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Augmented reality as a product presentation tool: focusing on the role of product information and presence in AR

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Abstract

As augmented reality (AR) technology advances, marketers are eager to adopt the technology for communication to persuade consumers to develop favorable attitudes and behaviors toward their products and services. This study aims to investigate the effect of product information (utilitarian vs. hedonic attributes) and presence on consumers' product evaluation in AR. Through a quasi experiment, this study demonstrates how product attribute information and presence in AR affect product evaluation by mediating imagery, information fulfillment, and psychological ownership. At the same time, this study identifies the moderating role of consumers' technological innovativeness in the effect of presence on consumers' imagery. This research offers new insights into the role of product information in AR, which previous studies lack, to explore and highlight the predictors of positive product experiences in AR. Innovative marketers are likely to benefit from this study in developing product presentation tactics with AR technology.

Keywords: Augmented reality, Product information, Presence, Imagery, Information fulfillment, Psychological ownership

Introduction

With one click, you can try on a dress with delicate details, and with one swipe, you can change the color of your lipstick instantly. You can check if a dress or lip color looks good on you without changing your clothes or risking contagion from the lipstick on the trial shelf in a store. Trying on virtual accessories in real time using augmented reality (AR) is a wonderful experience.

AR, a mixed reality in which the real world merges with a virtual world (Azuma et al., 2001), expanded its scope as a vital differentiator in the field of games, social media, entertainment, and shopping (Sallomi & Lee, 2017). The potential of AR in business industries is growing rapidly, as it can enhance consumer experience by fusing rich sensory information and virtual content with real environments (Suh & Prophet, 2018). Leading brands and retailers are introducing AR into their e-tail environments to replace or complement consumer offline store experiences (Beck & Crié, 2016; Kim & Sullivan, 2019). Gucci, which is a luxury brand, recently added an AR feature to its mobile

application, in which consumers can try on fashion items and cosmetics and examine home accessories virtually to experience products and items interactively.

As AR integrates product designs, colors, and silhouettes into three-dimensional virtual content and merges it with real-world environments, its advantages as a shopping tool that can facilitate consumers' evaluation of products' hedonic attributes without needing to visit offline stores are recognized. That is, as a new medium for presenting products vividly and interactively, emphasis is placed on the role of AR services in helping consumers test whether products visually match their bodies or other possessions (Yim & Park, 2019). Previous studies suggested that dynamic visuals and product interaction have a positive influence on consumers' response to hedonic shopping experiences (Roggeveen et al., 2015; Shen et al., 2016). Moreover, sensuous, branded content expressed through AR can prompt retailers to employ the medium as a marketing tool to deliver experiential values that are pleasant and new to consumers (Hilken et al., 2017; Yim et al., 2017).

However, the question is whether AR is effective in assisting consumers process information about products' utilitarian functions. In the online retail context, consumers are provided product information through texts and images. AR-equipped retailers have an advantage in providing consumers with high-quality visual information. However, this visual information richness may disturb consumers' processing of text information about utilitarian and hedonic attributes. Despite the weak explanation on the communication of products' utilitarian aspects when consumers shop using virtual reality (VR), a recent research on VR in the marketing domain investigated the technology's capability to deliver information to consumers. Similarly, a recent study reported that product information provided via a display can play a more important role in providing information to consumers than graphics quality in a technology-mediated environment (Kang et al., 2020).

Product evaluation is a crucial stage in the consumer decision-making process. Product evaluation in cyber shopping environments is often a demanding task, as important information, such as tactile features, is missing or incomplete. During their purchase journey, consumers evaluate a product's attributes, that is, utilitarian and hedonic attributes, to predict their satisfaction after purchase (Khan et al., 2005). Therefore, to utilize AR not only as an entertainment technology to invite consumers to a fun event but also as an integrated retail space, determining its role in consumer product evaluation is necessary. The research question should address which and how product information is delivered to and processed by consumers processing augmented visual images at the same time. As information type and ease of processing information influence consumers' decisions (Heller et al., 2019), examining how different digitized cues help consumers process information and develop attitudes toward a product is necessary. Although previous research explained that consumers' perception of quality of information in AR plays a vital role in satisfaction with shopping experiences (Chen & Tan, 2004), most previous research focused on the main effects of the technological characteristics of AR (Hilken et al., 2017; Yim et al., 2017).

Moreover, the role of presence in AR as a technology-induced psychological state influencing positive product experiences through the medium was highlighted in recent years. Therefore, this study examines how presence in AR affects product evaluation and

product information. First, the effect of product attribute information type (utilitarian vs. hedonic) provided in AR and presence on imagery is explored. Second, how product attribute information and presence influence product evaluation mediated by imagery, information fulfillment, and psychological ownership is examined. Imagery and information fulfillment can provide in-depth insights into how information processing and evaluation are supported by AR retail environments. In addition, psychological ownership can explain how consumers' information processing in AR can lead to positive attitudes toward products. Third, how consumers' technological innovativeness moderates the effect of presence on imagery in AR is investigated. Technological innovativeness can provide insights into how consumer characteristics can affect their information processing in the AR environment. Through this exploration, we suggest how AR services can develop into sophisticated and useful retail spaces to manage consumer expectations and improve satisfaction toward product purchases.

Literature review

Utilitarian and hedonic attributes as product information

Products consist of utilitarian and hedonic attributes, with differences in terms of degree or perception (Khan et al., 2005). Utilitarian attributes imply practical and rational features that can help solve problems and are related to functional, instrumental, and cognitive aspects. In other words, utilitarian attributes are related to practical values or benefits, including functional roles and goal-oriented, functional, and practical tasks (Strahilevitz & Myers, 1998). Meanwhile, hedonic attributes are related to aesthetic and sensory experiences, including psychological, experiential, and emotional aspects (Bazerman et al., 1998). The classification of a product as either hedonic or utilitarian reflects the relative salience of its hedonic and utilitarian attributes. For example, a pair of sneakers have both types of attributes, specifically, durability as a utilitarian feature and design as a hedonic feature. Ice cream, which is generally considered as a hedonic product, comprises utilitarian and hedonic dimensions, such as calorie content and taste (Khan et al., 2005).

The literature on utilitarian and hedonic attributes examines their different mechanisms affecting consumers' emotions, choices, and evaluation (Dhar & Wertenbroch, 2000). The effect of attributes on consumers' choices differs depending on the context of the choice. People are likely to prefer a utilitarian alternative over a hedonic option when choosing a product to possess but likely to give up the utilitarian option when making a forfeiture decision (Dhar & Wertenbroch, 2000). In addition, utilitarian attributes are preferred under certainty, but hedonic attributes are preferred under uncertainty (Bazerman et al., 1998). Despite utilitarian versus hedonic attributes not being a matter of good versus bad, choosing utilitarian over hedonic products decreases the need for justification and feelings of guilt, which can be explained by the fact that hedonic options are relatively stronger than utilitarian options in terms of their discretionary nature (Strahilevitz & Myers, 1998).

Utilitarian attributes as product attributes are compared with hedonic attributes as crucial information provided through retail environments (Dhar & Wertenbroch, 2000; Gill, 2008). As a concept of maintenance, utilitarian attributes represent essential characteristics that consumers expect based on reasoned preferences ("should"). Utilitarian

attributes tend to be cognitively superior to hedonic attributes based on reason and delayed gratification. Meanwhile, as a concept of expansion, hedonic attributes are based on desires and affective preferences ("want"; Bazerman et al., 1998). Hedonic attributes tend to be emotionally superior to utilitarian attributes and are based on feelings and immediate gratification (Shen et al., 2016). In addition, such attributes are closely related to sensory pleasures and sensory information processing (Maclnnis & Price, 1987), which can facilitate mental interaction simulation with products (Jang et al., 2011). The dynamic presentation of a touchable interface or product can positively facilitate the selection of a hedonic alternative; thus, the relationship between an interactive technological medium, such as AR, and hedonic attributes is discussed (Roggeveen et al., 2015).

As online retailers present products with images and attribute information, product attribute type can affect consumers' responses differently when searching for products through AR services. Researchers defined utilitarian attributes as features such as performance, functionality, efficacy, material, and price and hedonic attributes as features such as color, silhouette, fragrance, and taste (Dhar & Wertenbroch, 2000; Shen et al., 2016). In the current study, the utilitarian attribute information of a product represents functional and instrumental features, such as function, material, and comfort. In addition, hedonic attribute information is defined as attributes related to the aesthetic, sensory, and emotional characteristics of products, such as color, silhouette, and design.

AR

AR concept and research

AR is a mixed reality in which the real world and a virtual world coexist (Azuma et al., 2001). As an immersive technology that provides substantial high-quality sensory information, VR and AR are similar, as they allow users to experience coexisting environments (Milgram & Kishino, 1994). However, AR differs from VR, as it merges the real world with a virtual world. With the development of AR applications in business industries, luxury brands are seeking innovation by introducing AR into their platforms in the form of virtual fitting rooms, virtual centers, and virtual agents in offline retail stores to improve sales (Beck & Crié, 2016). Moreover, leading retailers, such as IKEA, Sephora, and L'Oreal, utilize smartphone developments to commercialize mobile virtual try-on services to enhance sales promotion strategies and improve consumer–brand relationships.

Early research on AR based on technology acceptance theory, media characteristics, and experiential values found that AR characteristics such as simulated physical control, environmental embedding (Hilken et al., 2017), interactivity, and vividness (Yim et al., 2017) play an important role in improving consumer experiences (Huang & Liao, 2015). Furthermore, AR can induce stronger emotions in consumers, such as enjoyment and curiosity, compared with online catalogs and elicit positive behavioral intention to visit offline stores (Beck & Crié, 2016), thereby implying that research to examine how AR can help consumers in actual purchases is necessary.

Presence in AR

Presence is defined as a psychological state in which users feel as if they are in a new world that differs from the real world while experiencing a virtual space (Steuer, 1992).

Some studies on AR explored the effect of presence and defined it as a concept similar to telepresence (Huang & Liao, 2015). However, Lee (2004) clarified that the feeling of presence can occur while using not only a highly mediated environment but also an environment created by low-level technological media. As AR is a synthesis of virtual worlds based on real surroundings, a sense of transportation is not required when using the technology. Therefore, this study defines presence in AR according to Lee (2004), that is, a psychological construct that deals with the perceptual processing of technology-generated stimuli, and measures it using physical and self-presence.

Physical presence is a psychological state in which a virtual object is experienced as an actual physical object in a sensory or nonsensory way (Lee, 2004). Moreover, physical presence involves the psychological state of users not noticing the para-authentic or artificial characteristics of mediated objects and environments. In virtual environments, physical presence is defined as the degree to which consumers perceive virtual objects and retail environments as real (Huizingh, 2000). Physical presence is affected by enhanced vividness, realism, and the level at which virtual objects are controlled and manipulated (Jin, 2011).

Meanwhile, self-presence is a psychological state in which a virtual self is experienced as an actual self in a sensory or nonsensory way (Lee, 2004). Self-presence is generally examined in the context of virtual environments, including games, as the degree to which users perceive and reflect their appearance in virtual avatars and game characters. Self-presence involves the psychological state of experiencing a physically presented or psychologically imagined self (Jin & Park, 2009; Williams, 2013). Consumers interacting with virtual products through AR can sense their augmented self, which is an integration of branded content and the consumers (Scholz & Duffy, 2018).

Imagery

Imagery involves the mental activity of visualizing a concept or relationship (Lutz & Lutz, 1978), in which sensory or perceptual information is expressed as a specific sensory representation, such as an idea, feeling, or memory, in an individual's working memory (MacInnis & Price, 1987). Imagery may be multisensory, as it occurs when individuals are exposed to various sensory stimuli, including auditory and visual stimuli, but may also include only a singular sensory dimension. In consumer imagery processing, information is processed in a sensory way and encoded substantially, thereby appearing as a representation in consumers' minds (Petrova & Cialdini, 2005).

Imagery is triggered by external factors, such as pictures, concrete words, image instructions, and guided imagery, and information recalled unintentionally from memory without external stimuli (Lutz & Lutz, 1978). Visual and verbal messages trigger imagery, which affects consumers' cognitive and emotional responses (Babin & Burns, 1997). Thus, positive correlations are found between the concreteness of texts and imagery and behavioral intention.

Hence, imagery enables consumers to visualize products and recall previous experiences related to a product or change their cognitive state. Imagery can also replace actual consumption, thereby allowing consumers to experience sensory and emotional scenarios related to products (MacInnis & Price, 1987), which can in turn affect approach or avoid responses toward an object (Gregory et al., 1982). The imagery of having and using

a desired object produces positive sensory and emotional experiences that enhance desire for the object and shorten the time gap between purchase intention and actual purchase (Mischel & Moore, 1973).

Product information and imagery

According to information richness theory, information richness is an information feature that can change people's understanding of an object within a certain time interval. Information richness can clarify an object's ambiguity, thereby enhancing consumers' understanding of the object (Daft & Lengel, 1986). Consumers can predict their level of satisfaction in purchasing a product based on the information they obtain during their product search (Chen & Tan, 2004). Thus, they expect a variety of rich and qualitative information that can enhance their understanding of the product. In terms of imagery, substantial attribute information can help fill in or improve product images by enhancing imagery precision and clarity, thereby facilitating consumers' evaluation of a product (MacInnis & Price, 1987). When insufficient attributes are provided, consumers perceive a vague image in their minds, thereby making product evaluation difficult.

Furthermore, diminishing marginal utility, which states that individuals' subjective satisfaction or need decreases gradually as they consume the same goods or services, can explain the mechanism in consumers' perception of information processing regarding products and services (Estes et al., 2018; Falk et al., 2010). That is, incremental value decreases gradually as similar characteristics or functions are added to products or services. Gill (2008) focused on the utilitarian and hedonic attributes of products and found that adding incongruent attribute functionality to a base product offers more incremental value than adding congruent functionality. In this context, the attribute information type consisting of concrete words can stimulate different levels of image incidences (Richardson, 1980). As AR services provide rich product sensory and aesthetic information (Suh & Prophet, 2018), utilitarian attribute information, rather than hedonic attribute information, will enable consumers to acquire qualitatively diverse product information and experience enhanced imagery.

H1   In AR, consumers provided with utilitarian attribute (vs. hedonic attribute) information will feel higher imagery.

Presence and imagery

Presence describes the quality of subjective experiences in immersive technology and is a key variable in information processing, which defines users' experiences in virtual environments (Bogicevic et al., 2019; Steuer, 1992). Although consumers can touch and see actual products in physical retail stores, presence in AR as a psychological state that can replace real experiences is noteworthy. That is, AR enables users to interact with a virtual object as they would a physical version of that object (Heller et al., 2019).

Moreover, the mental imagery evoked by retail environments can substantially impact consumer decision-making processes (Kim et al., 2020; Maier & Dost, 2018). However, research on virtual retail settings only recently examined mental imagery to understand

shopping experiences, and attention to the relationship between presence and imagery in virtual environments is lacking (Bogicevic et al., 2019).

Existing research found a positive relationship between presence and mental imagery (Biocca et al., 2001; Bogicevic et al., 2019; Burdea & Coiffet, 2003; Rodríguez-Ardura & Meseguer-Artola, 2016; Weibel et al., 2011), and others raised the possibility that the relationship between imagery and presence may vary depending on media type (Iachini et al., 2019). In addition, the relationship between imagery and variables that elicit presence was examined. The interactivity and vividness of AR can induce presence (Steuer, 1992; Van Kerrebroeck et al., 2017) and lead to intense imagery (Kim et al., 2020; Schlosser, 2003). Furthermore, the vivid nature of AR dynamic presentation formats can lead to high imagery by allowing users to feel presence in a mediated environment (Roggeveen et al., 2015). As AR represents a digitally designed interactive environment, sense of presence from digitally elaborated and enhanced product presentation is expected to elicit a high level of imagery.

H2   Presence in AR will have a positive effect on imagery.

Information fulfillment and psychological ownership

Information fulfillment is the extent to which consumers are provided with useful and rich information about a product (Lee et al., 2009). Fulfillment is used to determine whether delivered services meet users' expectations in the context of online or mobile services. Among various service quality dimensions, fulfillment is a component of outcome quality that is left to the customer when service production is completed (Wolfinbarger & Gilly, 2003). According to Yoon and Choo (2011), in the context of mobile shopping, utilitarian and hedonic benefits obtained from applications can be distinguished from those obtained from mobile devices, and information fulfillment indicates cognitive performance as a utilitarian benefit obtained from applications.

Existing studies on AR stated that information richness and perceived informativeness elicit positive attitudes toward products and intentions to use AR (Chen & Tan, 2004). In addition, when individuals perceive the high utility of an object, their attitude toward the object improves (Yi & Muhn, 2013); thus, improved information fulfillment can result in positive attitudes toward a product. However, discussions on constructs that can improve cognitive responses to information in AR services are lacking. This study expects imagery to allow consumers to acquire vivid information while interacting with products. The clearer the sensory representation of a product and a consumer interacting with the product in real time, the more the consumer will perceive the benefits of acquiring useful and abundant information (Yoon & Choo, 2011), which will enable them to predict product experiences accurately.

Psychological ownership is another psychological state that imagery can induce in AR, which refers to an individual's personal sense of possession of a material or immaterial target (Pierce et al., 2001). Despite the lack of legal ownership, an individual senses ownership by perceiving an object as "mine" (Vandewalle et al., 1995). Previous studies showed that controlling objects, intimately knowing objects, and investing in objects lead to psychological ownership in the real as well as virtual worlds (Lee & Chen, 2011).

Psychological ownership is established through the imaginary process of thinking of oneself as the owner of an object that is not in one's possession. Moreover, during this imaginary process, an individual invests in the target by thinking about product-related images or experiences and perceives control by intimately knowing the product. Psychological ownership increases by merely imagining touching a product (Peck & Shu, 2009) and mediates the relationship between imagery and attitude toward the product (Kamleitner & Feuchtl, 2015). Possession of an object can strengthen the association between possessions and the self, thereby encouraging consumers to endow a high value to psychologically owned targets (Gawronski et al., 2007). Most people implicitly evaluate themselves positively, and this self-association includes possessions, thereby improving the implied evaluation of the possessions (Beggan & Brown, 1994). Therefore, this endowment effect of psychological ownership can lead to the positive evaluation of and satisfaction toward products (Peck & Shu, 2009).

H3a   The relationship between imagery and product evaluation will be mediated by information fulfillment.

H3b   The relationship between imagery and product evaluation will be mediated by psychological ownership.

Based on the theoretical background presented above, this study hypothesizes that the effects of product attribute information and presence in AR on product evaluation are sequentially mediated by imagery, information fulfillment, and psychological ownership (See Fig. 1).

H4a   The effect of product attribute information on product evaluation will be sequentially mediated by imagery and information fulfillment.

H4b   The effect of product attribute information on product evaluation will be sequentially mediated by imagery and psychological ownership.

H5a   The effect of presence on product evaluation will be sequentially mediated by imagery and information fulfillment.

H5b   The effect of presence on product evaluation will be sequentially mediated by imagery and psychological ownership.

Moderating effect of technological innovativeness

Innovativeness refers to the degree to which an individual accepts a new idea or technology before the other members of the same social system (Rogers, 2010). A consumer with high innovativeness has strong motivations to accept a technology and demonstrates intentions to apply his/her knowledge to technology-based products or services. Previous studies suggested and verified that consumers' technological innovativeness moderates the relationship between their evaluations and attitudes toward new environments or technology-based products and services (Agarwal & Prasad, 1998; Citrin

et al., 2000). Among the five perceived characteristics of innovation, relative advantage explains that innovative methods provide more substantial benefits, convenience, satisfaction, and image enhancement than traditional methods (Rogers, 2010). In this study, presence in AR is a psychological construct that strongly deals with the perceptual processing of technology-generated stimuli (Lee, 2004; Steuer, 1992). Individuals with high innovativeness are less sensitive to the complexity of information technology but more aware of the relative advantages of image enhancement (Cheng, 2014; Rogers, 2010). Thus, we expect consumers with high innovativeness to experience strong image enhancement as a result of presence.
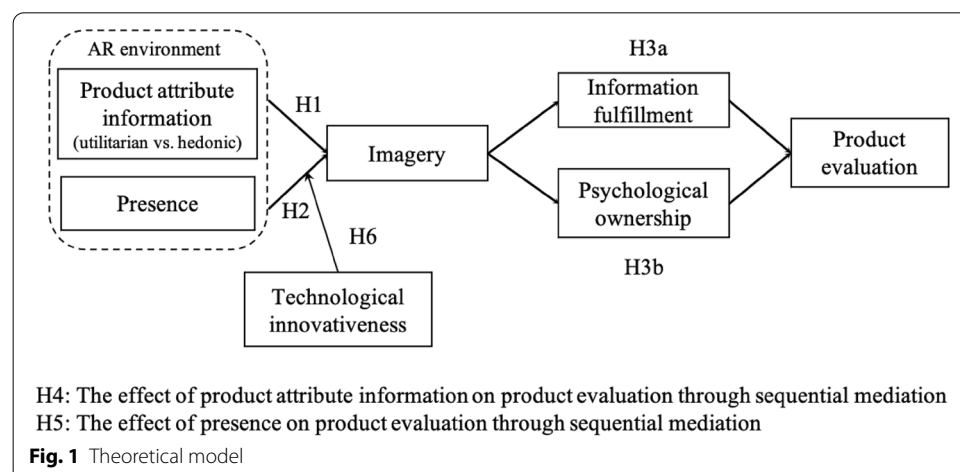
H6 The positive effect of AR's presence on imagery will be strengthened for individuals with high technological innovativeness.

Method

Stimuli

In this study, Wanna Kicks, which is a fashion application specializing in AR and sneakers, was used as the stimulus. Wanna Kicks can be accessed on mobile devices and provides a list of sneaker brands that consumers can select and try on virtually through AR. In the purchasing stage, consumers are directed to online retailers of the brands to continue the transaction. The application maximizes the effect of AR, as users can see themselves wearing the items from different angles by freely moving their feet toward the camera.

A small-scale test was conducted to select sneaker brands for the experiment. A total of 43 participants in their 20 s and 30 s were conveniently recruited and shown photos of six sports brand products, including Adidas, Nike, and New Balance. Next, the participants were asked to answer a survey on product preference. The Adidas product was selected as the stimulus, as it exhibited moderate preference (M = 4.26, SD = 1.38), and no difference in preference between genders was observed (M_{men} = 4.044, M_{women} = 4.500; t = 1.083, p = 0.285).

H4: The effect of product attribute information on product evaluation through sequential mediation
H5: The effect of presence on product evaluation through sequential mediation
Fig. 1 Theoretical model

Two types of Adidas product pages resembling typical online mall product pages were constructed. The two product pages differed only in terms of product information. Specifically, one page presented utilitarian attribute information, and the other page provided hedonic attribute information. The utilitarian attribute information consisted of information related to the functional, instrumental, and essential aspects of the product, such as function, material, and comfort. The hedonic attribute information provided the aesthetic, sensory, psychological, and emotional aspects of the product, such as color, silhouette, and design. Both types of information were presented in 32 words and consisted only of text information, excluding numerical information (Fig. 2).

We pretested the validity of the stimulus and scenarios on 21 participants and confirmed that they served the purpose of the experiment. The participants were instructed to answer the questionnaire after experiencing the selected Adidas product in AR with the product information. The stimulus provided the users with sufficient presence ($M = 5.512$, $SD = 1.223$). In addition, the participants identified the product information as either utilitarian or hedonic by answering a question using a seven-point semantic differential scale (1 = "utilitarian" and 7 = "hedonic"). The participants reported that the utilitarian scenario offered more utilitarian information than the hedonic scenario ($M_{util} = 1.700$, $M_{hed} = 4.818$; $t = -6.672$, $p = 0.000$).
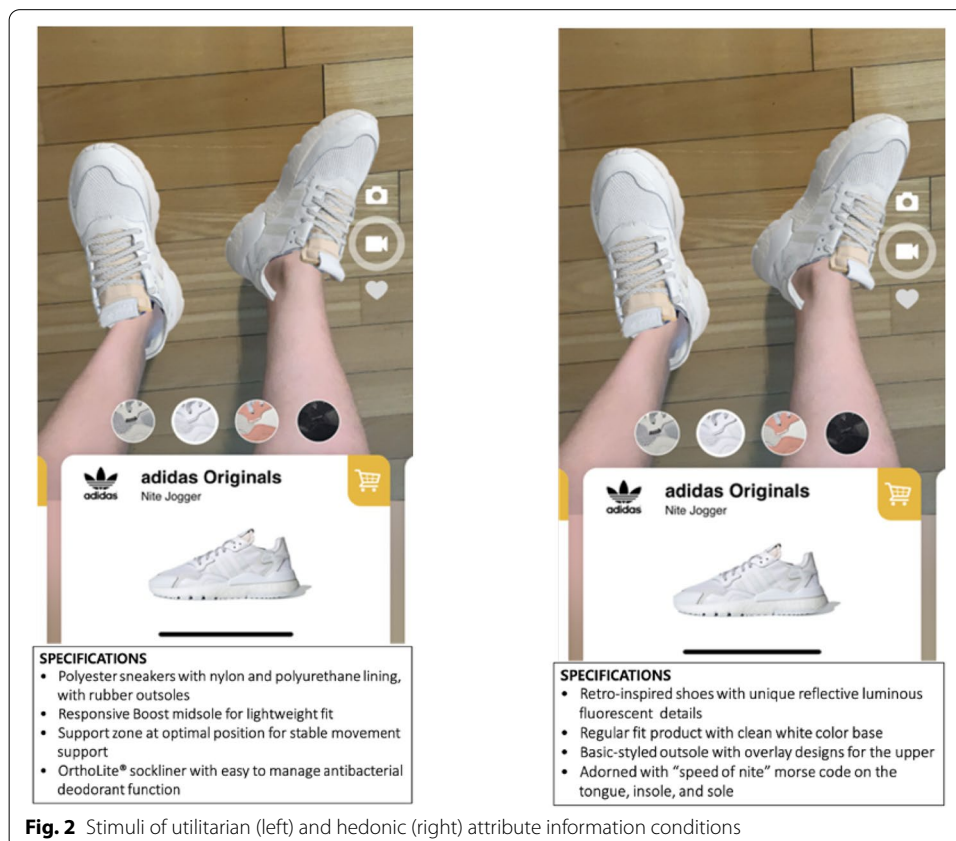

Fig. 2 Stimuli of utilitarian (left) and hedonic (right) attribute information conditions

Participants

This study collected data through a non-face-to-face experiment and survey, in which the respondents personally filled out the questionnaires. Consumers in South Korea in their 20 s and 30 s with online or mobile shopping experience were recruited via an on-campus online community. The rationale behind recruiting consumers in their 20 s and 30 s as the study participants is that they are the most active consumers who enjoy fashion shopping online (Opensurvey, 2018). The respondents participated voluntarily in the experiment and received KRW 5,000 (approximately USD 4.18) as a gift. A total of 115 participants were recruited, and 93 were retained after those who did not experience the selected product were excluded. Of the 93 participants, 78 were in their 20 s (83.9%), and 15 were in their 30 s (16.1%), and the average age was 25.8 years. Moreover, 43.0% of the participants were male, and 57.0% were female. Furthermore, 78.5% of the respondents participated in the experiment at home, followed by at the workplace (12.9%). In addition, 76.3% reported having previous AR experience, and 23.7% had no prior experience.

Based on a research on AR with a between-subjects design (Hilken et al., 2017), the 93 participants were placed randomly into two groups, specifically, 45 participants in the utilitarian attribute information condition, and 48 participants in the hedonic attribute information condition. The two groups were homogeneous with regard to gender composition ($\chi^2 = 0.022$, $p = 0.882$), age ($\chi^2 = 2.393$, $p = 0.122$), education ($\chi^2 = 0.322$, $p = 0.851$), occupation ($\chi^2 = 4.794$, $p = 0.188$), and monthly average household income ($\chi^2 = 1.482$, $p = 0.830$). The two groups exhibited no difference in terms of place of experiment participation ($\chi^2 = 5.828$, $p = 0.120$) and fashion involvement (M = 4.966, SD = 1.331).

Procedure

The experiment was conducted in a non-face-to-face way to allow the participants to experience the product with their mobile device in their everyday environment, as consumers typically experience AR in familiar environments (Scholz & Duffy, 2018). The participants were assigned randomly to one of two groups, that is, the utilitarian attribute information condition or hedonic attribute information condition. Next, they were informed of the purpose of the study and asked to complete the consent form. After a brief introduction, the participants were instructed to imagine themselves shopping for sneakers. The following detailed instructions were provided: (1) install and access the AR application on your smartphone, (2) select the Adidas sneaker product (the selected stimulus) when the list of sneaker products appears, and (3) experience the virtual try-on service with the provided product information. In step (3), the participants in the utilitarian condition were exposed to the utilitarian attribute information of the product, whereas the participants in the hedonic condition were exposed to the hedonic attribute information of the product. To verify the success of the manipulation, the participants were asked to rate their perception of the product information by responding to a question. The participants were told to spend as much time as needed on the application before answering the questionnaire. During the experiment, the participants were instructed to take a screenshot of their feet trying on the product and submit the screenshot to the researchers to prove that they experienced the selected product.

Measures

Presence was assessed by four items adapted from Jin and Park (2009) and Jin (2011). Imagery was measured by three items based on Schlosser (2003). Information fulfillment was measured by five items based on Lee et al. (2009) and Yoon and Choo (2011). Psychological ownership was assessed by four items adapted from Peck and Shu (2009) and Kamleitner and Feuchtl (2015). Product evaluation was measured by three items based on Taylor and Bearden (2002). Technological innovativeness was measured by two items based on Parasuraman (2000). The brand awareness and brand preference measures were analyzed as control variables with four items based on Kim and Park (2010), as the product brand shown to the participants during the experiment can affect the product evaluation. Each item for each construct was measured using a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

The participants rated the utilitarian attribute information and hedonic attribute information as utilitarian or hedonic, which was based on Roggeveen et al. (2015). In addition, the participants rated the AR as utilitarian or hedonic to confirm whether they perceived the technology as hedonic. Each item was measured using a seven-point semantic differential scale (1 = "utilitarian" and 7 = "hedonic").

Results

Measurement assessment

Confirmatory factor analysis was conducted to verify the construct validity of the measurement used in this study. Construct validity can be assessed by convergent validity and discriminant validity. In the case of convergent validity, the factor loadings should be statistically significant, each standardized factor loading should be higher than 0.7, the average variance extracted (AVE) value should be higher than 0.5, and construct reliability (CR) should be higher than 0.7 (Lee & Lim, 2013). In this study, all the standardized factor loadings were significant, and most were 0.6 or more. Moreover, all the CR values were 0.7 or higher, and all the AVE values were 0.5 or higher except for imagery (0.474), which exhibited an acceptable boundary value. For all the variables, the Cronbach's α reliability score ranged from 0.88 to 0.90, denoting satisfactory internal consistency (Table 1). In addition, by comparing the values of the correlation coefficient of each component and square root of the AVE, discriminant validity was secured, as each correlation coefficient was lower than the square root of the AVE (Table 2).

Hypothesis testing

Effects of product information and presence

Manipulation check   The participants in the utilitarian information condition reported the product information as more utilitarian compared with the participants in the hedonic information condition ($M_{util} = 2.267$, $M_{hed} = 5.042$, $t = -10.605$, $p = 0.000$). In addition, the participants perceived the AR experience as hedonic rather than utilitarian ($M = 4.570$, $SD = 1.741$; $t = 3.157$, $p = 0.002$).

Table 1 Measurement assessment

Factor	Items	FL	AVE	CR	Cronbach's α
Presence	While I was using this AR application		0.622	0.868	0.897
	It felt like the sneakers really existed	0.723			
	It felt like these sneakers were real	0.850			
	It felt like I was actually wearing the sneakers	0.810			
	My appearance wearing the product looked real	0.767			
Imagery	While I was using this AR application		0.474	0.723	0.884
	I could imagine wearing the sneakers	0.848			
	A specific image or scene related to the sneakers came to mind	0.634			
	I could imagine using the sneakers	0.548			
Information fulfillment	This AR service		0.619	0.889	0.907
	Provides detailed information about the product	0.610			
	Provides sufficient content for the information I want to know	0.780			
	Provides product information that is useful to me	0.845			
	Provides abundant information	0.847			
	Provides appropriate product information for my needs	0.826			
Psychological ownership	While I was using this AR application		0.539	0.806	0.889
	I felt like I owned these sneakers	0.978			
	I felt like these sneakers were my belongings	0.878			
	I felt as if these sneakers were mine	0.515			
	I could feel how it would be like to actually own these sneakers	0.402			
Product evaluation	I think that these sneakers are worth buying	0.871	0.785	0.916	0.901
	I think that I can highly value these sneakers	0.884			
	I am willing to buy these sneakers	0.903			

Table 2 Discriminant validity

	Presence	Imagery	Information fulfillment	Psychological ownership	Product evaluation
Presence	0.622[a]				
Imagery	0.201[b]	0.474			
Information fulfillment	0.392	0.305	0.619		
Psychological ownership	0.442	0.254	0.307	0.539	
Product evaluation	0.240	0.115	0.201	0.319	0.785

[a] AVE of constructs is displayed diagonally

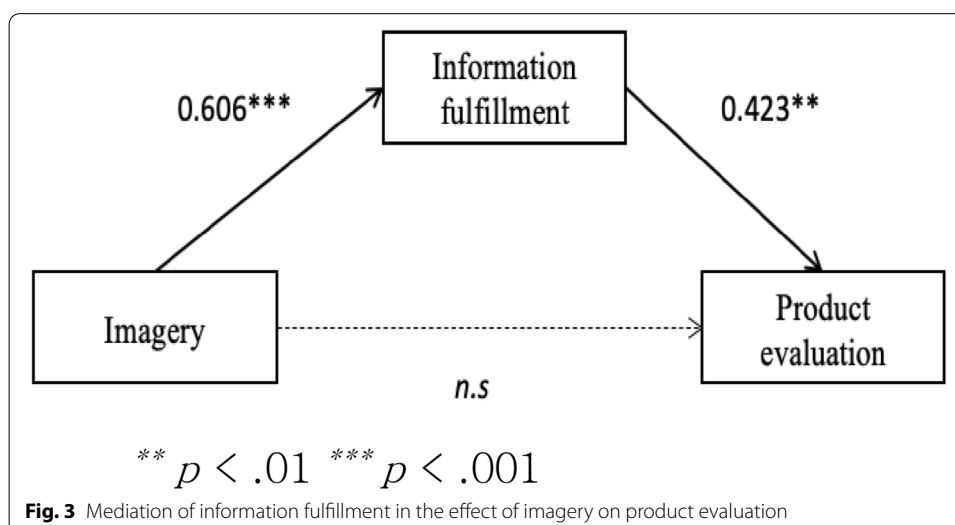[b] Numbers below the diagonal are squared correlation estimates of two variables

ANOVA   ANOVA was conducted to examine the effect of the product attribute information on imagery. The results showed that the participants in the utilitarian condition experienced enhanced imagery compared with those in the hedonic condition ($M_{util} = 6.008$, SD $= 0.780$; $M_{hed} = 5.583$, SD $= 1.118$; F [1, 91] $= 4.443$, $p < 0.05$); thus, H1 was supported.
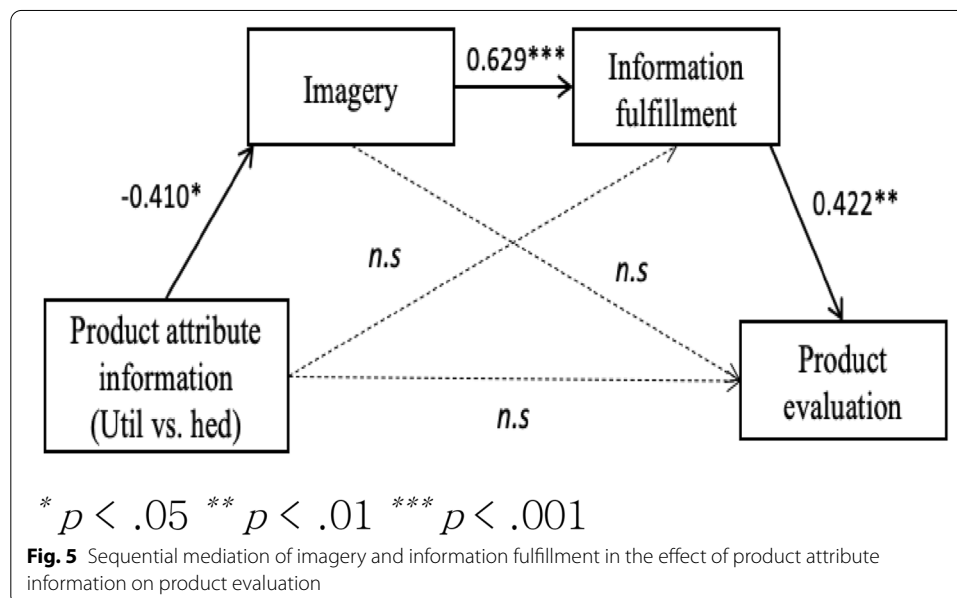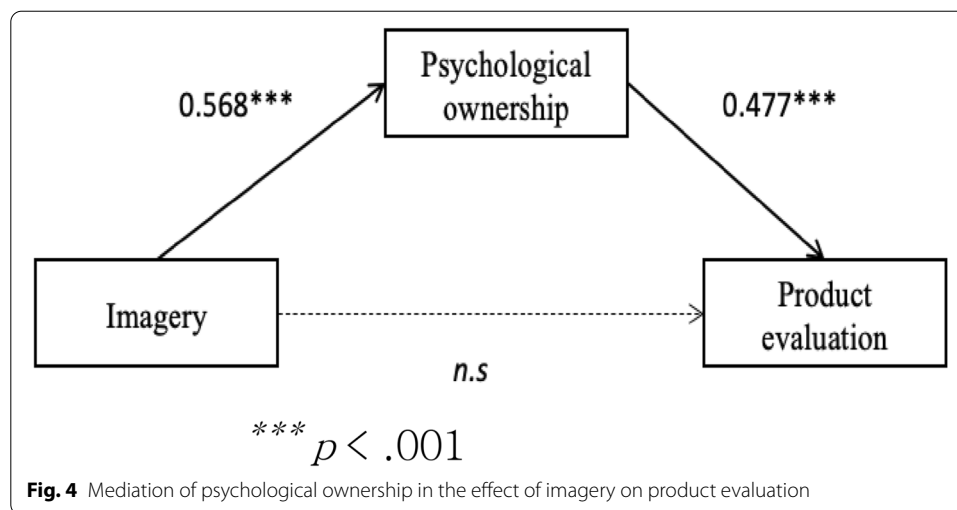
Multiple regression analysis   Multiple regression analysis was conducted to test the effect of presence on imagery. The independent variables were presence and information type. The utilitarian information condition was coded as 1, and the hedonic information condition was coded as 2. Brand awareness and preference were inputted as the control variables for the analysis. The results showed the positive effect of presence on imagery ($\beta = 0.410$, $p = 0.000$), thereby supporting H2. Consistent with the ANOVA results, the coefficient of product information type was also significant ($\beta = -0.217$, $p = 0.019$).

Mediation effects of imagery, information fulfillment, and psychological ownership
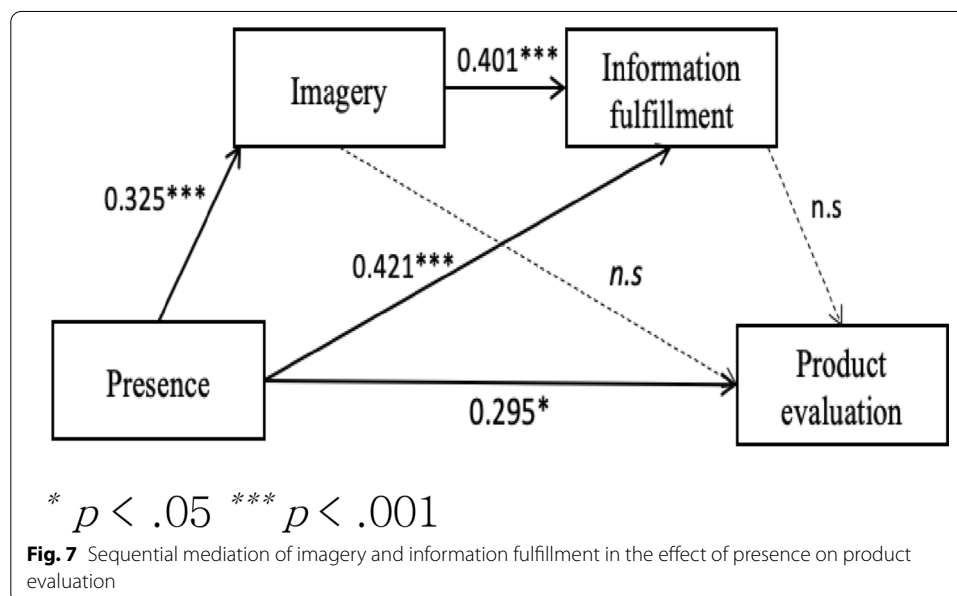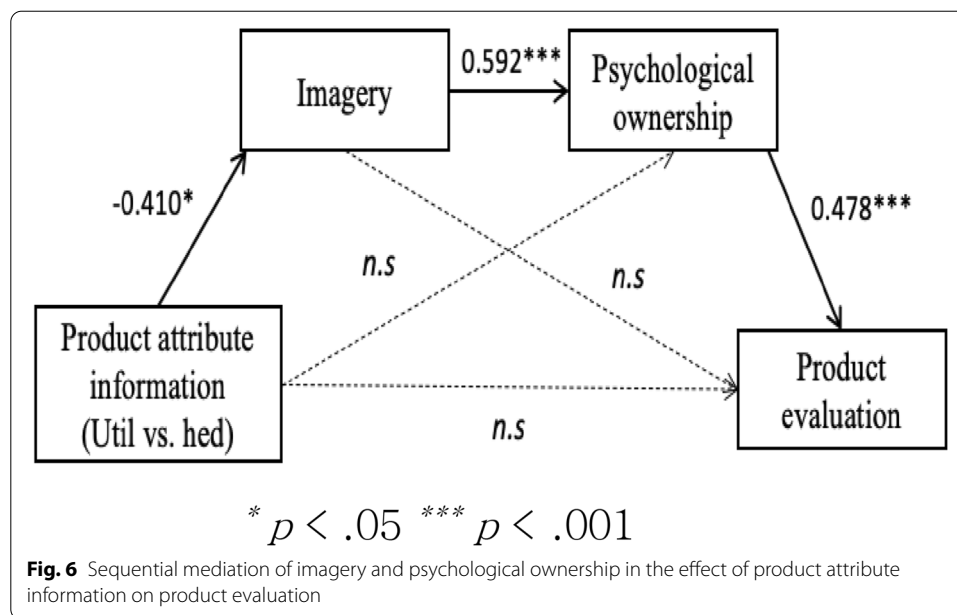
Mediation test: path between imagery and product evaluation   To test the mediating effect of information fulfillment and psychological ownership on the association between imagery and product evaluation, PROCESS SPSS Macro (Model 4, n = 5000 resamples; Hayes, 2017) was used. Two separate mediation analyses were conducted with each mediator, namely, information fulfillment and psychological ownership, with brand awareness and preference as covariates.

The results illustrated that the indirect effect of imagery on product evaluation through information fulfillment was significant (indirect effect: 0.256, 95% CI = 0.106, 0.442). Given that the direct effect of imagery on product evaluation was not significant ($p > 0.05$), this study concluded that information fulfillment fully mediated the effect of imagery on product evaluation; thus, H3a was supported (Fig. 3; total effect: 0.383, $p = 0.003$). In addition, the indirect effect of imagery on product evaluation through psychological ownership was significant (indirect effect: 0.271, 95% CI = 0.141, 0.456). Given that the direct effect of information fulfillment on product evaluation was not significant ($p > 0.05$), this study concluded that psychological ownership fully mediated the effect of imagery on product evaluation; thus, H3b was supported (Fig. 4; total effect: 0.383, $p = 0.003$).


Fig. 3 Mediation of information fulfillment in the effect of imagery on product evaluation

Fig. 4 Mediation of psychological ownership in the effect of imagery on product evaluation

Fig. 5 Sequential mediation of imagery and information fulfillment in the effect of product attribute information on product evaluation

Serial mediation test: path between product information and presence and product evaluation   To test the proposed serial mediation effect, PROCESS SPSS Macro (Model 6, n = 5000 resamples; Hayes, 2017) was used, with brand awareness and preference as covariates. The serial mediation effect of product information type on product evaluation through imagery and information fulfillment was significant (serial mediation effect: −0.109, 95% CI −0.297, −0.018). Figure 5 shows that the direct effect of product attribute information on product evaluation was not significant ($p > 0.05$). The serial effect of imagery and information fulfillment fully mediated the effect of product information type on product evaluation; thus, H4a was supported. The participants who were provided the utilitarian attribution information while experiencing the AR service felt enhanced imagery, which led to high information fulfillment and positive product evaluation.

Fig. 6 Sequential mediation of imagery and psychological ownership in the effect of product attribute information on product evaluation

Fig. 7 Sequential mediation of imagery and information fulfillment in the effect of presence on product evaluation

The serial mediation effect through imagery and psychological ownership was also significant (serial mediation effect: -0.116, 95% CI -0.296, -0.023); thus, H5b was supported (Fig. 6).

We predicted that the relationship between presence and product evaluation was sequentially mediated by imagery and information fulfillment, considering the covariates of brand awareness and preference. The serial mediation effect of imagery and information fulfillment did not drive the effect of presence on product evaluation (95% CI -0.001, 0.096); thus, H5a was rejected. The strong direct effect of presence on product evaluation was observed (direct effect: 0.295, 95% CI 0.055, 0.534), which resulted in a significant total effect (Fig. 7; total effect: 0.457, $p = 0.000$).

Fig. 8 Sequential mediation of imagery and psychological ownership in the effect of presence on product evaluation
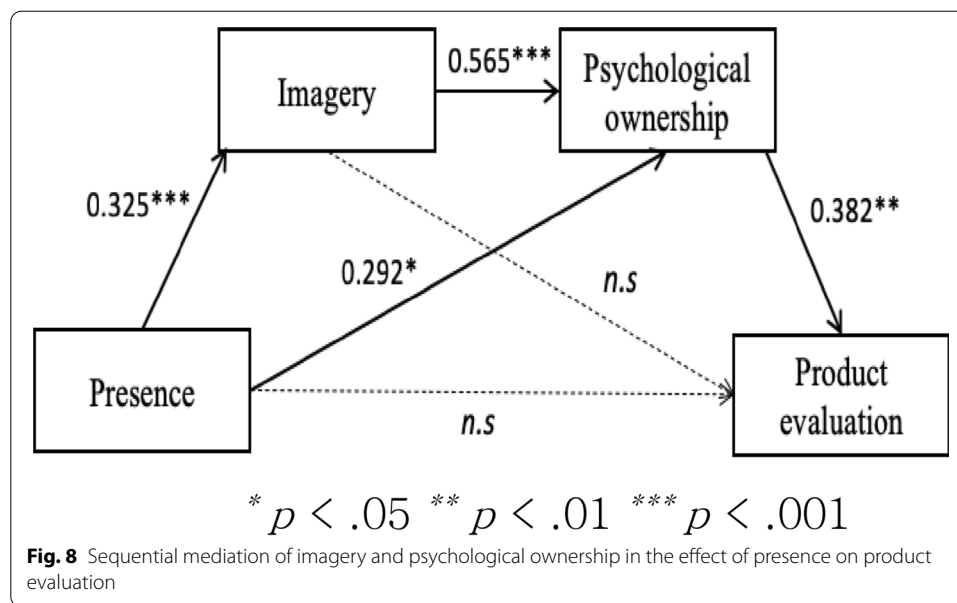
Supporting our theorization, the serial mediation effect of imagery and psychological ownership drove the effect of presence on product evaluation (serial mediation effect: 0.036, 95% CI 0.010, 0.103). Given that the direct effect of presence on product evaluation was not significant ($p > 0.05$), this study concluded that the serial effect of imagery and psychological ownership fully mediated the effect of presence on product evaluation; thus, H5b was supported (total effect: 0.457, $p = 0.000$). Additionally, the results demonstrated that the indirect effect of presence on product evaluation through psychological ownership was significant (Fig. 8; effect: 0.215, 95% CI 0.077, 0.423).

Moderation effect of technological innovativeness

The moderating effect of technological innovativeness on the relationship between presence and imagery was examined using hierarchical regression analysis. Regression analysis was conducted with imagery as a dependent variable, presence as an independent variable, technological innovativeness as a moderator, and brand awareness and preference as control variables. The significant interaction effect of presence and technological innovativeness was observed ($\beta = 1.313$, $p = 0.011$). Furthermore, technological innovativeness had a significant effect on imagery ($\beta = -0.942$, $p = 0.007$). The results showed that the positive effect of presence in AR on imagery was strengthened in individuals with high technological innovativeness; thus, H6 was supported.

Discussion

Theoretical implications

As AR boosts consumers' product experiences in online shopping spaces, its effect on the consumer decision-making process has become a crucial issue for academicians and practitioners. This study investigates how product information and presence influence consumers' product evaluation in AR. In addition, this study examines

how imagery, information fulfillment, and psychological ownership as mediators play a role in the relationship between product information, presence, and product evaluation. Moreover, the moderating role of consumers' technological innovativeness in the effect of presence on imagery in AR is investigated. Several theoretical implications are discussed based on the findings of this study.

First, this research has academic significance as an initial study focusing on the effect of product attribute information on consumers' AR experiences. Although several studies examined the positive relationship between a product's hedonic attributes and virtual shopping environment (Roggeveen et al., 2015; Shen et al., 2016), existing research lacks investigations into how utilitarian and hedonic product attributes displayed through AR can support consumers' purchase journeys. This study focuses on product information as a decisive component in an AR environment for consumer decision making and determines that product attribute information induces a different level of imagery among consumers. Consumers experience enhanced imagery when given utilitarian information instead of hedonic information when exposed to a product via AR technology. This finding demonstrates that the presentation of utilitarian information may fill in and improve the represented images of products in consumers' minds with rich information (Daft & Lengel, 1986), which can be differentiated from augmented visual information provided through AR (Gill, 2008). Moreover, the finding supports the discussion that product information provided in a virtual environment can play an important role in consumers' information processing (Kang et al., 2020) while clarifying the mechanism of how utilitarian and hedonic attribute information displayed in AR can lead to product evaluation.

Second, this study supports previous works examining the important role of presence in AR (Bae & Kim, 2015; Huang & Liao, 2015; Steuer, 1992) and further enhances understanding on its influence on consumers' psychological experiences. The research findings show the positive effect of presence on imagery, which support the findings on the positive relationship between presence and imagery (Bogicevic et al., 2019; Burdea & Coiffet, 2003; Rodríguez-Ardura & Meseguer-Artola, 2016) and broaden its application in the context of virtual retail environments. In addition, an unexpected finding is observed, that is, presence, unlike product attribute information, affects psychological ownership and information satisfaction without mediating imagery. This finding indicates that experiencing presence in a virtual environment is a powerful cognitive activity and can replace the role of imagery.

Third, the findings of this study indicate that the effect of imagery on product evaluation is mediated by information fulfillment and psychological ownership. In addition, consumers given utilitarian information experience enhanced imagery, which leads to high information fulfillment and psychological ownership and results in increased positive product evaluation. Meanwhile, the serial mediation effect of imagery and information fulfillment on the relationship between presence and product evaluation is not significant. This result can be explained by the direct effect of presence on product information, which is adequately strong to offset the indirect effect of imagery and information fulfillment on product evaluation. Moreover, the mediating effect of psychological ownership on the relationship between presence and product evaluation is greater than the serial mediating effect of imagery and psychological

ownership on the relationship between presence and product evaluation. The findings are in line with those of previous studies on the positive role of psychological ownership in shaping consumer experiences (Kamleitner & Feuchtl, 2015; Lee & Chen, 2011; Peck & Shu, 2009), with additional findings showing that presence can directly or indirectly induce the endowment effect of psychological ownership in AR.

Lastly, this study determines that technological innovativeness is a consumer characteristic that enhances the effect of presence in AR on imagery. Thus, this study suggests that consumers' tendency to accept and utilize new technologies is a decisive factor in responding sensitively to the advantages of innovative technology, such as AR, which can ultimately help them make purchase decisions.

Managerial implications

This study provides the following managerial implications for retailers aiming to utilize AR in the future. This study proposes a strategy for effectively presenting product information in AR, which is a vital component of e-tail environments. This study focuses on AR as an environment where product text information and augmented visual images are integrated to help consumers make purchase decisions. In AR, presenting fashion products with higher quality than actual products can help consumers feel presence and actively visualize product features. In addition, as rich product sensory and aesthetic information prevails in AR, providing increased utilitarian attribute information (e.g., function, material, and comfort) about products in AR services can enhance consumers' visualization, understanding, and positive attitude toward products. Based on the findings, additional questions can be raised on what type of product-related information can form a synergic relationship with AR environments to improve consumers' relationships with products, as the goal of retailers and brands should be to construct consumer-friendly environments for customers' purchasing journeys.

Moreover, this study supports the potential of AR as an effective technology for e-tail environments, which can replace offline store experiences. When consumers acquire information about products through AR, the effective presentation of product information and presence in AR can improve product evaluation. The findings support the potential of AR as a shopping channel that can replace or complement offline stores in the post-pandemic future, as consumers can have offline store-like product experiences through AR. The findings confirm that fashion brands' adoption of AR as an effective presentation tool can contribute to the implementation of consistent consumer experiences. In addition, retailers should consider consumers who are friendly and accommodating toward new technologies as early targets for AR marketing. Thus, retailers can expect consumers with high technological innovativeness to become supporters or distributors of brands or products.

Finally, this study demonstrates considerable managerial significance, because the validity of the results is enhanced through the collection of data via a non-face-to-face experiment method, which allows consumers to experience the product in their natural and everyday environments. While most existing AR studies conduct experiments in artificial laboratory environments, this study records the participants' responses in the context of actual AR use as they freely experience the product through a commercialized application. Additionally, while most existing studies use virtually implemented products, such as watches or sunglasses, as stimuli, this study explores the effect of AR using sneakers, which numerous

fashion brands offered recently through AR. Accordingly, this study broadens the range of items that can leverage AR to facilitate positive purchasing experiences.

Limitations and future research

This study has a few limitations that should be considered in future research. First, this study collected the data of consumers in their 20 s and 30 s, which are the main age groups active in mobile shopping. However, product evaluations in retail environments may differ from those in the online shopping context depending on the age group of the consumers (Im & Lee, 2014). Therefore, we recommend future studies to examine whether differences in responses exist depending on consumers' age group while using AR as a new technology.

Second, in this study, product information was presented as a scenario, and the participants experienced the product by imagining the text information provided in the AR application. However, as one of the strengths of this study is the enhanced validity of the results through an experiment in everyday environments, directly implementing a product's attribute information in an AR setting to identify consumers' responses can strengthen the explanations on the findings by increasing experiment validity.

Third, a single product and brand category was used in this study. However, replicating the study using other brand categories or different types of products can improve the generalizability of the study's findings in the fashion domain.

Fourth, though most of the participants experienced AR in their homes, some experienced the technology in public places, such as their workplace. The consumer–brand relationship may differ depending on the spatial context where mobile shopping occurs. In public environments, consumers typically form brand relationships based on transaction and utility (Olsson et al., 2013). However, experiencing products in a private space induces close and intimate brand relationships and sense of self (Scholz & Duffy, 2018). Although this study verifies the homogeneity between the groups to control for differences according to the place where the participants experienced the product, examining consumers' responses to the different contexts in which they experience AR would be interesting.

Lastly, future research is encouraged to comprehensively explore the synergic influences of other information types provided in AR. Although product information is a fundamental retail environment component in facilitating product experiences, other information types and AR presentation methods (e.g., visual vs. verbal or dynamic vs. static) may evoke different levels of psychological states in consumers. In addition, examining the effects of information type on consumers' emotions (e.g., enjoyment, curiosity, and surprise), which are important indicators of consumer behaviors in the e-tail environment (Beck & Crié, 2016), will enable retailers to update their strategies for constructing AR environment interfaces and keep pace with the emerging prevalence of AR services in the fashion domain.

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Availability of data and materials
The datasets used and analyzed during the current study are available from the first author on reasonable request.

Declarations

Competing interests
The authors declare that they have no competing interests.

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