The invisible hand of touch: testing a tactile sensation-choice satisfaction model in online shopping

Received: 26 September 2023 | Revised: 27 December 2023 | Accepted: 28 December 2023

DOI: 10.1111/joss.12897

ORIGINAL ARTICLE

Journal of Sensory Studies
WILEY

The invisible hand of touch: Testing a tactile sensation-choice satisfaction model in online shopping

Aya Shaban | Anastasiya Saraeva | Susan Rose | Moira Clark

Henley Business School, University of Reading, Greenlands Campus, Henley-on-Thames, Oxfordshire, UK

Correspondence
Aya Shaban, Henley Business School, University of Reading, Greenlands Campus, Henley-on-Thames, Oxfordshire, RG9 3AU, UK.
Email: aya.fshaban2@gmail.com

Funding information
The Henley Centre for Customer Management

Abstract

This study tests a model of the relationship between online store sensory environments and consumer responses using the stimulus-organism-response paradigm. The aim is to (a) examine the ability of three online product presentation formats (OPPFs) to induce tactile sensations, (b) identify the effect of tactile sensations upon choice satisfaction, and (c) examine the mediating role of cognitive effort and affective experience. Videos are found to induce the greatest tactile sensations followed by zoom image, whereas static image is found to induce the least. Furthermore, the more tactile sensations consumers experience while shopping online, the higher their emotional experience, resulting in lower cognitive effort and higher consumer choice satisfaction. Affective experience is found to mediate the tactile sensations and choice satisfaction relationship. The original contribution of the research is a newly validated model of OPPFs, tactile sensations, customer experience, and choice satisfaction that extends theoretical understanding of variables previously untested.

Practical applications

The study offers practical results from which small to medium sized, or new start-up, online clothing retailers can benefit. The study shows the advantages of using OPPFs such as videos and zoom images on retail websites to assist shoppers by enhancing the sensory buying experience. Such online retailers may not be able to afford the investment in more complex and costly advanced technologies such as the use of augmented reality in virtual mirroring. The study shows that when online retailers provide videos and/or zoom images on their websites, they allow shoppers to experience greater tactile sensations while evaluating and selecting a product compared to only being able to view it as a static image. Online clothing retailers can continue to rely on these technologies to compensate shoppers for the lack of touch in the online shopping context, which is so important when purchasing clothing.

1 | INTRODUCTION

Technological advances such as virtual reality (VR) and artificial intelligence are impacting the online shopping environment, making it crucial for online retailers to build an understanding of how consumers respond to them. Examples include the use of data analytics that enable online retailers to offer personalized engagement (Gupta et al., 2020), virtual try on technologies, and chatbots all of which ultimately provide customers with superior experiences (Kumar, 2021). They have a positive effect on consumers' attitudes toward online shopping (Tandon, 2023) with increased shopper satisfaction and trust online being important to loyalty and repurchase (Shafiee & Bazargan, 2018). Research conducted in a mall context has shown that shopper well-being is affected by hedonic value such as fun and pleasure, which impacts consumer loyalty (Shafiee & Es-Haghi, 2017). Given the absence of physical contact online compared to mall shopping, online retailers have begun to utilize VR technologies not only to compensate consumers for physical intangibility while evaluating products online but also to increase satisfaction while they are immersed in the online purchase process. However, there is currently a research gap in our understanding of the effect of such virtual sensory enabling technologies (SETs) on consumer responses and how this impacts shopper satisfaction, in particular choice satisfaction (CS). This paper therefore aims to address this gap by investigating how three virtual online product presentation formats (OPPFs) can generate tactile sensations (TSs) and the effect these have on affective experience (AE) and cognitive effort (CE) on the part of the shopper. The study also addresses the gap in understanding of how such responses impact online shopper CS.

Online shopping has existed for over 2 decades but became more prevalent due to the COVID-19 pandemic and its effect on consumer buying behavior (Young et al., 2022). Bringing shops into homes and consumers embracing more digital technologies are among the outcomes of the pandemic (Sheth, 2020; Truong & Truong, 2022). More than 75% of new online shoppers, who started to shop online since the pandemic, believe that they will continue to purchase online afterward (Diaz-Gutierrez et al., 2023). Additionally, there has been continuous development in technology in the retailing environment. For instance, online shopping scope has extended from consumers utilizing laptops or desktops to using tablets and smart phones (Singh & Basu, 2023). Online shopping is the process of selling and purchasing products over the Internet (Sahney et al., 2013) and involves consumers purchasing from a business through online channels (Le et al., 2022). Digital marketing relies on multiple channels to reach consumers, including websites, online advertising, social media, mobile marketing, and e-marketing (Garg et al., 2021). It can enable online retailers to enter new international markets, expand their market share, and build better relationships with customers, leading to higher sales (Goss, 2005). Also, among the benefits of online shopping for online retailers is that there are no geographical limitations, lower operational costs, higher efficiency, and ease of initiation as well as administration (Taher, 2021). From a consumer perspective, online shopping offers multiple benefits including purchasing products without having to leave their homes, a wider range of options and product comparisons (Alhaimer, 2022), and not having to physically visit multiple locations to find the product they are looking for, thus lowering purchase costs (Jiang et al., 2013). Further, online shopping offers convenience as well as product variety (Bhatti and Rehman, 2019). E-commerce stores are available 24/7, and they also allow for time saving and comparison of prices. Additionally, online shopping allows consumers to access a wide variety of products in no time unlike conventional shopping (Taher, 2021). Disadvantages of online shopping can include long delivery times and the lack of immediate possession of the product, security concerns of the online transactions, the lack of in-store entertainment and social interaction as well as the inability to touch, see, try, and feel the products (Aryani et al., 2021) Therefore, "reliability," "ease of use," "interactivity," "emotional appeal," "visual appeal," and "security" have been identified as crucial dimensions of the e-retailing industry (Tabaeeian et al., 2023). Further, trust plays a major role when consumers choose an online store to purchase from. It has been found that information security, website performance, responsiveness, contact, and compensation affect customers' loyalty (Shafiee & Bazargan, 2018).

With the development of online shopping as a nontouch medium, shoppers can access limited sensory information about products before they purchase. Specifically, the shopping environment lacks opportunities for tactile information gained through physically touching the product prior to purchase as would happen in a physical store. Online shopping is perceived as more risky than traditional shopping, as consumers cannot touch or experience the products they want to purchase (Hansen et al., 2004). Research shows that consumers perceive higher levels of risk when they shop online compared with instore shopping. Further, consumers' perception of risk can affect their decisions and preclude their adoption of online shopping (Shafiee et al., 2017). It has been found that the increase in consumers' perceived risk when purchasing online results in lower online purchasing decisions (Gazali & Suyasa, 2020). The perceived risk that online consumers experience is usually due to their lack of trust and credibility of online stores and its owners (Shafiee et al., 2017). Although a money-back guarantee policy can be considered as an effective measure to reduce risk, to some customers, however, it may not be considered as a risk reliever (Chang et al., 2005). Research shows that there are multiple factors that can be considered risk relievers such as website loyalty, being able to communicate with a salesperson (by mail or by phone), and word of mouth through comments on the Internet (Rajini & Krithika, 2016).

Products differ in the amount of inspection required to make a purchase decision. Some products need thorough inspection through physical interaction and touch, such as clothing (Zhang et al., 2021). The Zhang et al. (2021) study shows that consumers value physical interaction when purchasing what they refer to as a 'deep' or high-involvement product, so physical stores offer a learning experience that has positive effect on re-patronage. Zhang et al. (2021) propose that online retailers who are not able to establish an offline presence should mimic the physical engagement experiences of a physical store to make the online shopping more multisensory and tangible. As a result, one of the challenges for clothing e-retailers is how to compensate for the lack of physical touch in online shopping (Overmars & Poels, 2015). It has been found that the unfeasible touch, trying on, and inspection of the product in online shopping increases the product risk (Saprikis et al., 2010). Also, research shows that insufficient product information display, as well as the inability of examining the product, in the online context increases consumers' anxiety (Dastane et al., 2018; Wong et al., 2019). Research on how e-retailers can mitigate such a challenge remains quite unexplored. Therefore, this research fills this gap in the literature, as it examines the role of the

OPPFs in compensating consumers for the lack of touch in the online context. Further, this research examines the impact of the OPPFs on the customers' experience while shopping online and its impact on consumers' CS.

In order for online retailers to enhance the sensory online customer experience, they need to find another effective alternative for touch that can improve consumers' evaluation of products (Overmars & Poels, 2015). An effective digital display of products may help shoppers to make a choice decision. OPPFs can be effective for online retailers, as they can allow consumers to make their purchase decisions through a more exciting and informative product display (Li & Meshkova, 2013). OPPFs utilizing technology are also referred to in the literature as SETs and are defined as technologies that offer sensory input in the online shopping environment. These technologies include product visualization technologies that have been widely applied by online apparel retailers and widely adopted by online shoppers. Examples include 3D rotation views (from every angle), virtual try-on, zoom images (ZIs), and videos (Kim & Forsythe, 2009). OPPFs enable the shopper to have a sense of touch without using their hand—an invisible hand. Examples include ASOS offers a video in addition to the static image (SI) as an attempt to allow consumers to further explore the clothes before the purchase (ASOS, 2022). American Eagle offers a close-up view of the clothes, so consumers can better understand the fabric details while shopping online (American Eagle, 2022).

It has been found that vicarious product touch through touch-evoking product images elicits similar effects to those derived from an actual physical product touch, so online retailers can utilize these pictures to increase sales and online store traffic (Pino et al., 2020). However, Pino et al. (2020) study did not explore how the touch-evoking product display can impact consumers' CS. This gap in understanding of CS is important and therefore this study aims to address the relationship between OPPFs and CS and investigate this research gap. This study investigates how OPPFs can impact consumers' CS and the effects of TSs, CE, and affective processes in the online shopping context. Three research questions were developed at the outset.

1. What is the effect of different online product display formats upon tactile sensations?
2. What is the relationship between tactile sensations and choice satisfaction in an online shopping context?
3. What are the factors that mediate the effect of tactile sensations upon choice satisfaction?

2 | WHAT ARE THE FACTORS THAT MEDIATE THE EFFECT OF TACTILE SENSATIONS UPON CHOICE SATISFACTION?

The research contribution is the validation of a model of the effects of OPPFs on online consumers' CS via the intermediary influences of TSs, CE, and AE. As a result, this study contributes to the computer-mediated interactions literature in the online shopping context.

2.1 | Hypotheses development

Drawing on environmental psychology, the Stimulus-Organism-Response (SOR) framework is adopted to develop a proposed TSs-CS model for this study. The SOR framework suggests that the stimulus impacts the processing and perception of the organism, ultimately influencing the attitudinal and behavioral responses (Mehrabian & Russell, 1974). Silva et al. (2021) used the SOR framework in the online shopping context to show how information presentation impacts haptic imagery and, subsequently, behavioral responses. Haptic refers to "active use of hands to retrieve the attributes of an object stimulus, using both cutaneous and kinesthetic inputs" (James et al., 2007: 219). As shown in Figure 1, the OPPF is considered the stimulus (S), which is represented by three different format technologies: SI, video, and interactive ZI. TSs, CE, and AE of the consumer represent the organism (O), and CS is the response (R).

Applying the SOR framework, the model was developed to test the effect of different OPPFs upon internal consumer responses, specifically tactical sensation, CE, and affect. The model aims to extend the work of Mosteller et al. (2014) and Overmars and Poels's (2015) that examines the impact of TSs on CS.

2.2 | Stimuli: Online product display formats

Sensory marketing is concerned with generating sensory experiences through touch, sight, sound, smell, and taste (Schmitt, 1999). OPPFs are a substitute for the sensory experiences encountered at traditional bricks and mortar stores, where consumers can examine and evaluate products directly with their own senses (Kim & Forsythe, 2009).

It is suggested that visual OPPFs can offer e-shoppers both functional as well as a hedonic value. The perceived usefulness of visual OPPFs reflects their functionality, whereas enjoyment reflects the hedonic aspects of their utilization. Since visual OPPFs can provide product information that is similar to the information obtained from physical examination instore, they can lower the level of product risk (Kim & Forsythe, 2009). Product risk refers to the potential loss that a shopper may experience as a result of poor product performance and quality due to poor product choice (Forsythe & Shi, 2003). This occurs because the online consumer cannot physically touch the product to examine it and evaluate it before the purchase. Also, it was found that consumers with higher trust levels have higher online purchase intentions (Oliveira et al., 2017).

In a Wang et al. (2019) study, VR mode was used to present products online, which allowed participants to zoom in on, rotate and move the product. The results showed that situational VR (where the product is presented within a layout background) resulted in a higher level of purchase intentions and product knowledge than SIs, as well

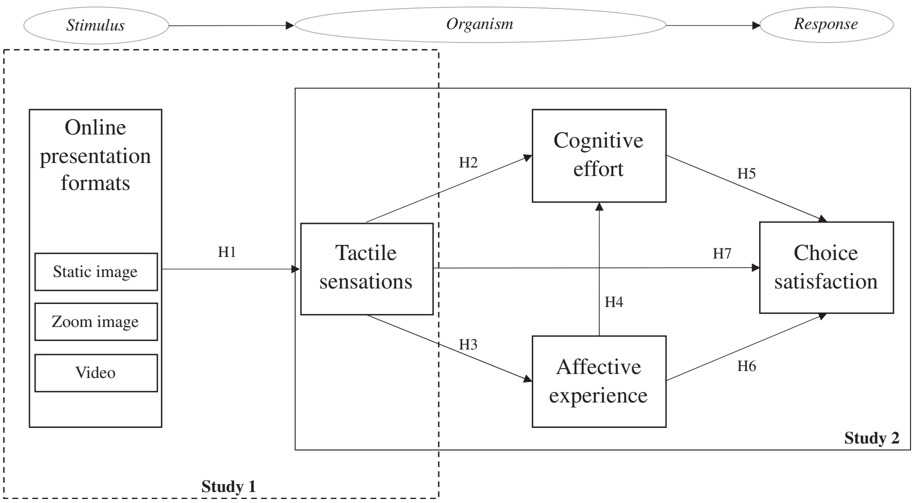


FIGURE 1 Tactile sensations-choice satisfaction conceptual model.

as higher mean values of purchase intentions and product knowledge than pure VR. Therefore, this shows that the presentation mode does affect consumers' responses. Kim and Forsythe (2009) found that utilizing OPPFs led to positive evaluations of such technologies and resulted in satisfactory outcomes. Løkke-Andersen et al. (2022) study also shows that presenting products using visual haptic information that is compatible with auditory haptic information can enhance the online shopping experience for high need-for-touch (NFT) consumers. Verhagen et al.'s (2014) study results show the superiority of the virtual mirror display of sunglasses compared to static pictures and 360-spin rotation in creating local presence of products, which refers to the sense that the product is being present with the online consumer. Further, the results also showed that product likability has a positive effect on online purchase intentions. Park et al. (2008) study results reveal that product rotation has an effective impact on the consumers' cognitive as well as affective responses. This is because the rotating online product presentation was found to offer additional product information compared with the nonrotating online product presentation. It has been found that the rotating online product presentation has a positive impact on consumers' affective states, as it simulates an enjoyable in-store experience compared to the nonrotating online product presentation. These consumer responses were found to have a positive influence on attitude and purchase intentions.

2.3 | Organism: Tactile sensations, cognitive effort, and affective experience

The organism is represented by consumers' TSs, CE (to represent the cognitive state), and AE (to represent the affective state). We propose that TSs are a key antecedent within the "organism" of the SOR framework. Prior research has found that consumers who rely heavily on product touch do prefer to make their purchase decisions through traditional offline stores, as a physical prepurchase touch is feasible (Citrin et al., 2003). Consumers' strongest reason for preferring to shop in traditional physical stores over online stores is the inability to touch products in the online context (Havas Worldwide, 2013). According to Flavián et al. (2016) when the tactile input is crucial for evaluating products, consumers prefer to touch the product themselves than relying on interpersonal sources including information generated by another consumer. However, according to Cano et al. (2017), touch screen technology can now complement the physical retail environment, as the study results show that image interactivity technology such as visual product rotation as well as touch fabric scrunch increased user engagement compared to the SI. Moreover, these technologies were found to be able to enhance the online shopping experience quality and satisfy the sensory need for touch in the online shopping context.

It is suggested that the brain may experience the mental simulation of touch without any actual tactile input (Ebisch et al., 2008). Overmars and Poels (2015) demonstrate that in online shopping, simulated TSs can be a crucial factor for understanding products. An interface that simulates stroking gestures through image interactivity was found to increase perceived diagnosticity of the experience attributes of a scarf as compared with an SI. Mediation analysis found that this impact is due to visually induced TSs. Therefore, it is important to explore whether such technologies can substitute for the missing tactile input through inducing TSs and, thereby, enhancing consumers' CS level. It has been found that a detailed as well as an effective close-up and zoom function of the fabric can be considered a crucial product presentation feature that online fashion retailers should adopt to help consumers' decision making in the online context (Boardman & Mccormick, 2019). De et al. (2013) reported that the increased use of ZI offers factual information, which is associated with fewer product returns. Detailed factual product-oriented information positively influences the consumer's product understanding, which results in more realistic prepurchase expectations (De et al., 2013). However, it is not clear whether this increased product understanding is due to aroused TSs. Li et al. (2002) similarly find that a ZI can improve presence and, to varying degrees, ultimately impact product knowledge, brand attitude, and consumers' buying intentions compared to an SI. Our model proposes that ZI can induce more TSs than an SI.

> **Hypothesis 1a.** An OPPF with a zoom image leads to greater tactile sensations than an OPPF with a static image.

Videos, compared to SIs, have been found to raise the excitement level concerning the shopping experience, as they improve how well-informed consumers are concerning the evaluated products (Li & Meshkova, 2013). Research has shown that a short video display that offers both the details of the product as well as the overall view of the product allows consumers to have high-quality perceptions of the product (Ma et al., 2020). Also, it has been found that video clips, displaying tactile assessments of the product, are suitable compensation for the lack of touch in the online context and even for consumers who have high NFT (Kühn et al., 2020). Additionally, existing literature has shown that product presentation videos have a positive impact on consumers' attitude toward the product due to the enhanced imagery and vividness of the product (Flavián et al., 2017). Therefore, it is proposed that a video can induce more TSs than an SI.

> **Hypothesis 1b.** An OPPF with video leads to greater tactile sensations than an OPPF with a static image.

Orús et al. (2017) using an experimental design and a survey, show that presenting products online through a video enhances consumers' imagination concerning the product and it also improves consumers' cognitive responses, as it boosts consumers' quality of product-related thoughts. Importantly they show that the ease of imagining the product is an antecedent of consumers' attitude toward the product and consumers' purchase intentions. Also, Jai et al.'s (2014) results demonstrate that a video displaying a model wearing a dress and rotating around can evoke more mental imagery of the product compared to a ZI that offers visual details of the dress. Therefore, it is proposed that a video can induce more TSs than a ZI.

> **Hypothesis 1c.** An OPPF with video leads to greater tactile sensations than an OPPF with a zoom image.

CE can be defined as the use of mental resources, collecting information, researching or investigating the alternatives, and the amount of time spent on a decision (Park & Hill, 2018). In retail contexts, tactile assessment of products is considered as a cognitive process. Experiments have shown that tactile input influences consumers' assessment through adding more information and providing clearer perceptions (Grohmann et al., 2007). According to Choi and Taylor (2014), it has been found that technologies can reduce negative cognitive reaction, such as effort, needed to make a decision. For instance, it has been revealed that images that are aided by interactive features so users can rotate, move, and zoom the product, offer clear product imagery. Clear product imagery was found to improve the message acceptance level by helping shoppers to develop cognitive representations that simulate direct experience with products, such as a product trial. It was found that this simulation can reduce adverse cognitive reactions, inducing strong affective reactions, and making experiences more realistic. Such cognitive representations can allow individuals to cognitively supply missing information through experiencing perceptual illusions, which are needed to make a decision (Choi & Taylor, 2014). Further, it has been found that a multisensory environment has a positive impact on consumers' cognitive responses. Research shows that augmented reality multisensory experience offers immediate feedback on how a furniture will fit into the physical setting. This feedback decreases the cognitive load of information processing as well as the associated purchase risks (Mishra et al., 2021). Therefore, it can be proposed that TSs induced from OPPFs have a negative effect upon consumers' CE (i.e., they reduce effort) during product selection.

> **Hypothesis 2.** Tactile sensations are negatively related to cognitive effort associated with completing the online shopping task.

According to Mano and Oliver (1993), consumers' affective responses to experiences can be conceptualized in terms of the arousal of positive and negative emotional responses as a result of a particular experiential episode. Based on Izogo and Jayawardhena (2018), the affective experiential states are related to the emotional feelings that result from consumers' engagement in the activity of online shopping.

This study will explore the effect of OPPF-induced TSs on consumers' AE. It has been found that the more interactive and vivid the OPPF, the better the AE of consumers. Further, AE has been found to have an impact on consumers' positive responses to products (Vonkeman et al., 2017). Vonkeman et al. (2017) demonstrated that the interactivity and vividness of the online presentation of products heightened participants' local presence perceptions. In turn, local presence was found to increase participants' AE of the product. Verhagen et al. (2014) study shows that shoppers' sense of local presence can be highly predictive of product likability (Verhagen et al., 2014).

Kühn et al. (2020) show that the need for touch has an adverse impact on consumers' affective responses and also that quality concerns partially mediate the need for touch and consumers' affective product evaluation relationship. This suggests that TSs can reduce consumers' quality concerns and need for touch, and thereby have a positive impact on consumers' affective responses. Therefore, it is proposed that there is a positive relationship between TSs induced from OPPFs and AE in relation to the online shopping task.

> **Hypothesis 3.** Tactile sensations are positively related to affective experience associated with completing the online shopping task.

It has been found that consumers' CE has an adverse impact on their level of satisfaction (Lee et al., 2019). Positive affect has been found to negatively influence CE during a shopping task (Mosteller et al., 2014). Positive affect attenuates shoppers' perceptions of time and effort needed to do the online shopping task (Wu et al., 2008). According to Schwarz (1990), positive affect makes individuals feel that they are in a satisfactory or safe place causing them to have a lower desire to engage in CE, and so they prefer to rely on simple heuristics instead of effortful strategies. On the other hand, negative affective states make individuals feel either a threat of negative outcomes or a lack of positive outcomes, and this makes them careful in evaluating the characteristics of a situation. Negative affective states are usually associated with a high willingness to engage in effortful strategies to find information that is relevant to the situation (Schwarz, 1990). Therefore, it can be proposed that there is a negative relationship between AE and CE (i.e., positive AE reduces CE).

Hypothesis 4. Affective experience is negatively related to cognitive effort associated with completing the online shopping task.

2.4 | Response: Choice satisfaction

It has been found that consumers' positive affect is positively related to their satisfaction (Lee et al., 2019). CS in this study refers to the confidence in, and satisfaction with, one's choice and selection, as well as perception of the quality of the choice based on provided criteria (Aksoy et al., 2006). It is normal for customers to assess their feelings concerning the decision they have made, as this is considered a part of the decision-making process (Guillet et al., 2020). Consumers evaluate and compare product attributes to enhance their chance of maximizing their satisfaction, given to money spent (Park & Hill, 2018). In this study, CS refers to the judgment and evaluation that consumers make about their decision immediately after choosing a product (rather than after using the product). The inclusion of CS as the outcome variable of the model is consistent with Mosteller et al. (2014). Further, Silva et al. (2021) study results demonstrate that there is a positive relationship between perceived product quality and purchase intentions. This suggests that a positive cognitive evaluation (perceived product quality) induces consumers' favorable responses. Mosteller et al. (2014) found that the perceived CE needed to complete the shopping task adversely affected CS. Thus, it is proposed that there is a negative relationship between CE and CS.

Hypothesis 5. Cognitive effort is negatively related to consumer's choice satisfaction.

A positive relationship has been found between positive affect and favorable consumer responses such as buying impulsively (Vonkeman et al., 2017). Further, it has been found that positive affect is positively related to CS. When pleasant feelings are associated with a particular choice, consumers attribute greater confidence in the decision (Mosteller et al., 2014). Therefore, it is proposed that there is a positive relationship between AE and CS.

Hypothesis 6. Affective experience is positively related to consumers' choice satisfaction.

Tactile imagery, conveyed through pictures, verbal haptic descriptions, and multimedia features, such as ZI and rotation, are positively related to quality perceptions (Ornati & Cantoni, 2020; Park, 2006, 2009; Rodrigues et al., 2017). Silva et al. (2021) found a positive link between haptic imagery and perceived product quality. This shows that higher haptic imagery allows online consumers to perceive the selected product more favorably. Kim et al. (2016) identify a number of antecedents of consumer satisfaction including sensory evaluation, cognitive evaluation, emotional evaluation, and well-being perception. Similarly, the sensory experience offered by the brand can affect customers' experiences with the brand, which in turn affects customers' satisfaction (Chahal & Dutta, 2015). In this study, it is proposed that TSs, induced by OPPFs, influence consumers' CE and AE that represent the customer experience while shopping online, which in turn can impact consumers' CS.

As a negative relationship exists between perceived mental effort and satisfaction, the more CE consumers need to exert in an online shopping task, the lower their CS (Mirhoseini et al., 2021). Although the cost of CE might not be tangibly calculated, it can affect the consumer's choice evaluation (Park & Hill, 2018). Evidence indicates that there is a clear price for exerting CE during an information search, as too much information searching increases CE, which may result in less than desirable feelings about the final product choice (Park et al., 2015). Therefore, it is proposed that CE can impact consumers' satisfaction with their choice.

AE has also been found to impact CS. Spassova and Isen (2013) found a positive relationship between levels of affect and levels of CS. Further, it has been observed that in the context of successful shopping, AE has a positive effect on positive word of mouth and customer satisfaction (Barari et al., 2020). Marinao-Artigas and Barajas-Portas (2020) found that shoppers' affective evaluations positively impacted trust and reputation of mobile commerce and shopper satisfaction. These previous studies show that AEs during online shopping have an effect on consumer satisfaction. Therefore, it is proposed that CE and AE mediate the relationship between TSs and CS.

Hypothesis 7. Cognitive effort and affective experience mediate the relationship between tactile sensations and choice satisfaction.

3 | MATERIALS AND METHODS

3.1 | Design and participants

The first stage in the study employed a between-subjects experimental design with three OPPFs: SI, video (V), and ZI manipulation conditions. Three simulation retail websites were created, where only

TABLE 1 Descriptive statistics.

Manipulation groups	N = 300	Online shopping frequency (less than once a month—More than 10 times a month)	Age (%)		Affective experience (SD)	Cognitive effort (SD)	Choice satisfaction (SD)	Tactile sensations (SD)
Static image	100	2.89 (0.994)	18–24 years	31%	3.59 (0.698)	1.84 (0.640)	3.95 (0.750)	2.59 (0.834)
			25–34 years	39%				
			35–44 years	30%				
Zoom format	0	3.01 (1.02)	18–24 years	35%	3.97 (0.603)	2.12 (0.897)	4.04 (0.668)	3.47 (0.808)
			25–34 years	21%				
			35–44 years	44%				
Video format	100	2.91 (1.036)	18–24 years	33%	3.84 (0.517)	1.77 (0.718)	4.01 (0.640)	3.09 (0.796)
			25–34 years	41%				
			35–44 years	26%				

product display formats differed. Participants were randomly assigned to only one of the websites with one specific OPPF. Participants viewed apparel—a selection of five jackets (see Appendix A for more detail on the manipulation conditions). All five jackets were female fashion jackets of the same color (black) and similar style and usage in order to avoid experimental confounds and to control for effects of other factors on the dependent variable.

Given the product (a female jacket), only female participants were invited to take part in the experiment. Women's jackets were selected because UK online apparel shopping is highest among female consumers. According to the UK's Office for National Statistics, in 2020, 62% of women bought clothing items online within the last 12 months compared to 49% of men, and more widely in the younger age groups across both genders (Sabanoglu, 2020).

3.2 | Procedure

Participants were recruited by Qualtrics during February 2021 an online recruitment panel, and invited to perform a simulated selection task followed by a postselection online questionnaire after giving their informed consent to participate in the experiment. Participants were directed to visit one of the three apparel simulated websites and using available functions (depending on the display format to which they had been assigned), select their most preferred jacket. To enhance experimental realism, participants could freely move between pages with different jacket products in order to make a choice. After viewing the products, participants needed to "add to bag" the preferred jacket and then click on "place order" to generate an order number. Respondents were asked to note the order number and insert it into the postselection questionnaire to verify the completion of the task. It is important to note that participants were informed that they were not required to make any payment due to the simulated nature of the task.

The total number of completed questionnaires was 486, but 186[1] responses were terminated due to manipulation check removals (please see section 3.3 for more detail). As a result, the model was tested with $n = 300$ of female online shoppers living in the UK whose ages ranged from 18 to 44, with equal split between manipulation conditions—see Table 1.

3.3 | Manipulation check and measures

Participants were asked a manipulation check question (Which jacket display did you view?) to identify the condition, they had experienced. This verified that participants were aware of the display format they had viewed on the website.

The TSs scale by Overmars and Poels (2015) was adapted and used. The construct was measured using 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.4 | Method and measures

The second stage in the study evaluates the effects of Organism on Response (H2–H7) with the use of structural equation modeling partial least squares (PLS-SEM), using SmartPLS 4 software (Ringle

TABLE 2 Measurement model.

	Descriptive statistics		Reliability estimates			Validity estimates			
Constructs	Mean	SD	Cronbach's alpha	rho_A	Composite reliability	AVE	HTMT		
Affective experience	3.8	0.63	0.877	0.88	0.916	0.731			
Cognitive effort	1.91	0.77	0.899	0.929	0.936	0.831	0.26		
Choice satisfaction	4	0.68	0.888	0.89	0.918	0.692	0.673	0.276	
Tactile sensations	3.05	0.89	0.86	0.861	0.905	0.705	0.602	0.103	0.366

et al., 2022). PLS-SEM is a nonparametric approach, which does not have distributional assumptions, provides robust analysis with small samples and allows for simultaneously estimating multiple interrelated dependence relationships (Hair et al., 2022). Importantly, PLS-SEM allows to account for the measurement error (unlike other methods like path analysis—Hair Jr et al., 2020), which is estimated within the measurement model analysis (see Stage 1 below). The application of PLS-SEM is comprehensive given it allows the analysis of factor loadings and other more traditional estimates in order to provide a robust model evaluation (Richter et al., 2023; Sarstedt et al., 2022; Sharma et al., 2023). Importantly, the collected data showed a few occurrences of nonnormal distribution, indicating a preference for the use of a nonparametric approach to testing the model (see Hair et al., 2019). Thus, it is deemed appropriate to apply PLS-SEM to test the proposed conceptual model.

Similar to stage 1, the TS scale was adapted from Overmars and Poels (2015). CE was measured using Mosteller et al.'s (2014) scale of CE in online shopping, and the AE scale was adapted from Chun et al. (2017). Finally, CS was measured as participants' satisfaction and confidence with the choice by Aksoy et al. (2006). All scales were measured on a 5-point Likert scale (Appendix B).

3.5 | Common method bias

To evaluate whether the collected sample suffered from common method bias, two statistical tests were performed. Harman's single factor test (Harman, 1976) (with unrotated solution) reveals that 23.96% of the total variance are extracted by one factor, which is below the recommended threshold of 50%. In addition, the Lindell and Whitney (2001) marker variable technique was performed, which shows no correlations between the marker and all other latent variables above the 0.3 threshold. Thus, we can conclude that the likelihood of common method bias in the collected data is low (see Appendix C).

4 | RESULTS

To examine the effects of antecedent conditions upon a dependent outcome variable, one-way ANOVAs were run (see Overmars & Poels, 2015; Silva et al., 2021) using SPSS 28. The results[2] show significant differences in TS when exposed to OPPFs: $F(2,297) = 29.980$, $p = .000$, $\eta^2 = 0.16$. Following the post hoc comparisons using the Tukey HSD test, we find that SI (M = 2.59, SD = 0.834) stimulates significantly lower TS compared to ZI (M = 3.09, SD = 0.796), $p = .000$. This finding supports H1a. Similarly, we find that SI triggers significantly lower TS compared to the video format (M = 3.48, SD = 0.808, $p = .000$). This provides support for H1b.

In addition, the post hoc test also revealed a significant difference in TS when comparing video (M = 3.48, SD = 0.808) to ZI (M = 3.09, SD = 0.796), $p = .003$, providing strong empirical support for H1c.

The model was subject to measurement and structural model evaluation (Hair et al., 2022). The results of the measurement model estimation demonstrate acceptable levels of both reliability (using indicator reliability, Cronbach's alpha, composite reliability and rho_A estimates) and validity (using average variance extracted and heterotrait-monotrait criterion) of all latent variables and their respective indicators (Hair et al., 2022)—see Table 2.

Using the bootstrapping procedure with 5000 subsample and percentile confidence interval method (Aguirre-Urreta & Rönkkö, 2018), the structural model was assessed. The analysis of the structural model revealed acceptable levels of predictive accuracy of the overall model with four path relationships significant (see Table 3). As such, the coefficient of determination for AE is $R^2 = 0.28$; for CE $R^2 = 0.06$; and for CS $R^2 = 0.37$.

Building on the recent developments related to the predictive capabilities of structural models (Shmueli et al., 2016), we applied PLSpredict to establish out-of-sample predictive power. The analysis is run with $k = 10$ folds and $r = 1$ repetitions and showed that the predictions Q^2 outperform the most naïve benchmark of 0 (Shmueli et al., 2019). Root mean square error was evaluated when comparing the PLS and linear regression model values, given the low level of distribution asymmetry (Shmueli et al., 2019). The results showed low predictive power for AE, medium predictive power for CS and no predictive power for CE (see Appendix D).

The above results show that there is no significant effect of TS on CE (ß = 0.094 n.s.), suggesting that H2 is not supported. On the other hand, we find that TS is positively related to AE (ß = 0.527***), thus supporting H3. H4 is also supported, given the path between AE to CE is found significant (ß = −0.290***). The results show significant effects of both CE and AE on CS (ß = 0.119***; ß = 0.557***), providing support for H5 and H6, respectively.

4.1 | Mediation analysis

When assessing a PLS-SEM model with two or more mediating variables, it is advised to test for multiple mediation, where both

TABLE 3 Structural model evaluation.

Path relationships	Path coefficient	t-value	p-value	Hypothesis	Support
Tactile sensations > Cognitive effort	0.094	1.409	.159	H2	No
Tactile sensations > Affective experience	0.527	11.372	0	H3	Yes
Affective experience > Cognitive effort	−0.290	4.447	0	H4	Yes
Cognitive effort > Choice satisfaction	−0.119	2.871	.004	H5	Yes
Affective > Choice satisfaction	0.557	8.325	0	H6	Yes
Tactile sensations > Choice satisfaction	0.024	0.378	.705	H7	Partial

TABLE 4 Mediation analysis.

Constructs	Direct effect	Specific effect: Via affective experience	Specific effect: Via cognitive effort	Total indirect effect	Total effect
Tactile sensations → Choice satisfaction	0.024 ($p = .706$)	0.294 ($p = .000$)	−0.011 ($p = .244$)	0.301 ($p = .000$)	0.324 ($p = .000$)

mediators are included in the model simultaneously (Hair et al., 2022). The considered mediators are significantly correlated ($r = 0.232$, $p < .001$) thus, the calculation of the indirect effects in a traditional mediation analysis would not be accurate owing to the omission of other, potentially more influential mediators (Hair et al., 2022). Multiple mediation analysis requires an evaluation of direct effects, specific indirect effects, and total indirect effects (see Table 4). The results show that the relationship between TS and CS is only mediated via AE, providing a partial support for H7.

5 | DISCUSSION

5.1 | Theoretical implications

We now discuss five key findings from the two stages of data analysis and their implications for theory. First, OPPFs of ZI and video did allow our shoppers to experience greater TSs than merely looking at an SI suggesting that these technologies enabled better understanding of the jacket fabrics. Therefore, H1a is supported, but this result contradicts with Boardman and McCormick (2019) findings that showed that the most influential product presentation feature is the SI of the models, as it attracted the most attention. However, they did not test for the differential effect of both the static as well as the ZI on the experienced TSs. H1a result supports that ZI allows for experiencing higher TSs compared to the SI, which is consistent with the results of Tabaeeian et al. (2023) showing interactivity as a crucial dimension in e-retailing.

Further, results supporting H1b and H1c are consistent with Li and Meshkova's (2013), and Jai et al. (2014) findings that highlight the effectiveness of the videos compared to the static and ZIs. H1a and H1b results are also consistent with Tabaeeian et al. (2023) results that illustrate the importance of visual appeal and innovation in e-retailing. Second, findings demonstrate that the more TSs consumers experience while shopping online, the higher their emotional experience, which results in lower CE. We conclude that TSs can lower consumers' CE while shopping online through AE. However, the results of the data analysis reveal no significant direct effect of TSs on CE. On the contrary, other studies' findings support H2 that there is a negative relationship between TSs and CE. For instance, Park et al. (2015) study suggests that the descriptions of touch information can be useful for consumers who are not willing to exert CE while they are shopping online. Additionally, TSs were found to allow product attributes to be accessible through the sense of touch so that understanding the product attributes mentally demands less effort (Klein, 2003; Li et al., 2001). However, the simulated nature of the task (with no risk) may have affected this result as respondents may not have exerted as much CE as in a real purchase.

Third, the finding that TSs have a significant positive effect on AE during online shopping task had not previously been empirically confirmed, supporting H3, and so this result provides a contribution to knowledge regarding this relationship. This aligns with the Verhagen et al. (2014) study which linked OPPF, local presence and liking the product. Further, we demonstrate that there is a significant negative effect of AE on CE, suggesting that the greater the positive AE of the online shopping task, the lower the CE exerted to complete the online shopping task, supporting H4. This is consistent with existing literature (Lee et al., 2019; Mosteller et al., 2014; Wu et al., 2008).

Fourth, the results show that CE has a significant negative effect on CS, supporting H5. This suggests that the higher the shopper's CE when buying online, the lower their satisfaction with the final choice. This is because feelings of uncertainty about making a good choice are usually associated with high CE when the decision is difficult (Mosteller et al., 2014). Additionally, the data analysis illustrates that there is a significant positive effect of AE on CS, thus supporting H6. This suggests that the more likeable and enjoyable the online shopping task, the more satisfied shoppers are with their selected choice. We conclude that positive feelings (e.g., feeling happy or confident) while shopping can lead to satisfaction with the selected choice. Both findings are consistent with the results of Mosteller et al. (2014) and Lee et al. (2019). H6 finding is also consistent with Tabaeeian et al. (2023) results that considered emotional appeal as an important dimension in the e-retailing industry. Further, both H5 and H6 findings reflect the importance of the customer experience, which is consistent with Shafiee and Bazargan (2018) whose results showed that website performance as well as information security have positive implications, as they directly influence quality perceptions. Further, the results align with Shafiee and Es-haghi (2017), whose study in a mall context illustrated that consumers' shopping well-being has a positive effect on loyalty. Therefore, both studies showed that shopping well-being can lead to positive consumers' responses.

Finally, our findings do not support H7 that TSs are directly affecting CS, but rather find a significant indirect effect on CS through AE. This suggests that the more TSs the consumer experiences while shopping online, the greater their positive AE toward the online shopping task, which results in higher levels of CS. This indirect positive effect of TSs on CS through AE only is consistent with Silva et al. (2021) who identified that haptic imagery positively influenced perceived product quality. Higher experience of haptic imagery allowed online shoppers to perceive the selected product more favorably, concluding that TSs have a positive effect on CS. Again, the simulated nature of our study may have influenced the direct effect of TSs on CS due to lack of a real purchase.

In summary, the research offers meaningful contributions to the literature on sensory marketing, digital marketing, emergent online product display technologies, and media richness. It supports the theoretical position that sensory information in the online shopping context is important to purchase (Verhagen et al., 2014). The study shows that sensory marketing is crucial for strengthening and enhancing the online customer experience. Further, it extends experiential marketing theory and specifically sensory marketing in online shopping (Overmars & Poels, 2015) and supports the importance of making online shopping more tangible. The results extend our theoretical understanding of the relationship between TSs and CS. Our study extends the literature on how to compensate consumers for the lack of touch in the online shopping context and the impact of OPPF technologies on CS (Mosteller et al., 2014; Overmars & Poels, 2015). It provides new findings on how TSs impact CE and the theoretical linkage between TSs and AE.

5.2 | Managerial implications

The managerial implications of the results provide online clothing retailers with evidence of the benefits of employing OPPF technologies, such as videos and ZIs, to display products that have touch-related experience attributes online. This may be particularly useful to the small to medium sized online retailers who cannot invest in newly emerging SETs such as VR. The study demonstrates that these OPPFs can allow consumers to experience greater TSs compared to the SI allowing shoppers to examine product texture better when online. Such technologies can be used by online apparel retailers to compensate consumers for the unfeasible physical touch prior to purchase. This study helps online apparel retailers to understand that OPPF technologies not only help consumers make online decisions, but also that this will impact their satisfaction with their choices.

Finally, this study highlights to online apparel retailers the importance of OPPF technologies in improving the online customer experience, as these technologies can improve AEs of consumers while shopping online. Therefore, online retailers that aim to enhance online customer experience and offer consumers an optimal product selection experience should consider adopting new OPPF technologies such as videos and ZIs.

5.3 | Limitations and future research

One of the research limitations is the sample of this research study, as it was sourced from female online shoppers in the UK aged 18–44 given the type of product used (female jacket). Further, the research tested the effect of only three OPPFs on TSs. Another limitation for this study is that due to the COVID-19 pandemic, participants took part in the online purchase task and filled in the online questionnaire remotely rather than within a physical laboratory setting which would have allowed for direct observation of the participants while they were conducting the online selection task.

Future research could further explore drivers of CS not included here such as price, impulsive purchasing or technological awareness and so widen the scope of the model. As further technology advances arrive, future research could test the model using other OPPFs. Finally, research could widen the age range and/or gender of the participants, to examine demographic interactions with OPPFs.

AUTHOR CONTRIBUTIONS

Aya Shaban: study design, literature review, methodology, questionnaire design, data collection, statistical analysis, interpretation of data, co-wrote the manuscript. **Anastasiya Saraeva**: methodology, statistical analysis, co-wrote the manuscript. **Susan Rose**: conceived the idea for the paper; supported the theoretical and experimental design. co-wrote the manuscript. **Moira Clark:** conceived the idea. supported the theoretical and experimental design, co-wrote the manuscript. All authors reviewed the manuscript.

ACKNOWLEDGMENTS

This study has been partially funded by Henley Centre for Customer Management at Henley Business School, University of Reading, UK. The authors want to thank Henley Centre for Customer Management for supporting this study.

CONFLICT OF INTEREST STATEMENT

The authors declare no potential conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Aya Shaban https://orcid.org/0000-0002-0117-1528

ENDNOTES

[1] The excluded cases were caused, by the nature of the online setting, the complexity of the experiment (noting the order number and inserting it into the survey) might have appeared complex to participants causing dropouts.

[2] The Welch and Brown-Forsythe tests show that the homogeneity of variance in the groups of comparison is not significant, suggesting that group comparison is possible, as the $p < .05$ in the tactile sensations for the three groups: $p = .000$.

REFERENCES

Aguirre-Urreta, M. I., & Rönkkö, M. (2018). Statistical inference with PLSc using bootstrap confidence intervals. *MIS Quarterly*, *42*(3), 1001–1020. https://doi.org/10.25300/misq/2018/13587

Aksoy, L., Bloom, P. N., Lurie, N. H., & Cooil, B. (2006). Should recommendation agents think like people? *Journal of Service Research*, *8*(4), 297–315. doi:10.1177/1094670506286326

Alhaimer, R. (2022). Fluctuating attitudes and behaviors of customers toward online shopping in times of emergency: The case of Kuwait during the COVID-19 pandemic. *Journal of Internet Commerce*, *21*(1), 26–50.

American Eagle. (2022). Men's & Women's jeans. *Clothes*. https://www.ae.com/intl/en

Aryani, D. N., Nair, R. K., Hoo, D. X. Y., Hung, D. K. M., Lim, D. H. R., Chew, W. P., & Desai, A. (2021). A study on consumer behaviour: Transition from traditional shopping to online shopping during the Covid-19 pandemic. *International Journal of Applied Business and International Management (IJABIM)*, *6*(2), 81–95.

ASOS. (2022). Online shopping for the latest clothes and fashion. https://www.asos.com/

Barari, M., Ross, M., & Surachartkumtonkun, J. (2020). Negative and positive customer shopping experience in an online context. *Journal of Retailing and Consumer Services*, *53*, 101985. doi:10.1016/j.jretconser.2019.101985

Bhatti, A., & Rehman, S. U. (2019). Perceived benefits and perceived risks effect on online shopping behavior with the mediating role of consumer purchase intention in Pakistan. *International Journal of Management Studies*, *26*(1), 33-54.

Boardman, R., & Mccormick, H. (2019). The impact of product presentation on decision-making and purchasing. *Qualitative Market Research: An International Journal*, *22*(3), 365–380.

Cano, M. B., Perry, P., Ashman, R., & Waite, K. (2017). The influence of image interactivity upon user engagement when using mobile touch screens. *Computers in Human Behavior*, *77*, 406–412.

Chahal, H., & Dutta, K. (2015). Measurement and impact of customer experience in banking sector. *Decision*, *42*(1), 57–70. doi:10.1007/s40622-014-0069-6

Chang, M., Cheung, W., & Lai, V. (2005). Literature derived reference models for the adoption of online shopping. *Information & Management*, *42*(4), 543–559. doi:10.1016/s0378-7206(04)00051-5

Choi, Y. K., & Taylor, C. R. (2014). How do 3-dimensional images promote products on the Internet? *Journal of Business Research*, *67*(10), 2164–2170. doi:10.1016/j.jbusres.2014.04.026

Chun, H. H., Diehl, K., & MacInnis, D. J. (2017). Savoring an upcoming experience affects ongoing and remembered consumption enjoyment. *Journal of Marketing*, *81*(3), 96–110. doi:10.1509/jm.15.0267

Citrin, A. V., Stem, D. E., Spangenberg, E. R., & Clark, M. J. (2003). Consumer need for tactile input. *Journal of Business Research*, *56*(11), 915–922. doi:10.1016/s0148-2963(01)00278-8

Dastane, D. O., Bin Md Jalal, M. I., & Selvaraj, K. (2018). Assessment of extended ES-qual model in an M-commerce setting. *International Journal of Management, Accounting and Economics*, *5*(12), 923–954.

De, P., Hu, Y. J., & Rahman, M. S. (2013). Product-oriented web technologies and product returns: An exploratory study. *Information Systems Research*, *24*(4), 998–1010. doi:10.1287/isre.2013.0487

Diaz-Gutierrez, J. M., Mohammadi-Mavi, H., & Ranjbari, A. (2023). COVID-19 impacts on online and in-store shopping behaviors: Why they happened and whether they will last post pandemic. *Transportation Research Record*, 03611981231155169.

Ebisch, S. J. H., Perrucci, M. G., Ferretti, A., del Gratta, C., Romani, G. L., & Gallese, V. (2008). The sense of touch: Embodied simulation in a visuotactile mirroring mechanism for observed animate or inanimate touch. *Journal of Cognitive Neuroscience*, *20*(9), 1611–1623. doi:10.1162/jocn.2008.20111

Flavián, C., Gurrea, R., & Orús, C. (2016). Choice confidence in the webrooming purchase process: The impact of online positive reviews and the motivation to touch. *Journal of Consumer Behaviour*, *15*(5), 459–476.

Flavián, C., Gurrea, R., & Orús, C. (2017). The influence of online product presentation videos on persuasion and purchase channel preference: The role of imagery fluency and need for touch. *Telematics and Informatics*, *34*(8), 1544–1556. https://doi.org/10.1016/j.tele.2017.07.002

Forsythe, S. M., & Shi, B. (2003). Consumer patronage and risk perceptions in internet shopping. *Journal of Business Research*, *56*(11), 867–875. doi:10.1016/s0148-2963(01)00273-9

Garg, M., Bansal, A., & Single, K. (2021). Impacts of digital marketing on consumer decision making. *International Journal for Scientific Research & Development*, *8*(3), 213–218.

Gazali, A. V., & Suyasa, P. T. Y. (2020, May). The role of the perceived risk to purchase decision (for consumers who use online shopping technology). In *Tarumanagara international conference on the applications of social sciences and humanities (TICASH 2019)* (pp. 375–379). Atlantis Press.

Goss, T. J. (2005). *Building a contingency menu: Using capabilities-based planning for homeland defense and homeland security*. Doctoral dissertation, Monterey, CA. Naval Postgraduate School.

Grohmann, B., Spangenberg, E. R., & Sprott, D. E. (2007). The influence of tactile input on the evaluation of retail product offerings. *Journal of Retailing*, *83*(2), 237–245. doi:10.1016/j.jretai.2006.09.001

Guillet, B. D., Mattila, A., & Gao, L. (2020). The effects of choice set size and information filtering mechanisms on online hotel booking. *International Journal of Hospitality Management*, *87*, 102379.

Gupta, S., Leszkiewicz, A., Kumar, V., Bijmolt, T., & Potapov, D. (2020). Digital analytics: Modeling for insights and new methods. *Journal of Interactive Marketing*, *51*(1), 26–43.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24.

Hair, J. F., Jr., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110.

Hansen, T., Møller Jensen, J., & Stubbe Solgaard, H. (2004). Predicting online grocery buying intention: A comparison of the theory of reasoned action and the theory of planned behavior. *International Journal of Information Management*, *24*(6), 539–550. doi:10.1016/j.ijinfomgt.2004.08.004

Harman, H. H. (1976). *Modern factor analysis* (3rd ed, Revised ed.). University of Chicago Press.

Havas Worldwide (2013). Digital and the new consumer: Emerging paths to purchase. http://theprblog.co.uk/mobile-shopping-consumer-habit/#.U58jWY1dXfV

Izogo, E. E., & Jayawardhena, C. (2018). Online shopping experience in an emerging e-retailing market: Towards a conceptual model. *Journal of Consumer Behaviour*, *17*(4), 379–392.

Jai, T. M. C., O'Boyle, M. W., & Fang, D. (2014). Neural correlates of sensory-enabling presentation: An fMRI study of image zooming and rotation video effects on online apparel shopping. *Journal of Consumer Behaviour*, *13*(5), 342–350. doi:10.1002/cb.1476

James, T. W., Kim, S., & Fisher, J. S. (2007). The neural basis of haptic object processing. *Canadian Journal of Experimental Psychology/Revue Canadienne de Psychologie Expérimentale*, *61*(3), 219–229. doi:10.1037/cjep2007023

Jiang, L. A., Yang, Z., & Jun, M. (2013). Measuring consumer perceptions of online shopping convenience. *Journal of Service Management*, *24*(2), 191–214.

Kim, H. C., Chua, B. L., Lee, S., Boo, H. C., & Han, H. (2016). Understanding airline travelers' perceptions of well-being: The role of cognition, emotion, and sensory experiences in airline lounges. *Journal of Travel & Tourism Marketing*, *33*(9), 1213–1234.

Kim, J., & Forsythe, S. (2009). Adoption of sensory enabling technology for online apparel shopping. *European Journal of Marketing*, *43*(9/10), 1101–1120. doi:10.1108/03090560910976384

Klein, L. R. (2003). Creating virtual product experiences: The role of telepresence. *Journal of Interactive Marketing*, *17*(1), 41–55. doi:10.1002/dir.10046

Kühn, F., Lichters, M., & Krey, N. (2020). The touchy issue of produce: Need for touch in online grocery retailing. *Journal of Business Research*, *117*, 244–255. doi:10.1016/j.jbusres.2020.05.017

Kumar, V. (2021). *Intelligent marketing: Employing new-age technologies*. Sage Publications Pvt. Limited.

Le, H. T., Carrel, A. L., & Shah, H. (2022). Impacts of online shopping on travel demand: A systematic review. *Transport Reviews*, *42*(3), 273–295.

Lee, M., Lee, S., & Koh, Y. (2019). Multisensory experience for enhancing hotel guest experience: Empirical evidence from big data analytics. *International Journal of Contemporary Hospitality Management*, *31*(11), 4313–4337.

Li, H., Daugherty, T., & Biocca, F. (2001). Characteristics of virtual experience in electronic commerce: A protocol analysis. *Journal of Interactive Marketing*, *15*(3), 13–30. https://doi.org/10.1002/dir.1013

Li, H., Daugherty, T., & Biocca, F. (2002). Impact of 3-D advertising on product knowledge, brand attitude, and purchase intention: The mediating role of presence. *Journal of Advertising*, *31*(3), 43–57. doi:10.1080/00913367.2002.10673675

Li, T., & Meshkova, Z. (2013). Examining the impact of rich media on consumer willingness to pay in online stores. *Electronic Commerce Research and Applications*, *12*(6), 449–461. doi:10.1016/j.elerap.2013.07.001

Lindell, M. K., & Whitney, D. J. (2001). Accounting for common method variance in cross-sectional research designs. *Journal of Applied Psychology*, *86*(1), 114–121. doi:10.1037/0021-9010.86.1.114

Løkke-Andersen, C. B., Wang, Q. J., & Giacalone, D. (2022). User experience design approaches for accommodating high "need for touch" consumers in ecommerce. *Journal of Sensory Studies*, *37*(2), e12727.

Ma, R., Shao, B., Chen, J., & Dai, D. (2020). The impacts of online clothes short video display on consumers' perceived quality. *Information*, *11*(2), 87.

Mano, H., & Oliver, R. L. (1993). Assessing the dimensionality and structure of the consumption experience: Evaluation, feeling, and satisfaction. *Journal of Consumer Research*, *20*(3), 451. doi:10.1086/209361

Marinao-Artigas, E., & Barajas-Portas, K. (2020). Precedents of the satisfaction of mobile shoppers. a cross-country analysis. *Electronic Commerce Research and Applications*, *39*, 100919. doi:10.1016/j.elerap.2019.100919

Mehrabian, A., & Russell, J. A. (1974). *An approach to environmental psychology*. MIT Press.

Mirhoseini, M., Pagé, S. A., Léger, P. M., & Sénécal, S. (2021). What deters online grocery shopping? Investigating the effect of arithmetic complexity and product type on user satisfaction. *Journal of Theoretical and Applied Electronic Commerce Research*, *16*(4), 828–845. doi:10.3390/jtaer16040047

Mishra, A., Shukla, A., Rana, N. P., & Dwivedi, Y. K. (2021). From "touch" to a "multisensory" experience: The impact of technology interface and product type on consumer responses. *Psychology & Marketing*, *38*(3), 385–396.

Mosteller, J., Donthu, N., & Eroglu, S. (2014). The fluent online shopping experience. *Journal of Business Research*, *67*(11), 2486–2493. doi:10.1016/j.jbusres.2014.03.009

Oliveira, T., Alhinho, M., Rita, P., & Dhillon, G. (2017). Modelling and testing consumer trust dimensions in e-commerce. *Computers in Human Behavior*, *71*, 153–164.

Ornati, M., & Cantoni, L. (2020). FashionTouch in E-commerce: An exploratory study of surface haptic interaction experiences. In *International conference on human-computer interaction* (pp. 493–503). Springer.

Orús, C., Gurrea, R., & Flavián, C. (2017). Facilitating imaginations through online product presentation videos: Effects on imagery fluency, product attitude and purchase intention. *Electronic Commerce Research*, *17*(4), 661–700. doi:10.1007/s10660-016-9250-7

Overmars, S., & Poels, K. (2015). Online product experiences: The effect of simulating stroking gestures on product understanding and the critical role of user control. *Computers in Human Behavior*, *51*, 272–284. doi:10.1016/j.chb.2015.04.033

Park, J., & Hill, W. T. (2018). Exploring the role of justification and cognitive effort exertion on post-purchase regret in online shopping. *Computers in Human Behavior*, *83*, 235–242. doi:10.1016/j.chb.2018.01.036

Park, J., Hill, W. T., & Bonds-Raacke, J. (2015). Exploring the relationship between cognitive effort exertion and regret in online vs. offline shopping. *Computers in Human Behavior*, *49*, 444–450.

Park, J., Stoel, L., & Lennon, S. J. (2008). Cognitive, affective and conative responses to visual simulation: The effects of rotation in online product presentation. *Journal of Consumer Behaviour*, *7*(1), 72–87.

Park, M. (2006). *The compensatory effects of pictorial and verbal information for haptic information on consumer responses in non-store shopping environments*. The Ohio State University.

Park, M. J. (2009). Online product information and visual imagery: Effects on mood and perceived product quality. *Journal of the Korean Home Economics Association*, *47*(5), 23–34.

Pino, G., Amatulli, C., Nataraajan, R., de Angelis, M., Peluso, A. M., & Guido, G. (2020). Product touch in the real and digital world: How do consumers react? *Journal of Business Research*, *112*, 492–501. doi:10.1016/j.jbusres.2019.10.002

Rajini, G., & Krithika, M. (2016). Online purchase: Risk cognizance influencing intention. *Indian Journal of Science and Technology*, *9*(32), 1–4.

Richter, N. F., Hauff, S., Ringle, C. M., Sarstedt, M., Kolev, A. E., & Schubring, S. (2023). How to apply necessary condition analysis in PLS-SEM. In *Partial least squares path modeling: Basic concepts, methodological issues and applications* (pp. 267–297). Springer International Publishing.

Ringle, C. M., Wende, S., & Becker, J.-M. (2022). *SmartPLS 4*. SmartPLS GmbH http://www.smartpls.com

Rodrigues, T., Silva, S. C., & Duarte, P. (2017). The value of textual haptic information in online clothing shopping. *Journal of Fashion Marketing and Management*, *21*(1), 88–102. doi:10.1108/jfmm-02-2016-0018

Sabanoglu, T. (2020). Share of individuals who purchased clothes (including sports clothing), shoes and accessories online in Great Britain in 2020, by age and gender. https://www-statista-com.eu1.proxy.openathens.net/statistics/286096/clothes-and-sports-goods-online-purchasing-in-great-britain-by-demographic/

Sahney, S., Ghosh, K., & Shrivastava, A. (2013). "Buyer's motivation" for online buying: An empirical case of railway e-ticketing in Indian context. *Journal of Asia Business Studies*, *8*(1), 43–64.

Saprikis, V., Chouliara, A., & Vlachopoulou, M. (2010). Perceptions towards online shopping: Analyzing the Greek university students' attitude. *Communications of the IBIMA*, *10*.

Sarstedt, M., Hair, J. F., & Ringle, C. M. (2022). "PLS-SEM: Indeed a silver bullet"–retrospective observations and recent advances. *Journal of Marketing Theory and Practice*, *39*(5), 1–15.

Schmitt, B. (1999). Experiential marketing. *Journal of Marketing Management*, *15*(1–3), 53–67. https://doi.org/10.1362/026725799784870496

Schwarz, N. (1990). *Feelings as information: Informational and motivational functions of affective states*. The Guilford Press.

Shafiee, M. M., & Bazargan, N. A. (2018). Behavioral customer loyalty in online shopping: The role of e-service quality and e-recovery. *Journal of Theoretical and Applied Electronic Commerce Research*, *13*(1), 26–38.

Shafiee, M. M., Bazargan, N. A., & Kazeminia, A. (2017). Modeling customer electronic trust in online stores: A risk reduction approach. *Communities*, *1*, 2.

Shafiee, M. M., & Es-Haghi, S. M. S. (2017). Mall image, shopping well-being and mall loyalty. *International Journal of Retail & Distribution Management*, *45*(10), 1114–1134.

Sharma, P. N., Liengaard, B. D., Sarstedt, M., Hair, J. F., & Ringle, C. M. (2023). Extraordinary claims require extraordinary evidence: A comment on "Recent Developments in PLS". *Communications of the Association for Information Systems*, *52*(1), 739–742.

Sheth, J. (2020). Impact of Covid-19 on consumer behavior: Will the old habits return or die? *Journal of Business Research*, *117*, 280–283.

Shmueli, G., Ray, S., Velasquez Estrada, J. M., & Chatla, S. B. (2016). The elephant in the room: Predictive performance of PLS models. *Journal of Business Research*, *69*(10), 4552–4564. https://doi.org/10.1016/j.jbusres.2016.03.049

Shmueli, G., Sarstedt, M., Hair, J. F., Cheah, J. H., Ting, H., Vaithilingam, S., & Ringle, C. M. (2019). Predictive model assessment in PLS-SEM: Guidelines for using PLSpredict. *European Journal of Marketing*, *53*(11), 2322–2347. https://doi.org/10.1108/ejm-02-2019-0189

Silva, S. C., Rocha, T. V., de Cicco, R., Galhanone, R. F., & Manzini Ferreira Mattos, L. T. (2021). Need for touch and haptic imagery: An investigation in online fashion shopping. *Journal of Retailing and Consumer Services*, *59*(102), 378. https://doi.org/10.1016/j.jretconser.2020.102378

Singh, K., & Basu, R. (2023). Online consumer shopping behaviour: A review and research agenda. *International Journal of Consumer Studies*, *47*(3), 815–851.

Spassova, G., & Isen, A. M. (2013). Positive affect moderates the impact of assortment size on choice satisfaction. *Journal of Retailing*, *89*(4), 397–408. https://doi.org/10.1016/j.jretai.2013.05.003

Tabaeeian, R. A., Mohammad Shafiee, M., & Ansari, A. (2023). Developing a scale for gamified e-service quality in the e-retailing industry. *International Journal of Retail & Distribution Management*, *51*(4), 444–464.

Taher, G. (2021). E-commerce: Advantages and limitations. *International Journal of Academic Research in Accounting Finance and Management Sciences*, *11*(1), 153–165.

Tandon, U. (2023). Chatbots, virtual-try-on (VTO), e-WOM: Modeling the determinants of attitude'and continued intention with PEEIM as moderator in online shopping. *Global Knowledge, Memory and Communication*, 2514-9342.

Truong, D., & Truong, M. D. (2022). How do customers change their purchasing behaviors during the COVID-19 pandemic? *Journal of Retailing and Consumer Services*, *67*, 102963.

Verhagen, T., Vonkeman, C., Feldberg, F., & Verhagen, P. (2014). Present it like it is here: Creating local presence to improve online product experiences. *Computers in Human Behavior*, *39*, 270–280. https://doi.org/10.1016/j.chb.2014.07.036

Vonkeman, C., Verhagen, T., & van Dolen, W. (2017). Role of local presence in online impulse buying. *Information & Management*, *54*(8), 1038–1048. https://doi.org/10.1016/j.im.2017.02.008

Wang, Y. S., Yeh, C. H., Wang, Y. M., Tseng, T. H., Lin, H. H., Lin, S., & Xie, M. Q. (2019). Investigating online consumers' responses to product presentation modes: Does product type really matter? *Internet Research*, *29*(6), 1233–1255.

Wong, S. W., Dastane, O., Safie, N., & Maarif, Y. (2019). What WeChat can learn from WhatsApp? Customer value proposition development for mobile social networking apps: A case study approach. *Journal of Theoretical and Applied Information Technology*, *97*(4), 1091–1117.

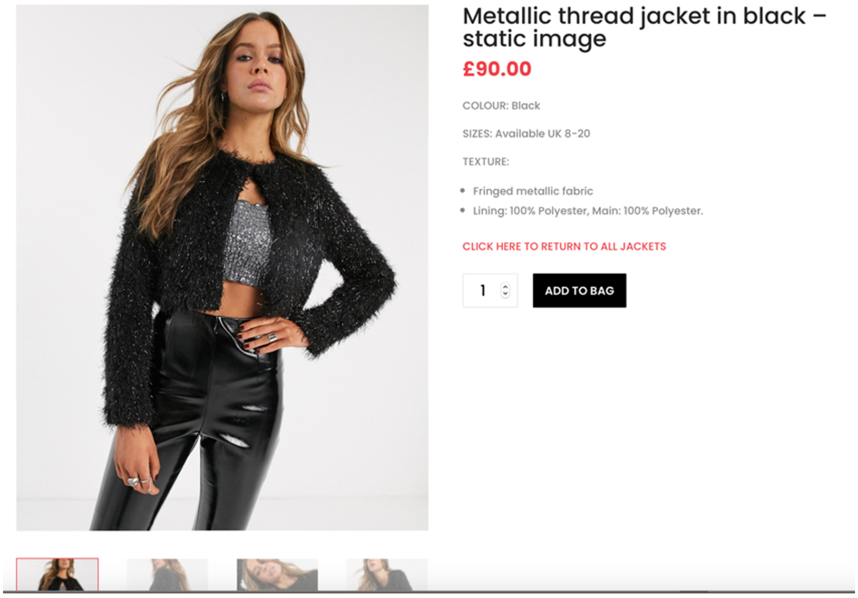
Wu, C. S., Cheng, F. F., & Yen, D. C. (2008). The atmospheric factors of online storefront environment design: An empirical experiment in Taiwan. *Information & Management*, *45*(7), 493–498. https://doi.org/10.1016/j.im.2008.07.004

Young, M., Soza-Parra, J., & Circella, G. (2022). The increase in online shopping during COVID-19: Who is responsible, will it last, and what does it mean for cities? *Regional Science Policy & Practice*, *14*, 162–178.

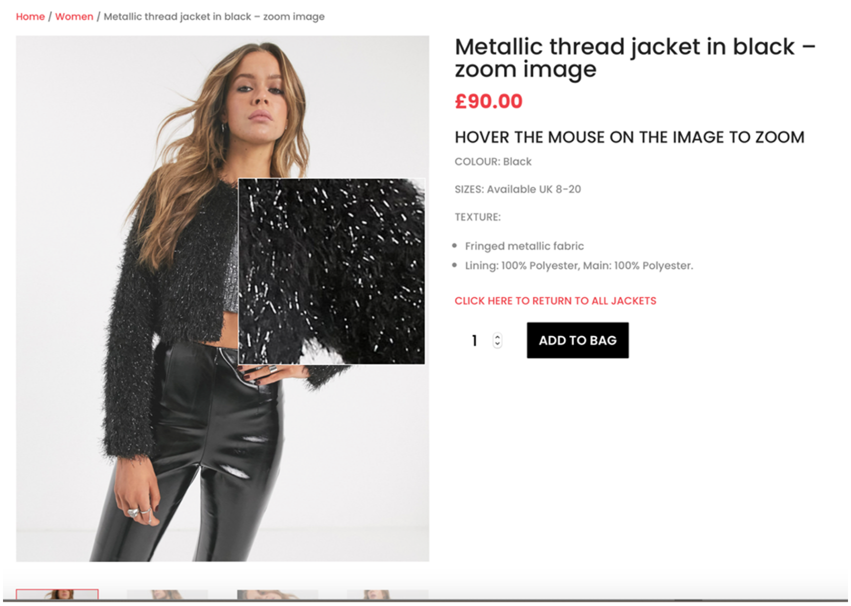
Zhang, J. Z., Chang, C. W., & Neslin, S. A. (2021). How physical stores enhance customer value: The importance of product inspection depth. *Journal of Marketing*, *86*(2), 166–185. https://doi.org/10.1177/00222429211012106

How to cite this article: Shaban, A., Saraeva, A., Rose, S., & Clark, M. (2024). The invisible hand of touch: Testing a tactile sensation-choice satisfaction model in online shopping. *Journal of Sensory Studies*, *39*(1), e12897. https://doi.org/10.1111/joss.12897

APPENDIX A: EXAMPLES OF THE THREE ONLINE PRODUCT DISPLAY FORMATS USED IN THE STUDY

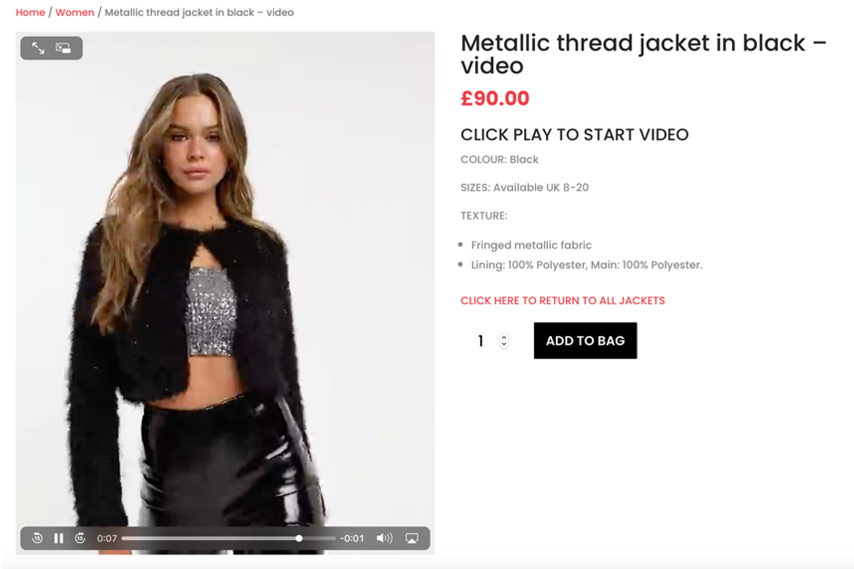


Static image https://shop.otiscreative.co.uk/?page_id=3295



Zoom image: https://shop.otiscreative.co.uk/?page_id=3291

Journal of Sensory Studies



Video https://shop.otiscreative.co.uk/?page_id=3302

APPENDIX B: CONSTRUCT MEASURES

Tactile sensations		**Overmars and Poels (2015)**
TS1	When evaluating the jackets, I felt that I could examine the textures of them	
TS2	When evaluating the jackets, I could imagine moving my fingers on them	
TS3	When evaluating the jackets, I felt as if they were in my hands	
TS4	When evaluating the jackets, I felt as though I could hold them	
Cognitive effort		Mosteller et al., 2014
CE1	It took too much time	
CE2	It required too much effort	
CE3	It was too complex	
Affective experience		Chun et al. (2017)
AE1	To what extent was your jacket selection experience enjoyable	
AE2	To what extent was your jacket selection experience fun	
AE3	To what extent was your jacket selection experience good	
AE4	To what extent you liked your jacket selection experience	
Choice satisfaction		Aksoy et al. (2006)
CS1	How satisfied are you with the choice that you have made?	
CS2	How confident are you with the choice that you have made?	
CS3	Please indicate your interest in the jacket you chose	
CS4	How well do you think that the jacket you chose fits your preferences?	
CS5	How much do you think you would like the jacket you chose?	

APPENDIX C: COMMON METHOD BIAS

	1	2	3	4	5
1_Marker	0.834				
2_Affective experience	−0.178	0.855			
3_Cognitive effort	0.132	−0.241	0.912		
4_Choice satisfaction	−0.148	0.598	−0.254	0.832	
5_Tactile sensations	−0.065	0.527	−0.059	0.324	0.84

APPENDIX D: PLSPREDICT RESULTS

	PLS-SEM values				LM values				PLS–LM		
Latent variables	RMSE	MAE	MAPE	Q^2_predict	RMSE	MAE	MAPE	Q^2_predict	RMSE	MAE	MAPE
Affective experience_1	0.617	0.476	14.167	0.246	0.613	0.473	13.966	0.255	0.004	0.003	0.201
Affective experience_2	0.685	0.55	17.328	0.201	0.686	0.546	17.17	0.2	−0.001	0.004	0.158
Affective experience_3	0.68	0.523	15.319	0.145	0.665	0.508	14.896	0.181	0.015	0.015	0.423
Affective experience_5	0.661	0.52	14.937	0.188	0.661	0.514	14.776	0.188	0	0.006	0.161
Choice satisfaction_1	0.686	0.534	14.401	0.06	0.688	0.544	14.604	0.055	−0.002	−0.01	−0.203
Choice satisfaction_2	0.806	0.634	19	0.102	0.809	0.643	19.087	0.096	−0.003	−0.009	−0.087
Choice satisfaction_3	0.832	0.619	20.577	0.053	0.835	0.624	20.689	0.046	−0.003	−0.005	−0.112
Choice satisfaction_4	0.877	0.666	22.389	0.037	0.875	0.661	22.294	0.042	0.002	0.005	0.095
Choice satisfaction_5	0.801	0.63	17.957	0.05	0.805	0.634	18.093	0.04	−0.004	−0.004	−0.136
Cognitive effort_1	0.876	0.584	36.713	−0.012	0.868	0.619	38.23	0.006	0.008	−0.035	−1.517
Cognitive effort_2	0.892	0.609	39.27	0.001	0.874	0.638	40.198	0.04	0.018	−0.029	−0.928
Cognitive effort_3	0.788	0.609	41.651	−0.012	0.778	0.591	40.427	0.012	0.01	0.018	1.224

Abbreviation: RMSE, root mean square error.