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AI-Powered Online Shopping: The Effects of Digital Multisensory Cues and Perceived Quality on Sustainable Consumption Intention

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Abstract

Artificial intelligence (AI)-powered online shopping is profoundly reshaping the way in which consumers engage with sustainable clothing. However, the relationships between digital multisensory cues and perceived quality with sustainable consumption intention still need to be explored. Based on the Stimulus–Organism–Response (S-O-R) framework, the present study explores the relationships of digital multisensory cues and perceived quality with consumers' flow experience, pleasure, and responses (e.g., engagement, loyalty, and sustainable consumption intention) in the context of AI-powered online shopping using a cross-sectional, scenario-based, assisted recall survey. A total of 571 valid responses were retained for analysis. Partial least squares structural equation modelling (PLS-SEM) was adopted for data analysis. The findings indicate that digital multisensory cues showed a positive relationship with pleasure, whereas perceived quality was positively associated with both flow experience and pleasure. Flow experience was positively linked to pleasure, which was further associated with engagement and sustainable consumption intention. Statistically significant indirect effects on sustainable consumption intention through pleasure were observed for flow experience, digital multisensory cues, and perceived quality. The results of this study offer practical implications for retailers seeking to design emotionally engaging AI-powered shopping experiences that may support sustainable consumption intention.

Keywords: digital multisensory cues; perceived quality; sustainable consumption intention; pleasure; artificial intelligence; PLS-SEM

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1. Introduction

Consumers can typically examine the products that they are interested in brick-and-mortar (B&M) retailing, while such multisensory engagement is more limited when shopping online (e.g., for sustainable clothing). On Taobao, for instance, artificial intelligence (AI)-empowered virtual try-on tools enable consumers to visualise the fit of a sustainable garment in real time [1]. Meanwhile, AI-powered online shopping has emerged as a prominent setting in which sensory, emotional, and behavioural responses interact to affect consumers' sustainable consumption intention [2,3]. Sustainable fashion consumption is currently regarded as an important approach to environmental protection. However, some consumers tend to buy unsustainable and fashionable clothing rather than choose

eco-friendly product offerings [4]. This discrepancy between awareness and behaviour is mainly caused by the lack of sufficient information and/or interaction when consumers assess sustainable products (e.g., concerning the felt texture) when shopping online [5]. Online shopping platforms (e.g., Taobao, Tmall) are widely used by consumers to purchase fashion products and provide AI-powered tools in the context of online retailing. Nevertheless, consumers' intention to buy sustainable products may depend largely on their digital shopping experience and perceived service quality [6].

Digital multisensory cues can simulate the tactile and visual dimensions of physical retail, thus reducing the sensory uncertainty that may lead to consumers' hesitation [7,8]. Researchers argue that digital multisensory cues influence shopping pleasure in the context of online retail [9]. On social media platforms (e.g., Douyin), visual displays and responsive sound can be adjusted automatically when individuals browse content to create an immersive multisensory experience. Previous studies have shown that sensory and AI-enabled features can enhance online shopping experiences. However, less is known about how these cues operate in the context of online sustainable clothing shopping, where consumers must evaluate both experiential product attributes and sustainability-related information.

Furthermore, perceived quality, including perceptions of product quality and the responsiveness of AI-powered customer service, can help to reduce consumers' uncertainty and increase the perceived credibility of sustainable clothing in the context of online retailing [10,11]. Perceived quality exerts a significant impact on consumers' emotions and flow experience while shopping online [12]. However, how digital multisensory cues and perceived quality are related to consumer responses in the context of online shopping for sustainable clothing still needs further exploration [13,14]. Prior research suggests that emotional responses mediate the relationship between consumer perceptions and behavioural intentions, and that AI-powered online shopping services can evoke flow experiences in online fashion shopping [15]. What remains insufficiently well understood, however, is how these perceptual and experiential factors are linked to sustainable consumption intention through a connected affective and relational pathway.

The purpose of the present study is therefore to explore the relationships of digital multisensory cues and perceived quality with consumers' flow experience and pleasure, as well as the relationships among flow experience, pleasure, engagement, loyalty, and sustainable consumption intention in the context of AI-powered sustainable clothing shopping. This study integrates the Stimulus–Organism–Response (S-O-R) framework to examine how digital multisensory cues and perceived quality are linked to consumers' internal experiential and affective states and subsequent responses, including sustainable consumption intention. Specifically, the proposed model links stimulus-related factors, namely digital multisensory cues and perceived quality, with sustainable consumption intention through flow experience, pleasure, engagement, and loyalty. The research questions are presented as follows: (1) How are digital multisensory cues and perceived quality related to flow experience and pleasure in AI-powered online shopping for sustainable clothing? (2) How are flow experience and pleasure related to engagement and sustainable consumption intention, and how is flow experience related to pleasure? (3) How is engagement related to loyalty, and how is loyalty related to sustainable consumption intention?

This study extends the application of the S-O-R framework to AI-powered shopping, online sensory marketing, and sustainable consumption. Rather than examining isolated path relationships, this study examines how sensory and quality-related factors are linked to sustainable consumption intention through experiential, affective, and relational processes in AI-powered online shopping.

This paper is structured as follows: The subsequent section reviews the literature and develops the research hypotheses. Next, the methodology and data analyses are presented, followed by the discussion and theoretical and practical implications. Finally, the limitations and future research directions are presented.

2. Theoretical Background and Hypotheses Development

2.1. Stimulus–Organism–Response (S-O-R)

The S-O-R framework, originally proposed by Mehrabian and Russell (1974) [16], posits that external environmental cues trigger individuals' internal psychological states, which subsequently shape behavioural outcomes. The stimulus refers to external environmental cues to which consumers respond [16]. The organism comprises the internal cognitive and affective states that mediate the relationship between environmental stimuli and behavioural outcomes [17]. The response denotes the outcome of internal processing [18].

The S-O-R framework has been adopted in online retail research to examine the relationships among environmental stimuli, consumers' internal states, and responses in online shopping environments [19–23]. Digital multisensory cues have been examined as environmental stimuli in online shopping contexts [13]. In the present model, perceived quality is treated as a stimulus insofar as it reflects consumers' perceptions of quality-related cues presented in the AI-powered shopping environment and is theoretically situated prior to their internal affective responses [24,25]. Pleasure represents an organism-level affective state that captures consumers' positive emotional responses to the shopping experience [16,26]. In the proposed model, pleasure is positioned between consumers' perceptions and experiences of the shopping environment and their engagement and sustainable consumption intention. Engagement, loyalty, and sustainable consumption intention are conceptualized as response constructs in the present model.

2.2. Sustainable Consumption Intention, Loyalty and Engagement

2.2.1. Sustainable Consumption Intention

Sustainable consumption intention is defined as consumers' psychological tendency to prioritise environmental and social factors in their purchasing decisions, favouring products that are resource-efficient and ecologically responsible [27]. Ngo et al. (2024) [28] identified that in the context of sustainable fashion shopping, consumers' environmental responsibility and preference for eco-friendly products impacts their purchase intention. As posited by Sharma and Paço [29], the intention to consume sustainably in the context of AI-powered online shopping is shaped by consumers' affective responses while shopping.

2.2.2. Loyalty

Customer loyalty is defined as a deeply held commitment to repeatedly choosing a preferred product or service in the future [30]. When shopping online, loyalty influences consumers' behavioural intentions toward sustainable clothing [31]. Consumers who are loyal to sustainable fashion brands are more likely to intend to purchase sustainable clothing. They intend to devote time and financial resources to sustainable clothing platforms, and to recommend sustainable clothing to others [32]. In AI-powered online shopping environments, intelligent recommendation systems recommend sustainable clothing and related products to attract consumers' attention [33]. Loyalty can help to strengthen the intention to consume sustainably [34]. In particular, loyal consumers are more likely to maintain consistent purchasing preferences rather than switch to alternative products or platforms. In the context of sustainable clothing, such consistency in preference may be related

to a greater propensity to continue choosing sustainable products in future purchases and stronger sustainable consumption intention. Thus, the following hypothesis is proposed:

H1. *Loyalty is positively associated with sustainable consumption intention.*

2.2.3. Engagement

Engagement is defined as the degree of positive, brand-related cognitive, emotional and behavioural activity when consumers interact with sustainable clothing platforms [35]. In the context of AI-powered online shopping, intelligent features (e.g., personalised recommendations, interactive product displays) can encourage consumers to engage more actively with the platform [22]. AI-powered interactions can help to deepen consumers' engagement with sustainable clothing while shopping, which may encourage them to explore sustainability-related information [36]. Specifically, consumers who are engaged with sustainable clothing are more likely to have greater loyalty, which may be reflected in stronger repurchase and recommendation intentions [37]. Greater engagement may correspond to stronger consumers' preference for sustainable clothing platforms and their willingness to maintain this relationship, both of which are consistent with greater loyalty. Engagement may also be linked to sustainable consumption intention through loyalty. Thus, hypotheses are presented as follows:

H2a. *Engagement is positively associated with loyalty.*

H2b. *Engagement has a positive indirect association with sustainable consumption intention through loyalty.*

2.3. Pleasure

Pleasure is defined as a positive affective response to a shopping experience, commonly reflected in feelings of excitement, happiness, and contentment [38,39]. Enjoyment can arise from AI-powered shopping interactions that draw consumers' attention towards sustainable clothing and increase their engagement [40]. Furthermore, researchers have demonstrated that consumers' emotions significantly affect their decision-making when purchasing sustainable clothing [41]. Pleasure has been identified as an emotional antecedent of sustainable consumption intention [42]. Positive emotions experienced during consumption can strengthen consumers' motivation to engage in environmentally responsible behaviour [43]. Pleasurable experiences in AI-powered online shopping environments may support consumers' continued involvement with the platform [40]. Consumers who associate sustainable clothing with positive shopping experiences are therefore more likely to purchase such products [44]. When consumers experience pleasure during AI-powered shopping, they may be more willing to remain involved in the shopping process, which may be reflected in sustained engagement. Pleasure may also be positively related to the intention to consume sustainably, as positive experiences associated with sustainable clothing may correspond to greater willingness to choose such products in future purchases. Thus, hypotheses are presented as follows:

H3. *Pleasure is positively associated with engagement.*

H4. *Pleasure is positively associated with sustainable consumption intention.*

2.4. Flow Experience and Perceived Quality

2.4.1. Flow Experience

Flow theory conceptualises flow as an experiential state characterised by deep absorption, an altered perception of time, and intrinsic enjoyment during an activity [45]. In the context of AI-powered online shopping, flow experience is characterised by a sense that time passes quickly, deep absorption in the shopping process, and curiosity about sustainable clothing [19]. When consumers experience flow while navigating AI-powered sustainable clothing stores, their absorption in the shopping process may be associated with greater pleasure [15]. Studies in technology-enabled shopping contexts have identified a positive relationship between flow experience and consumer engagement [20]. Similarly, flow experience has been positively associated with purchase and continuance intentions in online shopping contexts [46]. For instance, Kumar and Yadav reported a positive association between pleasure and consumers' sustainable consumption intention [45]. Because flow experience involves deep absorption and curiosity during shopping, it may naturally evoke positive affective responses such as excitement, happiness, and contentment. Pleasure may therefore provide an indirect pathway linking flow experience to sustainable consumption intention. Thus, the following hypotheses are presented:

H5a. *Flow experience is positively associated with pleasure.*

H5b. *Flow experience is positively associated with engagement.*

H5c. *Flow experience is positively associated with sustainable consumption intention.*

H5d. *Flow experience has a positive indirect association with sustainable consumption intention through pleasure.*

2.4.2. Perceived Quality

Perceived quality is defined as consumers' evaluation of product and service quality, including the usefulness of product information, the responsiveness of customer service, product performance, and overall product quality [47]. In the context of online shopping, perceived quality is associated with product descriptions and presentation, responsiveness to consumers' requests, and online service quality [48]. Moreover, the usefulness of product information can be associated with consumers' behavioural intentions when shopping online [49]. In addition, Meng et al. (2021) suggested that a shopping experience perceived to be of high quality is associated with positive emotional responses, such as excitement, happiness, and contentment [12]. In the context of sustainable clothing, confidence in product quality can help to strengthen consumers' positive emotional responses [50]. Pleasure arising from perceived quality in online shopping contributes to sustainable consumption intentions [51]. Furthermore, the provision of AI-powered intelligent service and clear product information can increase the perceived quality of the shopping experience among consumers [19]. Favourable quality evaluations may be accompanied by greater consumers' absorption and curiosity during shopping, thereby corresponding to a stronger flow experience. They may also coincide with more positive emotional responses and greater pleasure. Pleasure may therefore provide an affective pathway through which perceived quality is associated with sustainable consumption intention. Thus, hypotheses are presented as follows:

H6a–b. *Perceived quality is positively associated with flow experience (H6a) and pleasure (H6b).*

H6c. *Perceived quality has a positive indirect association with sustainable consumption intention through pleasure.*

2.5. Digital Multisensory Cues

Digital multisensory cues are defined as well-designed elements in online shopping environments that enrich individuals' experiences by stimulating multiple sensory channels [23]. Multisensory cues are delivered through AI-powered technologies that enable virtual try-on features, adaptive visual displays, and responsive soundscapes [15]. Rahman et al. (2023) highlighted the important role of digital multisensory cues in shaping consumer responses in AI-powered online shopping [13]. Multisensory digital shopping environments may also facilitate consumers' flow experience by providing more immersive and interactive shopping experiences [52]. Digital multisensory cues may help to reinforce perceptions of product authenticity and attractiveness, thereby being associated with greater shopping pleasure [8]. Pleasure arising from AI-powered multisensory stimulation has been associated with consumers' intention to consume sustainably [53]. The combined use of visual design, background music, simulated touch, and virtual try-on may evoke feelings of excitement, happiness, and contentment. Pleasure may therefore provide an indirect pathway linking digital multisensory cues to sustainable consumption intention. Thus, the following hypotheses are presented:

H7a–b. *Digital multisensory cues are positively associated with flow experience (H7a) and pleasure (H7b).*

H7c. *Digital multisensory cues have a positive indirect association with sustainable consumption intention through pleasure.*

Based on the above literature, the proposed conceptual framework is presented to investigate the factors related to consumers' sustainable consumption intention in the context of AI-powered online shopping (see Figure 1). This study explores the relationships of digital multisensory cues with flow experience and pleasure, and of perceived quality with flow experience and pleasure. Furthermore, the framework examines the proposed links among flow experience, pleasure, engagement, loyalty, and sustainable consumption intention in AI-powered online shopping.

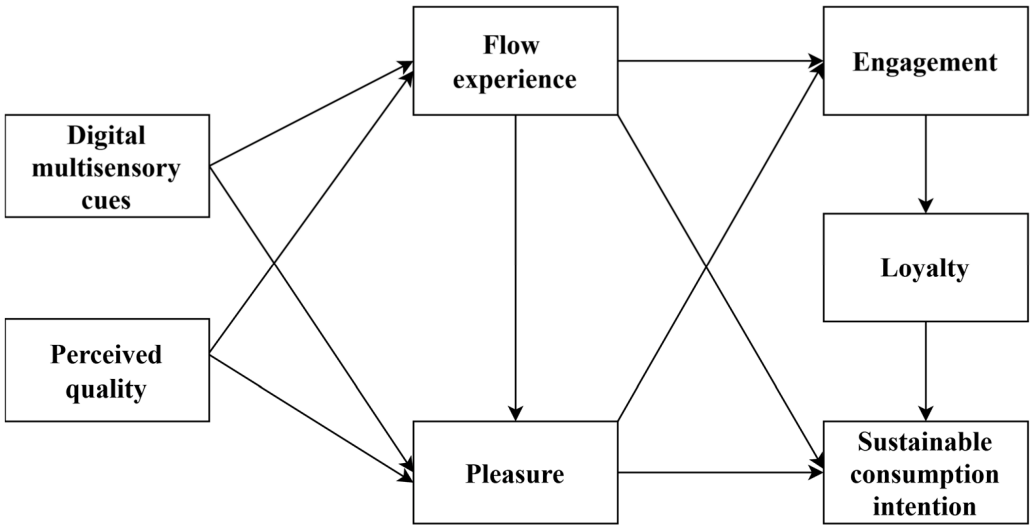


Figure 1. Research model for sustainable consumption intention.

3. Methodology

3.1. Data Collection

The participants were recruited via Wenjuanxing (https://www.sojump.com), email, WeChat, and a university bulletin board. Participants with prior experience using AI-powered online shopping services and an interest in sustainable consumption were invited to complete the questionnaire. Participants without prior experience with AI-powered online shopping were directed to the end of the questionnaire. Responses completed in less than four minutes were considered invalid. The study was approved by the university ethics committee (ethics approval number: EST2025034). The study was conducted in accordance with the principles of the Declaration of Helsinki.

The questionnaire consisted of six sections. First, the purpose of the study was explained to the participants. Second, participants were asked whether they had previously used AI-powered online shopping services. Those who answered "No" were directed to the end of the questionnaire. Third, participants viewed descriptions and images of AI-powered shopping scenarios (e.g., AI-powered virtual try-on, AI-powered sustainable clothing recommendations, and AI customer-service chatbots) and were asked to recall relevant prior experiences. The first three sections are shown in Appendix B. Fourth, participants completed the construct measures. Fifth, demographic information was collected. Finally, participants who completed the questionnaire were eligible to enter a lucky draw offering small incentives (e.g., WeChat red packets or daily-use items) offered as incentives. A total of 617 responses were initially collected. Of these, 40 were excluded because the respondents did not meet the age criterion, and 6 were excluded because they completed the questionnaire in less than four minutes. This resulted in a final sample of 571 valid responses. Of the respondents, 52.2% were female (n = 298) and 47.8% were male (n = 273). The demographic characteristics of the respondents are shown in Table 1.

Table 1. Demographic characteristics of the respondents.

Variable	Characteristics	Frequency	Percentage
Gender	Female	298	52.2
	Male	273	47.8
Age (Years)	18–23	205	35.9
	24–29	145	25.4
	30–35	111	19.4
	36–41	57	10.0
	Above 41	53	9.3
Education	High school and below	110	19.3
	Associate's degree	198	34.7
	Bachelor's degree	212	37.1
	Master's and PhD degree	51	8.9
Occupation	Government-sponsored institution	97	17.0
	Private sector	244	42.7
	State-owned sector	61	10.7
	Self-employed sector	73	12.8
	Freelancer	50	8.8
	Student	39	6.8
	Others	7	1.2

Table 1. *Cont.*

Variable	Characteristics	Frequency	Percentage
Monthly spend on clothing (Chinese yuan)	<1000	120	21.0
	1000–1999	106	18.6
	2000–2999	144	25.2
	3000–3999	103	18.0
	4000–4999	81	14.2
	>5000	17	3.0

3.2. Measurement of Constructs and Procedure

The questionnaire comprised seven constructs measured using 26 items. All measurement items were adopted or adapted from established scales in prior research to support content validity. All items were rated on a five-point Likert scale, ranging from "1 = strongly disagree" to "5 = strongly agree." Four items concerning digital multisensory cues were revised from Ivanov et al. (2022) [54], Li et al. (2022) [9], Li et al. (2022) [55] and Zha et al. (2022) [56]. Four items related to perceived quality were adapted from Baghirov and Zhang (2024) [10], Han et al. (2024) [8], Kim and Park (2013) [57] and San-Martín et al. (2017) [58]. Four items concerning flow experience were revised from Hsu et al. (2011) [46] and Lin and Huang (2024) [20]. Three items pertaining to the concept of pleasure were adapted from Li et al. (2020) [39] and Koo and Lee (2011) [38].

Four items concerning engagement were adopted from Hollebeek et al. (2014) [35] and Lin and Huang (2024) [20]. A total of three items measuring loyalty were revised from the study by Jung et al. (2020) [32]. Finally, four items concerning sustainable consumption intention were adapted from Minh and Quynh (2024) [59] and Paul et al. (2016) [27]. Demographic information was collected after the construct measures.

Prior to data collection, the original English questionnaire was translated into Mandarin Chinese by a professional translator. The Mandarin Chinese version was subsequently back-translated into English by an independent bilingual translator who was a native English speaker and did not have access to the original English questionnaire. The original and back-translated English versions were then compared by the research team, and any discrepancies were discussed and resolved by consensus to ensure semantic equivalence. Two experts in fashion marketing then reviewed and refined the Mandarin Chinese questionnaire for clarity, content relevance, and contextual appropriateness (no AI technology support). Finally, the questionnaire was pretested with five individuals who had experience with AI-powered online shopping to identify unclear or ambiguous wording and assess the comprehensibility of the questionnaire items.

3.3. Data Analysis

The valid responses were analysed using SmartPLS 4. First, internal consistency reliability was assessed using Cronbach's alpha and composite reliability (CR), with values above 0.70 indicating adequate internal consistency [60,61]. Convergent validity was assessed using outer loadings and average variance extracted (AVE), with outer loadings above 0.70 and AVE values above 0.50 considered acceptable [62,63].

Second, discriminant validity was assessed using the Fornell–Larcker criterion [63] and the heterotrait–monotrait ratio of correlations (HTMT), with HTMT values below the conservative threshold of 0.85 considered indicative of adequate discriminant validity [64]. Third, collinearity was assessed using VIF values (<5), and the structural model was evaluated using the estimated path coefficients. The explanatory power of the model was assessed using the coefficient of determination (R^2) and adjusted R^2 [60,65]. The f^2 values were also examined to assess the magnitude of each predictor's contribution to the R^2 of the

corresponding endogenous construct [60,66]. Fourth, the standardized root mean square residual (SRMR) and normed fit index (NFI) were reported as supplementary model-fit diagnostics [66].

The model's out-of-sample predictive performance was further assessed using the PLSpredict procedure with 10-fold cross-validation and 10 repetitions. Predictive relevance was evaluated using $Q^2_{predict}$ values, and the root mean square error (RMSE) values from PLS-SEM were compared with those from the linear model (LM) benchmark [66].

Finally, the statistical significance of the structural relationships was assessed using bootstrapping with 5000 resamples [67]. Bootstrap confidence intervals were also used to assess the statistical significance of the hypothesised indirect effects, with intervals excluding zero indicating statistical significance [68].

4. Results

4.1. Reliability and Validity

The outer loading of all items exceeded the recommended threshold of 0.70, providing support for indicator reliability [60,62]. Cronbach's alpha and composite reliability (CR) values were above 0.70, indicating satisfactory internal consistency reliability [61]. Convergent validity was also supported, as the average variance extracted (AVE) for each construct was greater than 0.50 [63]. The reliability and validity results for the constructs and their respective items are presented in Table 2. VIF values ranged from 1.461 to 2.025, remaining within the recommended threshold and indicating no critical collinearity concerns [67].

Table 2. Analysis of the measurement model.

Variable	Items	Outer Loading	VIF	Cronbach's Alpha	CR	AVE
Digital multisensory cues	DMC1	0.840	2.006	0.848	0.897	0.686
	DMC2	0.814	1.823			
	DMC3	0.836	1.902			
	DMC4	0.824	1.884			
Flow experience	FE1	0.813	1.747	0.833	0.889	0.667
	FE2	0.812	1.781			
	FE3	0.811	1.763			
	FE4	0.829	1.849			
Engagement	GG1	0.812	1.767	0.828	0.886	0.659
	GG2	0.785	1.679			
	GG3	0.835	1.826			
	GG4	0.815	1.748			
Loyalty	LY1	0.862	1.806	0.810	0.888	0.725
	LY2	0.839	1.720			
	LY3	0.853	1.789			
Pleasure	PL1	0.883	2.025	0.826	0.896	0.742
	PL2	0.861	1.883			
	PL3	0.839	1.764			
Perceived quality	PQ1	0.828	1.921	0.852	0.900	0.692
	PQ2	0.834	1.941			
	PQ3	0.845	1.958			
	PQ4	0.820	1.885			

Table 2. *Cont.*

Variable	Items	Outer Loading	VIF	Cronbach's Alpha	CR	AVE
Sustainable consumption intention	SCI1	0.810	1.737	0.811	0.876	0.638
	SCI2	0.751	1.461			
	SCI3	0.805	1.679			
	SCI4	0.828	1.884			

Notes: DMC = Digital multisensory cues; PQ = Perceived quality; FE = Flow experience; PL = Pleasure; GG = Engagement; LY = Loyalty; SCI = Sustainable consumption intention.

Discriminant validity was assessed using both the Fornell–Larcker criterion and the heterotrait–monotrait ratio (HTMT). All HTMT values were below the conservative threshold of 0.85 [64] (see Table 3). The square roots of the AVE values for all constructs exceeded their corresponding inter-construct correlations, satisfying the Fornell–Larcker criterion [63] (see Table 4). Together, these results support adequate discriminant validity.

Table 3. Heterotrait–monotrait ratio (HTMT).

	DMC	FE	GG	LY	PL	PQ	SCI
DMC							
FE	0.705						
GG	0.529	0.597					
LY	0.505	0.628	0.652				
PL	0.637	0.753	0.556	0.546			
PQ	0.658	0.758	0.517	0.563	0.707		
SCI	0.602	0.651	0.621	0.598	0.574	0.604	

Notes: DMC = Digital multisensory cues; PQ = Perceived quality; FE = Flow experience; PL = Pleasure; GG = Engagement; LY = Loyalty; SCI = Sustainable consumption intention.

Table 4. Fornell–Larcker criterion.

	DMC	FE	GG	LY	PL	PQ	SCI
DMC	0.828						
FE	0.593	0.816					
GG	0.445	0.498	0.812				
LY	0.418	0.516	0.536	0.851			
PL	0.534	0.625	0.465	0.446	0.861		
PQ	0.560	0.640	0.436	0.468	0.595	0.832	
SCI	0.499	0.535	0.510	0.485	0.470	0.501	0.799

Notes: DMC = Digital multisensory cues; PQ = Perceived quality; FE = Flow experience; PL = Pleasure; GG = Engagement; LY = Loyalty; SCI = Sustainable consumption intention.

4.2. Structural Model

The explanatory power of the PLS path model was assessed using the coefficient of determination (R^2), which indicates the proportion of variance accounted for in each endogenous construct [65]. As shown in Table 5, the R^2 values were 0.490 for flow experience, 0.287 for engagement, 0.287 for loyalty, 0.473 for pleasure, and 0.363 for sustainable consumption intention. The $Q^2_{predict}$ values for all endogenous constructs were above zero, indicating predictive relevance [66] (see Table 5). Supplementary model-fit diagnostics are reported in Table 6. The estimated-model SRMR was 0.088, and the NFI was 0.854, warranting a cautious interpretation of overall model fit [66]. Additionally, f^2 values were examined to assess the relative contribution of each predictor to the R^2 of the corresponding endogenous construct [69].

Table 5. Model explanatory power and predictive relevance.

	R^2	R^2 Adjusted	Q^2 Predict
FE	0.490	0.488	0.483
GG	0.287	0.284	0.234
LY	0.287	0.286	0.168
PL	0.473	0.471	0.406
SCI	0.363	0.359	0.279

Notes: FE = Flow experience; GG = Engagement; LY = Loyalty; PL = Pleasure; SCI = Sustainable consumption intention.

Table 6. Model-fit diagnostics.

	Saturated Model	Estimated Model
SRMR	0.044	0.088
d_ULS	0.676	2.743
d_G	0.297	0.340
Chi-Square	1004.847	1095.789
NFI	0.866	0.854

Finally, the model's out-of-sample predictive performance was assessed using the PLSpredict procedure with 10-fold cross-validation and 10 repetitions [66]. At the indicator level, all $Q^2_{predict}$ values for SCI1–SCI4 were above zero. The PLS-SEM RMSE was marginally lower than the corresponding linear model (LM) value for SCI1 but slightly higher than the LM values for SCI2–SCI4 (see Table 7). Accordingly, the positive $Q^2_{predict}$ values indicated predictive relevance, whereas the comparison with the LM benchmark suggested limited out-of-sample predictive performance.

Table 7. PLS predictive performance.

	Q^2 Predict	PLS-SEM_RMSE	LM_RMSE
SCI1	0.175	1.051	1.052
SCI2	0.177	1.050	1.034
SCI3	0.185	1.094	1.086
SCI4	0.173	1.104	1.098

Notes: SCI = Sustainable consumption intention.

4.3. Direct Relationships

Digital multisensory cues were positively associated with flow experience (β = 0.343, $p < 0.001$) and pleasure (β = 0.175, $p = 0.001$), supporting H7a and H7b, respectively. Pleasure showed positive associations with engagement (β = 0.251, $p < 0.001$) and sustainable consumption intention (β = 0.171, $p = 0.001$), supporting H3 and H4, respectively. Perceived quality was positively associated with both flow experience (β = 0.448, $p < 0.001$) and pleasure (β = 0.276, $p < 0.001$). These results support H6a and H6b. Flow experience was positively associated with pleasure (β = 0.345, $p < 0.001$), engagement (β = 0.341, $p < 0.001$), and sustainable consumption intention (β = 0.296, $p < 0.001$), supporting H5a, H5b, and H5c. Engagement was positively associated with loyalty (β = 0.536, $p < 0.001$), supporting H2a, while loyalty was positively associated with sustainable consumption intention (β = 0.256, $p < 0.001$), supporting H1.

The structural model results are presented in Table 8.

Table 8. Hypotheses results.

	β	Standard Deviation (STDEV)	T-Value (|O/STDEV|)	*p*-Value	f^2	95% Confidence		Path Coefficients
						2.50%	97.5%	
DMC → FE	0.343	0.042	8.257	<0.001	0.158	0.261	0.422	Supported (H7a)
DMC → PL	0.175	0.052	3.389	0.001	0.034	0.076	0.279	Supported (H7b)
FE → GG	0.341	0.051	6.674	<0.001	0.099	0.241	0.439	Supported (H5b)
FE → PL	0.345	0.058	5.969	<0.001	0.115	0.227	0.457	Supported (H5a)
FE → SCI	0.296	0.055	5.384	<0.001	0.074	0.188	0.404	Supported (H5c)
GG → LY	0.536	0.033	16.326	<0.001	0.403	0.469	0.598	Supported (H2a)
LY → SCI	0.256	0.048	5.367	<0.001	0.073	0.162	0.351	Supported (H1)
PL → GG	0.251	0.054	4.691	<0.001	0.054	0.148	0.355	Supported (H3)
PL → SCI	0.171	0.051	3.377	0.001	0.027	0.075	0.273	Supported (H4)
PQ → FE	0.448	0.043	10.455	<0.001	0.269	0.364	0.530	Supported (H6a)
PQ → PL	0.276	0.052	5.285	<0.001	0.078	0.171	0.374	Supported (H6b)

Notes: DMC = Digital multisensory cues; PQ = Perceived quality; FE = Flow experience; PL = Pleasure; GG = Engagement; LY = Loyalty; SCI = Sustainable consumption intention.

4.4. Indirect Relationships

The hypothesised indirect relationships were assessed using bootstrapping with 5000 resamples and 95% confidence intervals. The indirect association of digital multisensory cues with sustainable consumption intention through pleasure was positive and statistically significant (β = 0.030, p = 0.023, CI = [0.009, 0.059]), supporting H7c. A statistically significant positive indirect association was also observed between flow experience and sustainable consumption intention through pleasure (β = 0.059, p = 0.002, CI = [0.025, 0.099]), supporting H5d. Perceived quality was likewise positively and indirectly associated with sustainable consumption intention through pleasure (β = 0.047, p = 0.010, CI = [0.017, 0.089]), supporting H6c. Finally, the positive indirect association between engagement and sustainable consumption intention through loyalty was statistically significant (β = 0.137, p < 0.001, CI = [0.083, 0.195]), supporting H2b. Results for these indirect relationships are presented in Table 9 and Appendix C.

Table 9. Hypotheses result.

	β	Standard Deviation (STDEV)	T-Value (|O/STDEV|)	*p*	95% Confidence		Path Coefficients
					2.50%	97.5%	
DMC → PL → SCI	0.030	0.013	2.278	0.023	0.009	0.059	Supported (H7c)
FE → PL → SCI	0.059	0.019	3.110	0.002	0.025	0.099	Supported (H5d)
PQ → PL → SCI	0.047	0.018	2.584	0.010	0.017	0.089	Supported (H6c)
GG →LY → SCI	0.137	0.029	4.775	<0.001	0.083	0.195	Supported (H2b)

Notes: DMC = Digital multisensory cues; PQ = Perceived quality; FE = Flow experience; PL = Pleasure; GG = Engagement; LY = Loyalty; SCI = Sustainable consumption intention.

5. Discussion and Implications

5.1. Main Findings and Practical Implications

This study examined the relationships among digital multisensory cues, perceived quality, flow experience, and pleasure, as well as the associations of engagement and loyalty with sustainable consumption intention in AI-powered online shopping. First, loyalty was positively associated with sustainable consumption intention in AI-powered online shopping for sustainable clothing, in line with prior research [70]. Engagement was positively related to loyalty, consistent with previous research [36,40]. A statistically significant indirect relationship between engagement and sustainable consumption intention through loyalty was also observed. This indirect relationship may reflect a pattern in which deeper engagement with AI features is accompanied by stronger loyalty. Thus, retailers could

use AI-powered systems to deliver personalised product information based on consumers' sustainable purchase histories, which may support their continued interaction with sustainable clothing. Furthermore, on e-commerce platforms such as Taobao and Tmall, online retailers could use the AI-powered recommendation systems to facilitate consumers' exploration of sustainable clothing information, which may support their engagement and sustainable consumption intention.

Second, pleasure was positively related to engagement in AI-powered online shopping for sustainable clothing, in line with previous findings [7]. Consumers who report greater pleasure when interacting with AI-powered features also tend to report greater interest in sustainable clothing and spend more time engaging with it. Thus, retailers may consider incorporating AI-powered features that make the online shopping experience more enjoyable and interactive. Retailers could design shopping experiences offer greater opportunities for consumers to move from passive browsing to active involvement with sustainable clothing. AI-powered style recommendations could also enrich product discovery and support consumers' exploration of sustainable clothing. Furthermore, retailers could use AI-powered fabric-texture features to give consumers a richer sense of the quality of sustainable materials, which may support pleasure and engagement.

Third, the findings indicated a positive relationship between pleasure and sustainable consumption intention in the context of AI-powered online shopping, in line with prior findings [3]. Consumers who report greater pleasure in AI-powered online shopping may also perceive sustainable clothing as more personally meaningful and desirable, alongside a stronger sustainable consumption intention. Thus, retailers could incorporate eco-friendly storytelling that connects products with their use in realistic contexts. Moreover, brand operators could use interactive features to help consumers understand the environmental implications of their consumption choices. AI-generated real-time sustainability indicators could clarify the environmental benefits of sustainable clothing and may enhance the personal relevance of sustainable consumption. However, retailers should remain aware of potential consumer resistance to AI-based marketing, as some consumers may disengage from information presented in an AI-generated format.

Fourth, flow experience was positively related to pleasure in AI-powered online shopping for sustainable clothing, as also reported in previous research [71]. Flow experience was also positively related to engagement and sustainable consumption intention. The indirect relationship between flow experience and sustainable consumption intention through pleasure was statistically significant, consistent with previous research [15]. In AI-powered online shopping environments, consumers who report a stronger flow experience may also report greater curiosity, absorption, and interest in learning more about sustainable clothing, together with greater pleasure and engagement. Thus, online retailers could enrich the shopping experience in ways that capture consumers' attention and support pleasure and engagement. AI-powered interfaces that present the features of sustainable clothing in engaging ways may help sustain consumers' involvement in the shopping process and provide more opportunities to explore product features. AI-powered store navigation could also facilitate store exploration and help consumers remain absorbed in the shopping process. Retailers could use AI-powered virtual try-on tools that provide different style and colour combinations of sustainable clothing across various scenarios.

Fifth, the present results indicated a positive association between digital multisensory cues and pleasure in AI-powered online shopping for sustainable clothing, consistent with previous findings [14]. Digital multisensory cues were also positively related to flow experience. The indirect relationship between digital multisensory cues and sustainable consumption intention through pleasure was also statistically significant. The digital multisensory cues (e.g., attractive visual design, background music, AI-powered virtual

try-on) enrich consumers perception of sustainable clothing in their online shopping. In the present study, these cues were related to both flow experience and pleasure, while pleasure formed a significant indirect relationship with sustainable consumption intention. Thus, online retailers could present sustainable clothing using high-quality imagery and clear visual signals of eco-friendliness. AI-powered recommendation could align with individuals' browsing preferences and needs. In addition, online operators could improve the quality and variety of online shopping scenarios, including appropriate sounds or music and virtual try-on features for sustainable clothing. Furthermore, brand operators could enhance the functionality of AI-powered virtual displays, enabling consumers to visualise the appearance of sustainable clothing on their screens.

Sixth, perceived quality showed positive relationships with both flow experience and pleasure in AI-powered online shopping for sustainable clothing, in line with previous research [71,72]. A statistically significant indirect relationship between perceived quality and sustainable consumption intention through pleasure was also observed. Consumers who perceive AI-powered online stores as providing useful product information, timely intelligent customer service, and high-quality sustainable clothing may also report stronger flow experience and pleasure. Thus, online retailers could develop AI-powered customer service systems that respond to consumers' product queries accurately and promptly, as perceived quality was positively related to flow experience.

Taken together, the supported findings suggest an integrated pattern of experiential, affective, and relational associations in AI-powered sustainable clothing shopping. Digital multisensory cues and perceived quality were not isolated shopping-related perceptions. Both were connected with consumers' internal experiences through different pathways. Digital multisensory cues were associated with flow experience and pleasure, whereas perceived quality showed positive relationships with both. Flow experience was further associated with pleasure, engagement, and sustainable consumption intention. Pleasure was associated with engagement and sustainable consumption intention. Engagement was indirectly associated with sustainable consumption intention through loyalty. These relationships highlight pleasure as an important affective link within the model, while engagement and loyalty represent a broader relational pattern extending beyond the immediate shopping experience. Given the model-fit diagnostics and limited out-of-sample predictive performance, the practical implications of these findings should be interpreted cautiously.

5.2. Theoretical Implications

This study advances the existing literature on AI-powered online shopping and sustainable clothing consumption. First, previous S-O-R-based sustainability research has examined environmental attitudes, multisensory stimuli, affective states, and sustainable clothing consumption [73]. By extending this line of research to AI-powered sustainable fashion retailing, the study broadens the application of the S-O-R framework in this context. Second, the study also extends research on AI-enabled sensory experiences in online shopping. The findings indicate that digital multisensory cues are positively related to flow experience and pleasure, while perceived quality shows positive relationships with flow experience and pleasure. Flow experience, in turn, is related to engagement and sustainable consumption intention. Together, these relationships suggest that sensory and quality-related perceptions of the AI-powered shopping environment are connected with distinct but interrelated internal experiences, engagement, loyalty, and sustainable consumption intention. In particular, pleasure emerges as an affective link between perceptions of the AI-powered shopping environment and sustainable consumption intention,

while engagement and loyalty form a relational pathway associated with sustainable consumption intention.

6. Conclusions

Drawing on the S-O-R framework, this study examined the relationships among digital multisensory cues, perceived quality, flow experience, pleasure, engagement, loyalty, and sustainable consumption intention in AI-powered online shopping. Digital multisensory cues and perceived quality were each positively related to flow experience and pleasure. Flow experience was positively related to pleasure, engagement, and sustainable consumption intention. Pleasure was also positively associated with engagement and sustainable consumption intention, while engagement was positively associated with loyalty, which, in turn, was positively related to sustainable consumption intention. Statistically significant indirect relationships with sustainable consumption intention were observed for digital multisensory cues, perceived quality, and flow experience through pleasure, and for engagement through loyalty. The study contributes to the literature by applying the S-O-R framework to AI-powered sustainable clothing shopping and highlighting the roles of digital multisensory cues and perceived quality within this framework. Our research also offers practical insights that may inform the design of AI-powered online shopping environments, with particular relevance to consumers' engagement, loyalty, and sustainable consumption intention.

Limitations and Future Research

Several limitations should be acknowledged. First, the data were collected using a cross-sectional, scenario-based, assisted recall survey. Accordingly, the observed relationships should not be interpreted as evidence of causal or temporal ordering. Future research could use longitudinal or experimental designs to examine these relationships over time or under controlled conditions. Second, the data were collected in one country, China. Future, cross-cultural research could assess the model across different cultural contexts. Third, the study did not capture real-time interactions with AI-powered shopping systems. Research involving real-time human–AI interactions could examine consumers' responses in such settings and further inform the design of online retail environments.

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Institutional Review Board Statement: Approval was obtained from the ethics committee of the Shanghai University of Engineering Science (ethics approval number: EST2025034; date of approval: 22 April 2025). The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data that support the findings of this study are available from the first author and corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

All measurement items are shown in Table A1.

Table A1. The items of the measurement.

Variable	Items	Sources
Digital multisensory cues	When I shop online for sustainable clothing, DMC1. Attractive visual design and background music make me search for more information. DMC2. I get a sense of moving my fingers over the fabric. DMC3. I feel like I am trying on the products on the screen. DMC4. I feel multisensory congruence is high.	Ivanov et al. (2022) [54]; Li et al. (2022) [9,55]; Zha et al. (2022) [56]
Perceived quality	When I shop online for sustainable clothing, PQ1. Online clothing stores provide useful information on the product that I want to purchase. PQ2. Intelligent customer service can always timely reply. PQ3. The performance of sustainable clothing is high. PQ4. The quality of sustainable clothing is high.	Baghirov & Zhang (2024) [10]; Han et al. (2024) [8]; Kim & Park (2013) [57]; San-Martín et al. (2017) [58]
Flow experience	When I shop online for sustainable clothing, FE1. I feel time passes quickly. FE2. I feel curious about the sustainable clothing. FE3. I am entirely absorbed by the feature of the sustainable clothing. FE4. I am interested to learn more about the store.	Hsu et al. (2011) [46]; Lin & Huang (2024) [20]
Pleasure	When I shop online for sustainable clothing, I feel PL1. Excited PL2. Happy PL3. Contented	Li et al. (2020) [39]; Koo & Lee (2011) [38]
Engagement	GG1. Using the AI feature on online stores makes me think about the sustainable clothing. GG2. Using the AI feature on online stores stimulates my interest to the sustainable clothing. GG3. I often think about the sustainable clothing when using the digital feature on online stores. GG4. I spend more time shopping online sustainable clothing than for other kinds of products.	Hollebeek et al. (2014) [35]; Lin & Huang (2024) [20]
Loyalty	LY1. I will choose sustainable clothing rather than others. LY2. I will invest time and money to visit sustainable clothing sites online. LY3. I will recommend sustainable clothing to others.	Jung et al. (2020) [32]
Sustainable consumption intention	SCI1. I will consider buying sustainable clothing because they are less polluting in the future. SCI2. I will consider switching to environmentally friendly brands for ecological reasons. SCI3. I plan to spend more on environmentally friendly clothing rather than conventional ones. SCI4. I expect to purchase the sustainable clothing in the future.	Minh & Quynh (2024) [59]; Paul et al. (2016) [27]

Appendix B

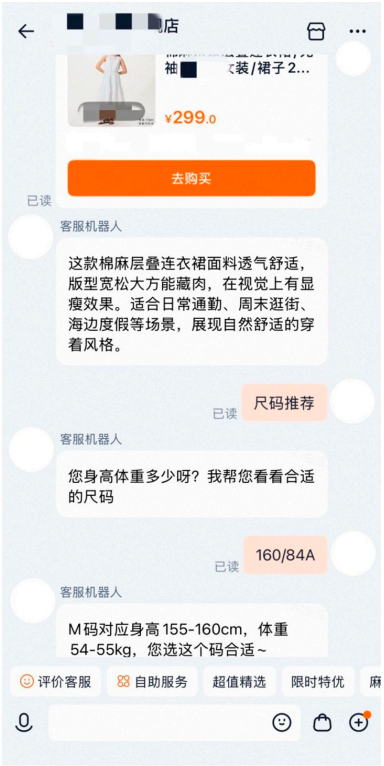
The starting part of the questionnaire is shown in Table A2.

Table A2. Screenshot of the initial questionnaire.



Step 1	Step 2	Step 3
Dear Participant, You are cordially invited to participate in an academic study investigating AI-powered online shopping experiences for sustainable clothing. The aim of this questionnaire is to understand consumers' perceptions and evaluations of sustainable clothing information, product presentation, shopping experiences, and their intention to consume sustainably in an AI-powered online shopping context. Your responses will be anonymous and will be used solely for academic research purposes. Your responses will be kept strictly confidential. Participation in this study is entirely voluntary, and you may withdraw at any point while completing the questionnaire. Before answering, please carefully read the provided shopping scenario and review the accompanying images illustrating the relevant AI-powered features. Imagine that you are browsing and selecting sustainable clothing in this scenario and answer the subsequent questions based on it. There are no right or wrong answers. Please respond according to your genuine feelings and initial reactions. Thank you for your support and participation.	1. You are invited to participate in an academic study examining the impact of AI-powered features on the consumer experience of online clothing platforms. This questionnaire is anonymous, and all data collected will be used solely for academic research purposes and kept strictly confidential. Your participation is entirely voluntary, and you can withdraw from the survey at any time without facing any consequences. By clicking 'I Agree', you confirm that you have read and understood the information above and that you are voluntarily consenting to participate in this study. ○ I agree to participate and proceed to the survey ○ I do not agree to participate. (exit)	2. These features include AI customer service chatbots, intelligent product recommendations, virtual try-on tools, size recommendations via AI and product-matching suggestions generated from AI. ○ Yes ○ No (exit)

Table A2. *Cont.*

Step 4a Please read the following shopping scenario carefully. Imagine that you are browsing for sustainable clothing on a mainstream e-commerce platform such as Taobao or Tmall. During the shopping process, the platform provides the following three AI-powered features: **(a) AI-powered virtual try-on tool.** This feature allows you to visualise how the clothing would look and fit you.  Note: The Chinese interface terms are translated as follows: “发现” means “Discover,” “AI 试穿” means “AI virtual try-on,” “我的” means “My,” “共1件” means “1 item in total,” “暂无价格” means “Price unavailable,” “加购” means “Add to cart,” “上装” means “Tops,” “下装” means “Bottoms,” “鞋子” means “Shoes,” “帽子” means “Hats,” “试穿记录” means “Try-on history,” “推荐” means “Recommendations,” “订单” means “Orders,” “购物车” means “Shopping cart,” “收藏” means “Favorites,” and “足迹” means “Browsing history.”	**Step 4b** **(b) Intelligent product recommendation system** This feature recommends sustainable clothing that matches your personal preferences based on your browsing history, style preferences, and shopping needs.  Note: The Chinese text shows an interaction with an AI shopping assistant. The user asks, “Please recommend sustainable clothing under RMB 888 that is suitable for daily commuting.” The AI shopping assistant recommends several options that combine sustainable materials with a professional style and identifies a Tencel shirt dress as the most suitable option. It explains that Tencel/Lyocell is a sustainable material produced through a closed-loop process and describes the garment as comfortable, smooth, well-draped, and suitable for commuting. “AI 购物助手” means “AI shopping assistant,” “AI 试穿” means “AI virtual try-on,” and “内容由 AI 生成” means “Content generated by AI.”	**Step 4c** **(c) AI shopping assistant/customer-service chatbot.** It provides real-time product information and sustainability-related details such as fabric composition, size recommendations, product features and environmental information.  Having read the above shopping scenario carefully and viewed the accompanying images illustrating these features, please imagine using these AI-powered features to browse and select sustainable clothing. Answer all subsequent questions based on this scenario. Note: The Chinese text shows an interaction with an AI customer service chatbot. The chatbot describes the cotton–linen dress as breathable, comfortable, and loose-fitting and states that it is suitable for daily commuting, weekend shopping, and beach vacations. When the user requests a size recommendation (“尺码推荐”), the chatbot asks for the user’s height and weight. After the user provides the size information “160/84A,” the chatbot recommends size M, which it indicates is suitable for a height of 155–160 cm and a weight of 54–55 kg. “客服机器人” means “customer service chatbot,” and “去购买” means “Buy now.”

Appendix C

The mediating effects of the variables are shown in Table A3.

Table A3. The mediating effects of the variables.

	β	Standard Deviation (STDEV)	T-Value (|O/STDEV|)	*p*	95% Confidence		Path Coefficients
					2.50%	97.5%	
DMC → FE → GG	0.117	0.023	5.065	<0.001	0.075	0.165	Supported
PQ → FE → PL→ GG → LY → SCI	0.005	0.002	2.742	0.006	0.002	0.010	Supported
DMC → FE → PL	0.118	0.024	4.924	<0.001	0.074	0.168	Supported
DMC → FE → SCI	0.101	0.022	4.649	<0.001	0.062	0.148	Supported
GG → LY → SCI	0.137	0.029	4.775	<0.001	0.083	0.195	Supported
FE → PL → GG → LY → SCI	0.012	0.004	2.860	0.004	0.005	0.021	Supported
PQ → FE → GG	0.153	0.028	5.398	<0.001	0.102	0.213	Supported
PQ → FE → PL	0.154	0.029	5.316	<0.001	0.099	0.214	Supported
DMC → PL → GG → LY	0.024	0.010	2.431	0.015	0.008	0.046	Supported
PQ → FE → SCI	0.133	0.030	4.486	<0.001	0.079	0.194	Supported
DMC → FE → PL → SCI	0.020	0.007	2.824	0.005	0.008	0.037	Supported
FE → GG → LY → SCI	0.047	0.012	3.912	<0.001	0.026	0.072	Supported
PQ → FE → PL → GG	0.039	0.010	3.749	<0.001	0.020	0.061	Supported
DMC → FE → GG → LY	0.063	0.014	4.538	<0.001	0.039	0.092	Supported
DMC → FE → PL → GG	0.030	0.008	3.702	<0.001	0.015	0.047	Supported
PQ → FE → GG → LY	0.082	0.017	4.806	<0.001	0.053	0.119	Supported
PQ → FE → PL → SCI	0.026	0.009	3.057	0.002	0.011	0.045	Supported
PQ → FE → GG → LY → SCI	0.021	0.006	3.560	<0.001	0.011	0.034	Supported
DMC → FE → PL → GG → LY → SCI	0.004	0.001	2.727	0.006	0.002	0.007	Supported
DMC → FE → GG → LY → SCI	0.016	0.005	3.456	0.001	0.008	0.026	Supported
DMC → PL → GG	0.044	0.018	2.461	0.014	0.014	0.083	Supported
FE → PL → GG	0.087	0.022	4.005	<0.001	0.047	0.131	Supported
DMC → PL → SCI	0.030	0.013	2.278	0.023	0.009	0.059	Supported
FE → GG → LY	0.183	0.032	5.717	<0.001	0.124	0.249	Supported
FE → PL → SCI	0.059	0.019	3.110	0.002	0.025	0.099	Supported
PQ → PL → GG	0.069	0.020	3.466	0.001	0.032	0.111	Supported
PL → GG → LY	0.135	0.030	4.471	<0.001	0.077	0.194	Supported
PQ → PL → SCI	0.047	0.018	2.584	0.010	0.017	0.089	Supported
FE → PL → GG → LY	0.046	0.012	3.798	<0.001	0.024	0.072	Supported
PL → GG → LY → SCI	0.034	0.010	3.342	0.001	0.016	0.057	Supported
PQ → PL → GG → LY	0.037	0.011	3.368	0.001	0.017	0.061	Supported
PQ → FE → PL → GG → LY	0.021	0.006	3.567	<0.001	0.011	0.034	Supported
DMC → FE → PL → GG → LY	0.016	0.005	3.498	<0.001	0.008	0.026	Supported
DMC → PL → GG → LY → SCI	0.006	0.003	2.182	0.029	0.002	0.013	Supported
PQ → PL → GG → LY → SCI	0.010	0.003	2.919	0.004	0.004	0.017	Supported

References

1. Ho, C.; Jones, R.; Jones, R.; Murray, L.; Spence, C. Multisensory Augmented Reality in the Context of a Retail Clothing Application. In *(((ABA))) Audio Branding Academy Yearbook 2012/2013*; Nomos Verlagsgesellschaft mbH & Co. KG: Baden-Baden, Germany, 2013; pp. 167–175.
2. Laukkanen, T.; Xi, N.; Hallikainen, H.; Ruusunen, N.; Hamari, J. Virtual technologies in supporting sustainable consumption: From a single-sensory stimulus to a multi-sensory experience. *Int. J. Inf. Manag.* **2022**, *63*, 102455. [CrossRef]
3. Mahajan, A.; Sharma, S.; Agrawal, V.; Nikalje, V. Influence of artificial intelligence on consumers' lifestyle product choices and the key to driving sustainable behaviour. *Young Consum. Insight Ideas Responsible Mark.* **2025**, *26*, 808–830. [CrossRef]
4. Abbate, S.; Centobelli, P.; Cerchione, R.; Nadeem, S.P.; Riccio, E. Sustainability trends and gaps in the textile, apparel and fashion industries. *Environ. Dev. Sustain.* **2024**, *26*, 2837–2864. [CrossRef] [PubMed]
5. Brand, B.M. Bridging the intention-behavior-gap through digitalized information (?)-Two laboratory experiments in the textile industry. *J. Retail. Consum. Serv.* **2025**, *84*, 104179. [CrossRef]
6. Zhang, X.; Liu, Q.; Li, Y.; Xu, Z. Bloggers' minimalist consumption guidance for sustainability: Exploring the determinants to reduce excessive apparel consumption. *Sustainability* **2024**, *16*, 10462. [CrossRef]
7. Gao, Y.; Liang, J. The impact of AI-powered try-on technology on online consumers' impulsive buying intention: The moderating role of brand trust. *Sustainability* **2025**, *17*, 2789. [CrossRef]
8. Han, B.; Li, P.; Tan, X. The effects of quality perception and multisensory perception on purchase intention when consumers shop online. *Asia Pac. J. Mark. Logist.* **2025**, *37*, 800–817. [CrossRef]
9. Li, P.; Guo, X.; Wu, C.; Spence, C. How multisensory perception promotes purchase intent in the context of clothing e-customisation. *Front. Psychol.* **2022**, *13*, 1039875. [CrossRef] [PubMed]

10. Baghirov, F.; Zhang, Y. Assessment of the association between aesthetic products and perceived product quality: An analysis of customer attitudes. *J. Consum. Mark.* **2024**, *41*, 789–803. [CrossRef]
11. Pandey, S.; Mittal, S.; Chawla, D. Tackling consumer information asymmetry and perceived uncertainty for luxury re-commerce through seller signals. *J. Retail. Consum. Serv.* **2024**, *79*, 103736. [CrossRef]
12. Meng, L.M.; Duan, S.; Zhao, Y.; Lü, K.; Chen, S. The impact of online celebrity in livestreaming e-commerce on purchase intention from the perspective of emotional contagion. *J. Retail. Consum. Serv.* **2021**, *63*, 102733. [CrossRef]
13. Rahman, M.S.; Bag, S.; Hossain, M.A.; Fattah, F.A.M.A.; Gani, M.O.; Rana, N.P. The new wave of AI-powered luxury brands online shopping experience: The role of digital multisensory cues and customers' engagement. *J. Retail. Consum. Serv.* **2023**, *72*, 103273. [CrossRef]
14. Xiao, Y.; Li, Q.; Zhang, Z.; Zhang, Y. Research and evaluation of multi-sensory design of product packaging based on VR technology in online shopping environment. *Appl. Sci.* **2024**, *14*, 7736. [CrossRef]
15. Khare, A.; Kautish, P.; Khare, A. The online flow and its influence on awe experience: An AI-enabled e-tail service exploration. *Int. J. Retail Distrib. Manag.* **2023**, *51*, 713–735. [CrossRef]
16. Mehrabian, A.; Russell, J.A. *An Approach to Environmental Psychology*; MIT Press: Cambridge, MA, USA, 1974.
17. Sherman, E.; Mathur, A.; Smith, R.B. Store environment and consumer purchase behavior: Mediating role of consumer emotions. *Psychol. Mark.* **1997**, *14*, 361–378. [CrossRef]
18. Zhu, L.; Li, H.; Wang, F.-K.; He, W.; Tian, Z. How online reviews affect purchase intention: A new model based on the stimulus-organism-response (S-O-R) framework. *Aslib J. Inf. Manag.* **2020**, *72*, 463–488. [CrossRef]
19. El Abed, M.; Castro-Lopez, A. The impact of AI-powered technologies on aesthetic, cognitive and affective experience dimensions: A connected store experiment. *Asia Pac. J. Mark. Logist.* **2024**, *36*, 715–735. [CrossRef]
20. Lin, K.-Y.; Huang, T.K. Shopping in the digital world: How augmented reality mobile applications trigger customer engagement. *Technol. Soc.* **2024**, *77*, 102540. [CrossRef]
21. Manzo, D.S.H.; Jiang, Y.; Elyan, E.; Isaacs, J. Artificial intelligence-based conversational agents used for sustainable fashion: Systematic literature review. *Int. J. Hum.–Comput. Interact.* **2025**, *41*, 4640–4652. [CrossRef]
22. Nguyen, M.T.; Thach, K.T.D.; Nguyen, C.N.L.; Nguyen, A.C.; Doan, H.K. The influence of AI chatbots on green satisfaction and loyalty: Evidence from sustainability-driven consumer behavior. *J. Glob. Mark.* **2026**, *39*, 103–132. [CrossRef]
23. Petit, O.; Velasco, C.; Spence, C. Digital sensory marketing: Integrating new technologies into multisensory online experience. *J. Interact. Mark.* **2019**, *45*, 42–61. [CrossRef]
24. Jang, S.S.; Namkung, Y. Perceived quality, emotions, and behavioral intentions: Application of an extended Mehrabian–Russell model to restaurants. *J. Bus. Res.* **2009**, *62*, 451–460. [CrossRef]
25. Souki, G.Q.; Oliveira, A.S.d.; Guerreiro, M.M.M.; Mendes, J.d.C.; Moura, L.R.C. Do memorable restaurant experiences affect eWOM? The moderating effect of consumers' behavioural engagement on social networking sites. *TQM J.* **2023**, *35*, 2255–2281. [CrossRef]
26. Erensoy, A.; Mathrani, A.; Schnack, A.; Elms, J.; Baghaei, N. Consumer behavior in immersive virtual reality retail environments: A systematic literature review using the stimuli-organisms-responses (S-O-R) model. *J. Consum. Behav.* **2024**, *23*, 2781–2811. [CrossRef]
27. Paul, J.; Modi, A.; Patel, J. Predicting green product consumption using theory of planned behavior and reasoned action. *J. Retail. Consum. Serv.* **2016**, *29*, 123–134. [CrossRef]
28. Ngo, T.T.A.; Vo, C.H.; Tran, N.L.; Nguyen, K.V.; Tran, T.D.; Trinh, Y.N. Factors influencing Generation Z's intention to purchase sustainable clothing products in Vietnam. *PLoS ONE* **2024**, *19*, e0315502. [CrossRef] [PubMed]
29. Sharma, N.; Paço, A. AI and emotions: Enhancing green intentions through personalized recommendations—A mediated moderation analysis. *AI Soc.* **2025**, *40*, 2821–2838. [CrossRef]
30. Oliver, R.L. Whence consumer loyalty? *J. Mark.* **1999**, *63*, 33–44. [CrossRef]
31. Agu, E.E.; Iyelolu, T.V.; Idemudia, C.; Ijomah, T.I. Exploring the relationship between sustainable business practices and increased brand loyalty. *Int. J. Manag. Entrep. Res.* **2024**, *6*, 2463–2475. [CrossRef]
32. Jung, J.; Kim, S.J.; Kim, K.H. Sustainable marketing activities of traditional fashion market and brand loyalty. *J. Bus. Res.* **2020**, *120*, 294–301. [CrossRef]
33. Khamoushi Sahne, S.S.; Kalantari Daronkola, H. Enhancing loyalty in luxury fashion with AI: The mediation role of customer relationships. *Asia-Pac. J. Bus. Adm.* **2025**, *17*, 1441–1479. [CrossRef]
34. Li, J.; Lin, Z.; Zhang, X. The study on the effectiveness of sustainable customer relationship management: Evidence from the online shopping industry. *Sustainability* **2023**, *15*, 5911. [CrossRef]
35. Hollebeek, L.D.; Glynn, M.S.; Brodie, R.J. Consumer brand engagement in social media: Conceptualization, scale development and validation. *J. Interact. Mark.* **2014**, *28*, 149–165. [CrossRef]
36. Sahoo, S.K.; Fabus, J.; Garbarova, M.; Kvasnicova-Galovicova, T.; Pattnaik, L.; Sahoo, S. Devising AI-based customer engagement to foster positive attitude towards green purchase intentions. *Sustainability* **2025**, *17*, 9282. [CrossRef]

37. Wang, Y.; Chowdhury Ahmed, S.; Deng, S.; Wang, H. Success of social media marketing efforts in retaining sustainable online consumers: An empirical analysis on the online fashion retail market. *Sustainability* **2019**, *11*, 3596. [CrossRef]
38. Koo, D.-M.; Lee, J.-H. Inter-relationships among dominance, energetic and tense arousal, and pleasure, and differences in their impacts under online vs. offline environment. *Comput. Hum. Behav.* **2011**, *27*, 1740–1750. [CrossRef]
39. Li, P.; Wu, C.; Spence, C. Multisensory perception and positive emotion: Exploratory study on mixed item set for apparel e-customization. *Text. Res. J.* **2020**, *90*, 2046–2057. [CrossRef]
40. Deng, K.; Zhang, C.; Song, M.; Hu, X. Exploring key factors influencing generation Z users' continuous use intention on human-ai collaboration in secondhand fashion e-commerce platforms. *Sustainability* **2026**, *18*, 964. [CrossRef]
41. Diddi, S.; Yan, R.-N.; Bloodhart, B.; Bajtelsmit, V.; McShane, K. Exploring young adult consumers' sustainable clothing consumption intention-behavior gap: A behavioral reasoning theory perspective. *Sustain. Prod. Consum.* **2019**, *18*, 200–209. [CrossRef]
42. Huang, M.; Mohamad Saleh, M.S.; Zolkepli, I.A. The moderating effect of green advertising on the relationship between gamification and sustainable consumption behavior: A case study of the ant forest social media app. *Sustainability* **2023**, *15*, 2883. [CrossRef]
43. White, K.; Habib, R.; Hardisty, D.J. How to SHIFT consumer behaviors to be more sustainable: A literature review and guiding framework. *J. Mark.* **2019**, *83*, 22–49. [CrossRef]
44. Lundblad, L.; Davies, I.A. The values and motivations behind sustainable fashion consumption. *J. Consum. Behav.* **2016**, *15*, 149–162. [CrossRef]
45. Nakamura, J.; Csikszentmihalyi, M. *The Concept of Flow*; Springer: Dordrecht, The Netherlands, 2014; pp. 239–263.
46. Hsu, C.L.; Chang, K.C.; Chen, M.C. Flow experience and internet shopping behavior: Investigating the moderating effect of consumer characteristics. *Syst. Res. Behav. Sci.* **2012**, *29*, 317–332. [CrossRef]
47. Kettinger, W.J.; Lee, C.C. Perceived service quality and user satisfaction with the information services function. *Decis. Sci.* **1994**, *25*, 737–766. [CrossRef]
48. Kumar, R.; Jain, V.; Eastman, J.K.; Ambika, A. The components of perceived quality and their influence on online re-purchase intention. *J. Consum. Mark.* **2025**, *42*, 38–55. [CrossRef]
49. Li, X.; Zhao, X.; Pu, W. Measuring ease of use of mobile applications in e-commerce retailing from the perspective of consumer online shopping behaviour patterns. *J. Retail. Consum. Serv.* **2020**, *55*, 102093. [CrossRef]
50. Chen, L.; Halepoto, H.; Liu, C.; Kumari, N.; Yan, X.; Du, Q.; Memon, H. Relationship analysis among apparel brand image, self-congruity, and consumers' purchase intention. *Sustainability* **2021**, *13*, 12770. [CrossRef]
51. Legere, A.; Kang, J. The role of self-concept in shaping sustainable consumption: A model of slow fashion. *J. Clean. Prod.* **2020**, *258*, 120699. [CrossRef]
52. Huang, T.-L.; Liao, S.-L. Creating e-shopping multisensory flow experience through augmented-reality interactive technology. *Internet Res.* **2017**, *27*, 449–475. [CrossRef]
53. Fakhfakh, A.; Noureldin, A.; Khalifa, T.; Afify, G.; Sumarmi, S.; Al-Hariri, B. AI stimuli and responsible consumer choices: Understanding the pathways to sustainability. *J. Int. Crisis Risk Commun. Res. (JICRCR)* **2024**, *7*, 408–423.
54. Ivanov, A.; Head, M.; Biela, C. Mobile shopping decision comfort using augmented reality: The effects of perceived augmentation and haptic imagery. *Asia Pac. J. Mark. Logist.* **2023**, *35*, 1917–1934. [CrossRef]
55. Li, P.; Pan, M.; Qu, H.; Wu, C. The effects of visual-audio merchandising elements on consumers' impulsive purchase intentions in apparel e-customization. *Text. Res. J.* **2022**, *92*, 4678–4694. [CrossRef]
56. Zha, D.; Foroudi, P.; Melewar, T.; Jin, Z. Experiencing the sense of the brand: The mining, processing and application of brand data through sensory brand experiences. *Qual. Mark. Res. Int. J.* **2022**, *25*, 205–232. [CrossRef]
57. Kim, S.; Park, H. Effects of various characteristics of social commerce (s-commerce) on consumers' trust and trust performance. *Int. J. Inf. Manag.* **2013**, *33*, 318–332. [CrossRef]
58. San-Martín, S.; González-Benito, Ó.; Martos-Partal, M. To what extent does need for touch affect online perceived quality? *Int. J. Retail Distrib. Manag.* **2017**, *45*, 950–968. [CrossRef]
59. Minh, T.C.; Quynh, N.N.T. Factors affecting sustainable consumption behavior: Roles of pandemics and perceived consumer effectiveness. *Clean. Responsible Consum.* **2024**, *12*, 100158. [CrossRef]
60. Hair, J.F.; Risher, J.J.; Sarstedt, M.; Ringle, C.M. When to use and how to report the results of PLS-SEM. *Eur. Bus. Rev.* **2019**, *31*, 2–24. [CrossRef]
61. Nunnally, J.; Bernstein, I. *Psychometric Theory*, 3rd ed.; McGraw-Hill: New York, NY, USA, 1994.
62. Chin, W.W. The partial least squares approach to structural equation modeling. In *Modern Methods for Business Research*; Psychology Press: East Sussex, UK, 1998; pp. 295–336.
63. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **1981**, *18*, 39–50. [CrossRef]
64. Henseler, J.; Ringle, C.M.; Sarstedt, M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J. Acad. Mark. Sci.* **2015**, *43*, 115–135. [CrossRef]

65. Hair, J.F.; Ringle, C.M.; Sarstedt, M. PLS-SEM: Indeed a silver bullet. *J. Mark. Theory Pract.* **2011**, *19*, 139–152. [CrossRef]
66. Hair, J.; Hult, G.T.M.; Ringle, C.; Sarstedt, M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*; Sage Publishing: Thousand Oaks, CA, USA, 2022.
67. Hair, J.F.; Hult, G.T.M.; Ringle, C.M.; Sarstedt, M.; Danks, N.P.; Ray, S. *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R: A Workbook*; Springer: Berlin/Heidelberg, Germany, 2021.
68. Preacher, K.J.; Hayes, A.F. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav. Res. Methods* **2008**, *40*, 879–891. [CrossRef] [PubMed]
69. Cohen, J. *Statistical Power Analysis for the Behavioral Sciences*; Routledge: Oxfordshire, UK, 2013.
70. Zaid, A.A.; Bawaqni, S.A.; Shahwan, R.; Alnasr, F. Effects of greenwashing on green purchase intention: The mediating role of green skepticism, green brand love and green brand loyalty. *J. Foodserv. Bus. Res.* **2025**, *28*, 927–954. [CrossRef]
71. Lopes, J.M.; Massano-Cardoso, I.; Silva, F. From AI-enabled service quality to digital immersion state: Effects on the awe experience in fashion e-retail. *Future Bus. J.* **2026**, *12*, 53. [CrossRef]
72. Yeo, S.F.; Tan, C.L.; Kumar, A.; Tan, K.H.; Wong, J.K. Investigating the impact of AI-powered technologies on Instagrammers' purchase decisions in digitalization era–A study of the fashion and apparel industry. *Technol. Forecast. Soc. Change* **2022**, *177*, 121551. [CrossRef]
73. Zang, L.; Wang, L.; Zhang, D.; Bai, Q. Data-driven review of customer engagement: Key research themes and future directions. *Electron. Commer. Res.* **2026**, *26*, 1887–1917. [CrossRef]

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