of manipulative digital practices, thereby creating a gap between technological innovation and the ethical principles that should safeguard consumer interests [12], [13]. Consequently, algorithm-based manipulation can occur with minimal oversight, increasing the likelihood of long-term consumer harm through systematic decision distortion [14].

Although prior studies have explored dark patterns in digital interfaces, most have focused on typologies and general behavioral impacts rather than examining the integrated role of personalization algorithms in shaping cognitive processes and decision outcomes [15], [16]. Furthermore, existing research tends to adopt a single-disciplinary perspective, lacking a comprehensive integration between behavioral economics—which explains cognitive biases—and business ethics, which emphasizes moral responsibility in digital practices [17], [18], [19]. This study addresses these gaps by proposing an integrative model that links algorithm-based dark patterns, cognitive bias, and ethical evaluation in explaining consumer decision distortion. Accordingly, the primary objective of this research is to analyze the influence of personalization-based dark patterns on consumer decision distortion and to develop a comprehensive framework that integrates technological, behavioral, and ethical dimensions. The novelty of this study lies in its cross-disciplinary approach and its empirical examination of cognitive bias as a mediating mechanism, offering both theoretical contributions to digital business research and practical implications for designing more transparent, ethical, and sustainable e-commerce platforms.

2. Method

This study adopts a quantitative approach with an explanatory design to examine the causal relationships between personalization-based dark patterns and consumer decision distortion. The approach is selected due to its ability to provide empirical evidence regarding the interaction among variables within the context of digital consumer behavior [20]. Data were collected using a scenario-based survey, in which respondents were exposed to simulated e-commerce interfaces containing elements of algorithm-driven dark patterns. This method enables the capture of cognitive and behavioral responses in a more contextual and realistic setting compared to conventional survey techniques. The research instrument was developed using a five-point Likert scale, ranging from strongly disagree (1) to strongly agree (5), to measure respondents' perceptions of digital manipulation and its influence on decision-making.

The population of this study consists of active e-commerce users who have conducted digital transactions within the past six months. A purposive sampling technique was employed to ensure the relevance of respondents to the research context, with criteria including: having completed at least two e-commerce transactions in the last three months, being at least 17 years of age, and having experience using platforms with personalization features. Based on the requirements of the SEM-PLS approach, which recommends a minimum sample size of 5–10 times the number of indicators, the study targets between 150 and 250 respondents to ensure robustness and reliability of the results.

The research model was developed to represent the causal relationships among variables, where personalization-based dark patterns function as the independent variable, consumer decision distortion as the dependent variable, and cognitive bias as the mediating variable. Conceptually, the model illustrates that the influence of dark patterns occurs both directly and indirectly through psychological mechanisms. As shown in Figure 1, the structural framework captures the complexity of interactions

between technological design, cognitive processes, and consumer behavior in the digital ecosystem.

The independent variable, personalization-based dark patterns, is operationalized through indicators such as scarcity manipulation, forced urgency, and deceptive interface design. The dependent variable, consumer decision distortion, is measured through indicators including impulsive purchasing, post-purchase regret, mismatch between needs and purchases, and perceived loss of control. Meanwhile, the mediating variable, cognitive bias, consists of two dimensions, namely loss aversion and anchoring effect, which represent key psychological mechanisms influencing decision-making.

Data analysis was conducted using Structural Equation Modeling based on Partial Least Squares (SEM-PLS), which is suitable for analyzing complex models with latent variables. The analysis procedure includes evaluation of the measurement model (outer model) through tests of convergent validity (loading factor > 0.70), discriminant validity (HTMT < 0.90), and reliability (Cronbach's Alpha and Composite Reliability > 0.70). Subsequently, the structural model (inner model) is assessed using the coefficient of determination (R^2), predictive relevance (Q^2), and overall model fit. Hypothesis testing is performed by examining path coefficients, t-statistics (>1.96), and p-values (<0.05).

The structural relationships among variables are formulated as follows: $Y=\beta 1X+\beta 2M+\varepsilon$, which represents the influence of personalization-based dark patterns and cognitive bias on consumer decision distortion, and $M=\beta 3X+\varepsilon$, which represents the influence of dark patterns on cognitive bias.

Based on this model, eight hypotheses are proposed to test both direct and indirect effects. The direct effect hypothesis examines the influence of dark patterns on decision distortion. Additional hypotheses evaluate the effects of dark patterns on loss aversion and anchoring effect, as well as the influence of these cognitive biases on decision distortion. Furthermore, mediation hypotheses assess the indirect effects of dark patterns through cognitive bias, while a comparative hypothesis examines whether loss aversion exerts a stronger mediating effect than anchoring effect. Through this comprehensive methodological framework, the study aims to capture the underlying mechanisms of consumer decision distortion in digitally mediated environments.

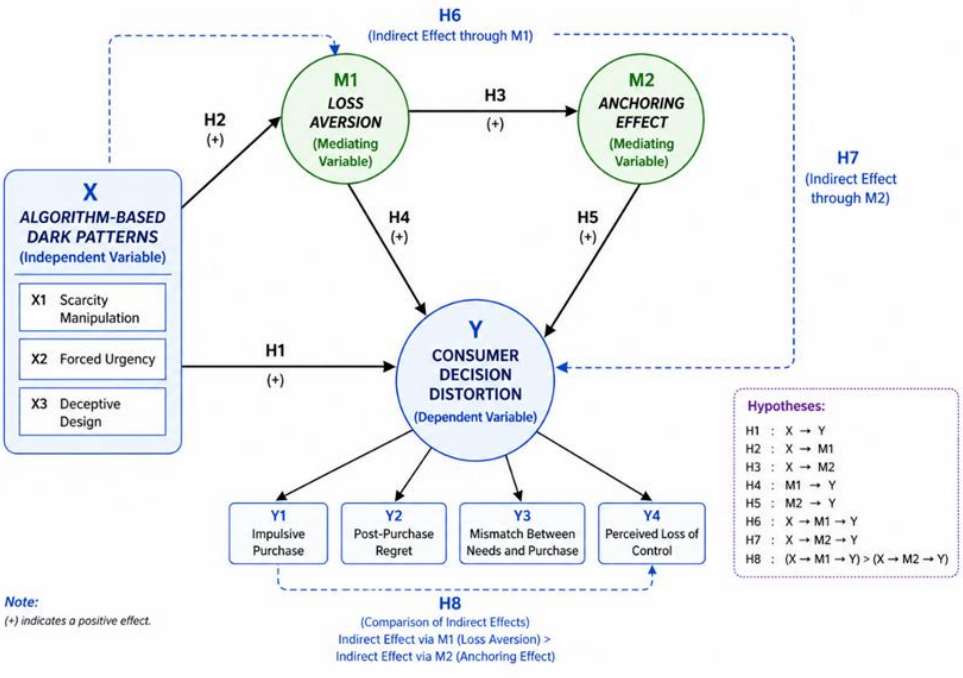

Figure 1. Research Model

3. Results and Discussion

Based on data collected from 212 respondents who met the research criteria, it was found that the majority of participants were active e-commerce users with relatively high transaction intensity. Descriptive statistical analysis indicates that the perception of personalization-based dark patterns falls within the medium to high category, with an average score of 3.72. Meanwhile, the level of consumer decision distortion shows an average value of 3.65, suggesting that decision-making is moderately influenced by non-rational factors. The mediating variables, namely loss aversion and anchoring effect, recorded average values of 3.81 and 3.54, respectively, indicating that cognitive bias plays a substantial role in shaping consumer decisions in digital environments.

The evaluation of the measurement model demonstrates that all indicators meet the criteria for convergent validity, with loading factor values exceeding 0.70. The Average Variance Extracted (AVE) for each construct is above 0.50, confirming that the latent variables adequately explain the variance of their respective indicators. In addition, both Composite Reliability and Cronbach's Alpha values exceed the threshold of 0.70, indicating high reliability of the research instrument. The discriminant validity assessment using the HTMT approach also shows values below 0.90, confirming that each construct is empirically distinct.

Further analysis of the structural model reveals that the coefficient of determination (R^2) for consumer decision distortion is 0.68, indicating that 68% of the variance in decision distortion can be explained by personalization-based dark patterns and cognitive bias. The predictive relevance value (Q^2) of 0.42 suggests that the model has good predictive capability. Hypothesis testing results indicate that personalization-based dark patterns have a positive and significant effect on consumer decision distortion, with a path coefficient of 0.41 and a t-statistic of 6.27. Moreover, dark patterns significantly influence loss aversion ($\beta = 0.53$; $t = 8.14$) and anchoring effect ($\beta = 0.47$; $t = 7.02$). Both mediating variables are also found to significantly affect decision distortion, with coefficients of 0.36 ($t = 5.89$) for loss aversion and 0.29 ($t = 4.76$) for anchoring effect. Mediation analysis further indicates that loss aversion exerts a stronger indirect effect (0.19) compared to anchoring effect (0.14), thereby confirming that all proposed hypotheses (H1–H8) are empirically supported.

These findings demonstrate that personalization-based dark patterns play a significant role in shaping consumer decision distortion, both directly and indirectly through cognitive bias mechanisms. This supports the perspective of behavioral economics, which posits that individuals do not always act rationally but are influenced by heuristics and biases that can be strategically exploited by digital systems. Practices such as scarcity manipulation and forced urgency are shown to trigger loss aversion, where consumers are more driven by the fear of missing out than by objective evaluation of benefits. In addition, the anchoring effect highlights how initial information presented by digital platforms, such as discounted prices or personalized recommendations, serves as a reference point that unconsciously shapes consumer value perception.

From a business ethics perspective, these results reveal a fundamental tension between profit optimization and consumer protection in digital platforms. The integration of dark patterns with AI-driven personalization has the potential to undermine principles of transparency and fairness, as it leverages users' cognitive limitations without sufficient disclosure. Compared to prior studies, this research offers a more comprehensive contribution by integrating technological, psychological, and ethical dimensions into a unified analytical framework. It goes beyond descriptive analyses of dark patterns by empirically demonstrating the internal mechanisms through which digital manipulation translates into decision distortion via cognitive bias.

Theoretically, this study reinforces the understanding that technological systems are not neutral, but actively shape consumer behavior through embedded psychological mechanisms. The integration of

behavioral economics and business ethics provides a more holistic framework for analyzing decision-making in digital contexts. Practically, the findings highlight the need for digital platform developers to prioritize transparency and ethical considerations in user interface design, rather than focusing solely on conversion performance. Furthermore, the results provide a basis for policymakers to develop more adaptive and comprehensive regulations addressing manipulative digital practices. Ultimately, this study contributes to promoting a more transparent, fair, and sustainable digital business ecosystem.

4. Conclusion

This study demonstrates that personalization-based dark patterns have a significant influence on consumer decision distortion in the context of e-commerce, both directly and indirectly through cognitive bias mechanisms. The findings confirm that consumer decision-making in digital environments is not entirely rational, but is shaped by system designs that strategically exploit users' psychological tendencies. Among the mediating variables, loss aversion is identified as the more dominant mechanism compared to the anchoring effect, indicating that the fear of missing out plays a critical role in driving distorted decisions.

The research objective of analyzing the effect of algorithm-based dark patterns and developing an integrative model has been successfully achieved. The proposed model effectively explains the interaction between digital manipulation, cognitive bias, and ethical considerations within a unified framework. This contributes to expanding the theoretical discourse in digital business and management, particularly by integrating perspectives from behavioral economics and business ethics to better understand consumer behavior in technologically mediated environments.

From a practical standpoint, the study underscores the importance of incorporating ethical principles into the design of digital platforms. Developers are encouraged to adopt more transparent and user-oriented interface designs to minimize manipulative practices. In addition, the findings highlight the need for stronger regulatory frameworks that can keep pace with the rapid development of AI-based technologies and ensure adequate consumer protection.

For future research, it is recommended to extend the model by incorporating moderating variables such as digital literacy, consumer trust, or cultural factors, as well as applying the framework across different digital sectors. Such efforts are expected to provide a more comprehensive understanding of consumer decision dynamics and contribute to the development of a more ethical and sustainable digital economy.

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