Analyzing visual behavior of consumers in a virtual reality fashion store using eye tracking

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Abstract

This study investigated the visual behavior of consumers within an immersive virtual reality (VR) fashion store on the basis of their fashion involvement. Their shopping motivation was considered as a moderator. A total of 23 consumers participated, and the participants' actual visual behaviors were recorded in real-time during their store experience section using an eye-tracking device attached to a VR head-mounted display. Results revealed that the greater the consumer's fashion involvement, the greater their attention to the store area, and the greater their ability to observe more diverse areas in the store. Consumers with higher fashion involvement and browsing motivation spent less time focusing on the product area. Meanwhile, consumers with higher fashion involvement and searching motivation spent more time focusing on the product area. Visual attention to the store area positively affected experience satisfaction, and the effect of visual attention to the product area on satisfaction was moderated by consumers' shopping motivation.

Keywords: Immersive virtual reality, Virtual reality store, Visual behavior, Eye-tracking, Shopping motivation, Satisfaction

Introduction

To adapt to the *metaverse* era, every industry must now develop innovative strategies for hybridized real and virtual environments. Following the rapid transformation toward contactless market trends caused by the COVID-19 pandemic, the prevalence of the *metaverse* has intensified. The term *metaverse* was first coined by Neal Stephenson in his 1992 cyberpunk science fiction novel, *Snow Crash*, and refers to a 3D virtual world in which real people reside in the form of avatars (Kim, 2021; Smart et al., 2007). This concept has been discussed and predicted for a long time. For example, the *Metaverse Roadmap* (2007), published 15 years ago, considers the metaverse a nexus or junction between the physical and the virtual world, proposing four key components in predicting the future scenario of the metaverse: virtual worlds, mirror worlds, augmented reality, and lifelogging (Smart et al., 2007). Particularly, Smart et al. (2007) predicted that ultimately virtual worlds would be expressed in the form of immersive virtual reality

(VR) technology, and that the economic and social activities of the physical world would be increasingly connected with the virtual world.

Based on a McKinsey & Company survey, consumers are most interested in the retail sector (i.e., shopping) of the metaverse (Aiello et al., 2022). Therefore, brands are testing new concepts and media in physical and virtual environments in order to attract digital shoppers (WGSN Insight Team, 2022). To differentiate themselves in a crowded e-commerce environment, brands are seeking to implement the delivery of experiential values in the online shopping space that were once performed in the physical retail space. Global e-commerce spending grew 25% year on year in 2020, heightening the need for developing an enhanced e-commerce experience in an effort to attract additional spending from digital customers (Poile, 2021).

For the fashion and beauty industries, sensory and emotional experiences are vital factors that influence consumers when choosing products (Citrin et al., 2003) and retail channels (Nicholson et al., 2002). As such, fashion and beauty brands are trying to connect the virtual world with the real world by building and introducing their own virtual stores and products. According to Obsess, a startup specializing in building VR e-commerce stores, in April 2020 after the COVID-19 outbreak began, inbound inquiries increased 300% compared to the average monthly number in early 2019 (Flora, 2020). Many fashion brands, including Gucci, Vans, Balenciaga, Ralph Lauren, and Burberry, opened VR stores in 2020. These recent attempts, such as virtual stores, NFT products, and brand-game partnerships, are the precursors to a complete "meta-commerce experience" (Mcdowell, 2021).

Despite the continuous efforts to blend virtual and physical spaces, whether consumer behavior in the virtual space differs from brick-and-mortar stores must be determined. Thus, this study explores the actual visual behavior of fashion consumers in immersive VR stores using the eye-tracking method. The eye-tracking method, one of the standard physiological techniques (Hwang & Lee, 2017) for analyzing visual behavior, provides objective data while people perform a certain task. Therefore, the eye-tracking technique is generally adopted for analyzing human's visual behaviors in the various fields including human–computer interaction, marketing, education, and communication (Hwang & Lee, 2017; King et al., 2019). The user's visual behavior in a shopping situation can be used as an indicator to reveal the cognitive processes taking place when a consumer searches for a product and makes a purchase decision, and can be used to identify the area in which the consumer is interested and participates (Zhang et al., 2009). By analyzing visual behavior in this way, this study also contributes to laying the foundation for empirical research using eye-tracking technology in VR environments for immersive retail research.

The fashion industry includes a diverse range of target consumers with varying levels of knowledge and experience with fashion. Given these characteristics of fashion consumers, consumer fashion involvement is an important variable for predicting fashion consumer behaviors (O'Cass, 2004; Park et al., 2006), and was used as an independent variable. Meanwhile, the store- and product-related attributes in the whole store environment are important for consumers' decision-making process. Consumers integrate evaluations about the attributes of both the store and the product and make inferences and decisions on both products and the store (Chan & Wong, 2012; Sen et al., 2002). To

confirm the effect of consumer fashion involvement on visual behavior and form their satisfaction in an immersive VR fashion store, this study aims to analyze visual behavior in an immersive VR environment using eye-tracking technology. Therefore, we propose the following research questions:

RQ1: Based on their fashion involvement level, how do fashion consumers in VR stores exhibit visual attention toward store- and product-areas?

RQ2: What affect does a consumer's visual attention toward store- and product-areas within a VR store have on their satisfaction toward the VR store experience?

Literature Review

Consumer satisfaction through the store environment experience

Consumer satisfaction is a concept that includes emotional evaluations, such as pleasure from consumption experience and cognitive evaluations that the experience was better than expected (Batra & Ahtola, 1990; Hirshman & Holbrook, 1982; Homburg et al., 2006). Given that consumer satisfaction positively affects brand or specific distribution channel re-patronage, customer loyalty, word of mouth, and how it ultimately contributes to brand equity formation (Babin et al., 2005; Bloemer & Ruyter, 1998; Neslin & Shankar, 2009; Torres & Tribó, 2011), increasing consumer satisfaction through impressive shopping experiences is a major challenge for companies in a competitive market. Especially in the retail context, consumer satisfaction generally reflects the overall evaluation of a store and is an important outcome of a retail experience (Macintosh & Lockshin, 1997). Consumers perceive value in the shopping process and form preferences for products or services on the basis of the store environment (Shukla & Babin, 2013), the sensory experience at the store, and the interaction with products and the environment, thereby leading to customer satisfaction (Hirshman & Holbrook, 1982).

Although the store environment is defined as the physical environment of an offline store (Bitner, 1992; Lam, 2001), the concept of the store environment has been expanded to virtual spaces connected through the internet as shopping through online channels is activated (Shergill & Chen, 2005). Owing to technological advancements, creating an appealing store environment in an online virtual space and delivering impressive experiences to consumers via various media are now possible (Kozinets et al., 2002). For instance, immersive VR media has the advantage of providing an experience similar to shopping in a physical store. Blázquez (2014) emphasized that new technologies, such as VR, will play an important role in improving the consumer experience of online fashion shopping and discussed the need for more impressive and superior store experiences to satisfy fashion consumers. Therefore, consumer satisfaction was taken into consideration as a dependent variable, which is an important and essential outcome of an immersive VR store experience.

As VR technology provides an opportunity to make life-like virtual fashion store simulations, another notable point is that consumers can obtain store- as well as product-related cues from the virtual fashion store experience. Traditional online shopping environments only provide product-related cues, but lack store-related cues. However, an advanced VR store allows consumers to experience a store's atmosphere. Typically, a physical store environment provides consumers with both

store-related and product-related cues, and to make decisions and evaluations about certain products and stores, consumers use both cues separately or together (Chan & Wong, 2012; Sen et al., 2002). Thus, to understand consumer behaviors in this new kind of shopping channel, the VR store, further research is needed to explore how consumers pay attention to both store- and product-areas and integrate their evaluation of each to form an overall evaluation.

Fashion involvement

Involvement is an essential framework to understand consumer decisions and behaviors (Chakravarti & Janiszewski, 2003; Russell-Bennett et al., 2007). It reflects consumers' enduring perceptions of specific product categories on the basis of their needs, interests, and values (De Wulf et al., 2001). Consumer fashion involvement refers to the level of individual involvement in fashion product categories. Fashion involvement is the degree to which an individual has an interest in fashion products or a fashion shopping situation, or the degree to which an individual perceives it as important and reflects their continued interest and importance in fashion (O'Cass, 2000, 2004).

Consumers with high fashion involvement are highly likely to influence other consumers and promote fashion trends. This makes them an extremely important group to consider when developing a marketing strategy, especially in the fashion industry, where predicting consumers and markets is difficult due to rapid trend changes (Goldsmith et al., 1999). High fashion involvement consumers pay more attention to and understand more information in the shopping context than low involvement consumers, and they also use more diverse fashion information sources—such as the store environment cues—whereas other consumers are likely to use peripheral cues, such as the aesthetic value of products (Andrews & Shimp, 1990; Gordon et al., 1998).

In the consumer literature, participation and satisfaction are well-studied concepts, and high levels of engagement generally lead to high levels of satisfaction (Mudie et al., 2003; Richins & Bloch, 1991). Consumers with high involvement are more likely to be motivated to experience greater satisfaction (McColl-Kennedy & Fetter, 2001; Tsiotsou, 2006). In the context of fashion shopping for buying shoes, Tsiotsou (2006) found that consumers' involvement positively affects purchase intention through perceived overall satisfaction, confirming the findings of Richins and Bloch (1991). Overall, with regard to the visual behavior of consumers in the virtual environment store, consumers with a high degree of fashion involvement will not only pay attention to products but also to more diverse and richer areas of the store. In addition, higher fashion involvement and richer visual attention toward the store will lead to higher satisfaction with the VR store experience. Thus, we propose the following hypotheses:

> *H1*: Consumers' fashion involvement level will positively affect satisfaction with the VR store experience.
> *H2*: Consumers' fashion involvement level will positively affect visual attention toward the store-area of the VR store environment.
> *H3*: Visual attention to the store-area will positively affect satisfaction with the VR store experience.

Role of shopping motivations

Consumer behavior in a computer-mediated environment can be divided into two broad categories: goal-directed behavior and experiential behavior (Hoffman & Novak, 1996). In the marketing literature, these behaviors are frequently described in terms of utilitarian and hedonic or experiential benefits (Havlena & Holbrook, 1986; Hoffman & Novak, 1996). In the shopping context, these behaviors can be regarded as searching and browsing behavior (Moe, 2003). The consumer's browsing behavior is experiential and is related to the intrinsic motivation to pursue hedonistic profit, such as orientation toward a pleasant experience, whereas the consumer's searching behavior is related to the achievement of a goal or task of purchasing a product and the pursuit of practical profit. Consumers with purchase motivation focus on reviewing products in-depth before purchase, efficiently searching for product-related information, and interpreting collected information; whereas consumers with experience motivation focus on pleasant experiences in the shopping process (Hoffman & Novak, 1996; Janiszewski, 1998; Schlosser, 2003). Consumers with browsing motivation show simple information collection without purchase intention and product search for entertainment purposes, and these information search activities are related to the enjoyment of sensory stimuli and satisfaction of curiosity rather than product judgment and evaluation (Fiore & Kim, 2007).

In each case, searchers and browsers are driven by different motives and thus respond differently to varying marketing messages (Moe, 2003). Browsing behaviors can be driven by enduring involvement with a product category and more varied search motives than just product purchase, whereas searching behaviors are characterized by and related to situational involvement and directed search motives direct for specific products (Hoffman & Novak, 1996). As a result, consumer visual behavior in a VR fashion store can vary depending on their shopping motivations, and the shopping motivation will also affect the process by which visual attention in the store affects consumer satisfaction. Specifically, consumers with searching motivation will pay more attention to the product-area than consumers with browsing motivation, and the visual attention on the product-area will result in VR shopping satisfaction for these searchers. Therefore, we propose the following hypotheses:

> *H4: The effect of fashion involvement on visual attention to the product-area will be moderated by consumers' shopping motivation (searching vs. browsing).*
> *H5: The effect of visual attention to the product-area on consumer satisfaction will be moderated by consumers' shopping motivation (searching vs. browsing).*

The conceptual framework of this study is shown in Fig. 1.

Methods

VR store stimuli

A VR store of the Hyundai Department Store, which recently introduced virtual store service in the Korean retail industry, was used as a stimulus to secure the external validity of the study. The virtual store can be accessed through The Hyundai.com (http://www.thehyundai.com), an online store operated by Hyundai Department
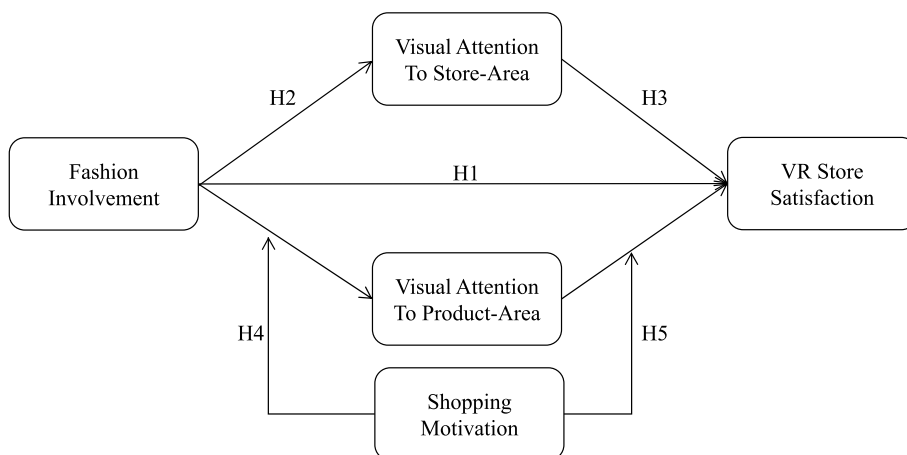
Fig. 1 The conceptual framework of the study

Store. This VR store environment provides consumers with a strong sense of immersion, or telepresence, by replicating its physical offline store in the virtual realm (Jang et al., 2019).

Among the VR stores provided by Hyundai.com, the NIKE VR store was selected as the stimuli of this study given that the store has a relatively large space and includes womenswear and menswear products. Moreover, consumers are able to spend enough time in this VR store to gain a sense of the store's atmosphere and to browse various areas and products. On the Hyundai.com website, the Nike's Pangyo branch of the Hyundai department store was provided. The images of the VR store are provided in Fig. 2.

Measuring visual behaviors

This study used eye-tracking technology for measuring consumers' visual behaviors in the VR store, in particular the visual attention toward each store- and product-area in the store. When studying and analyzing visual behaviors using eye-tracking, researcher can set up an Area of Interest (AOI) in the presented scene. While participants view the scene, the eye-tracker can gather data of their visual behavior simultaneously, including the eye-fixation and eye-movement paths within the each AOIs (Hwang & Lee, 2017). To identify the participants' visual behavior, usually two metrics are adopted and used as the visual attention index: total fixation duration (TFD), and total fixation count (TFC). Consumers can provide cognitive and emotional responses only after paying attention to the object. These indices indicate levels of cognitive processing by measuring how individuals visually respond to stimuli (Holmqvist et al., 2011; Hwang & Lee, 2017). More intuitively, the TFD and TFC is calculated as the sum of duration or number for all fixations within an AOI, therefore it indicates strong visual attention toward the AOI (Holmqvist et al., 2011; Hwang & Lee, 2017). The current study also set up two AOIs with each store- and product-area in the VR store, and measured TFD and TFC of each AOIs for analyzing consumers' visual attentions.

Fig. 2 The VR store stimuli of this study

Participants and procedure

This study was conducted with consumers in their 20s and 30s, the main target group of the brand selected as the stimuli. The previous findings that consumers' demographics such as age can affect VR experiences (Bangay & Preston, 1998) was considered; thus, this study limited the participants' ages to young consumers in their 20s and 30s who are relatively familiar with advanced technologies and have similar demographics. Based on the suggestions of Holmqvist et al. (2011), the minimum requirement of a sample size for each cell is 10. Our study contained two cells (i.e., shopping motivation condition of browsing vs. searching), therefore, data from 23 people (5 males and 18 females) who voluntarily participated in the experiment were collected and analyzed. The demographic characteristics of participants are presented in Table 1.

Research participants first answered questions to confirm their level of experience with VR technology with two items (e.g., "I have experienced VR more than others") and then responded to fashion involvement, an individual characteristic (five items, Choo et al., 2014; O'Cass, 2000). Afterward, the participants were randomly assigned to one of two groups according to the shopping motivation conditions ($N_{searching} = 11$, $N_{browsing} = 12$). Participants in the searching condition were guided to immerse themselves in a scenario in which they were asked to choose a product to purchase while looking around the VR

Table 1 Demographic characteristics of participants

Variable	Category	Frequency (%)	Variable	Category	Frequency (%)
Age	23	3 (13.0)	Gender	Female	18 (78.3)
	25	2 (8.7)		Male	5 (21.7)
	26	1 (4.3)	Education	Undergraduate student	3 (13.0)
	27	3 (13.0)			
	28	3 (13.0)		Bachelor's degree	1 (4.3)
	30	2 (8.7)			
	31	3 (13.0)		Graduate student	17 (73.9)
	32	1 (4.3)			
	34	1 (4.3)		Graduate degree (Master's, Ph.D.)	2 (8.7)
	36	1 (4.3)			
	38	2 (8.7)	Occupation	Student	19 (82.6)
	39	1 (4.3)		Worker	3 (13.1)
	Mean	29.61		Other	1 (4.3)

store. Instead of being given a specific shopping task, participants in the browsing condition were given a scenario in which they were asked to explore the VR store in their spare time.

The HTC VIVE system with a headset applied a lens-type eye-tracking camera and an analyzing solution system from *VisualCamp* (https://visual.camp), a startup company in Korea that provides eye-tracking solutions in a VR environment, were used for VR eye tracking and analysis. After familiarizing themselves with the scenario, the study participants were instructed on how to operate the device and how to experience the virtual store, and a stabilization procedure was performed so that they could become accustomed to operating the device through a simple tutorial. In the experience section, participants left their seats while wearing a headset and freely explored the virtual store for three minutes. Visual behaviors were recorded in real time through an eye-tracking camera attached to an immersive VR device while the participants explored the store. After the experience was over, the participants were asked to respond to the items about experiential shopping orientation (two items, Sands et al., 2015) to check the manipulation of shopping motivation. They also responded to questions about their satisfaction with the shopping experience (three items, Vasquez-Parraga, 2017), and basic demographics.

Before the eye-tracking data extraction, the virtual store was divided into two Areas of Interest (AOI): a store-area and a product-area, as shown in Fig. 3 (yellow-colored area: AOI for store, blue-colored area: AOI for product). Next, for statistical analysis, total fixation duration (TFD) and total fixation count (TFC), which are visual attention indexes for each AOI, were extracted as numeric data. The collected data were analyzed using SPSS 26.0 and SPSS PROCESS Macro 3.5.

Results

Before hypothesis testing, the validity and reliabilities of every variable were confirmed as satisfactory with values of the Cronbach's α over 0.85, while they were extracted within one factor. For manipulations check, a t-test was performed with shopping motivation condition as an independent variable and experiential shopping orientation as a dependent variable. The result revealed that participants with the browsing condition
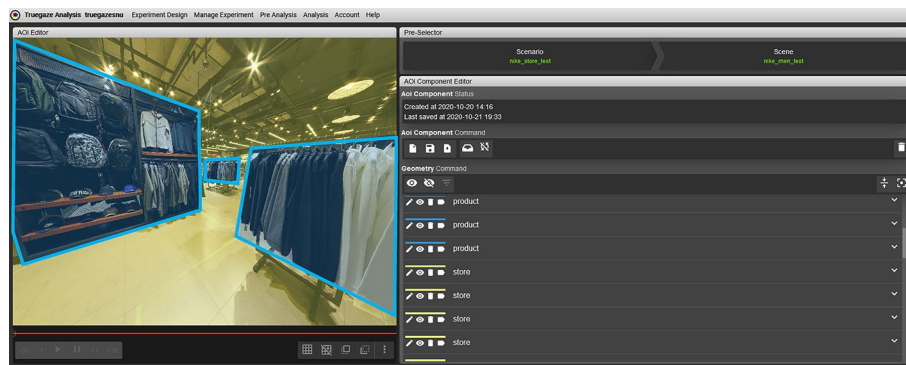
Fig. 3 Creating areas of interest

showed statistically higher experiential shopping orientation than participants with the searching condition ($M_{searching} = 3.5$, $M_{browsing} = 4.5$; $t(21) = -4.06$, $p < 0.01$), indicating the manipulation was successful.

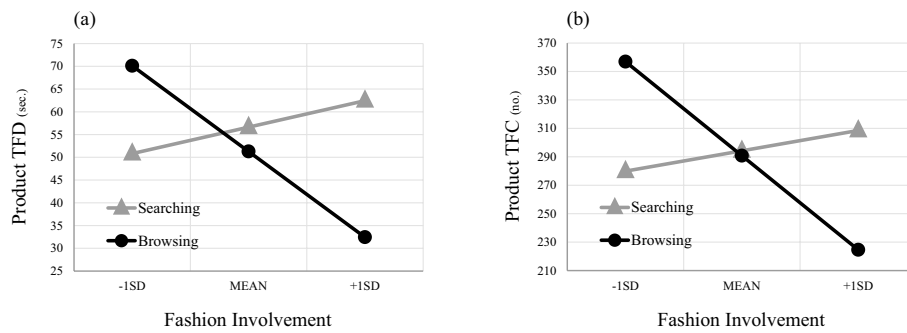**Consumer satisfaction according to consumer fashion involvement**

To test H1, a linear regression analysis was conducted with fashion involvement as an independent variable, and satisfaction as a dependent variable. In the testing model, the fashion involvement had a significant effect on satisfaction ($p < 0.01$) with an *Adj. R^2* of 0.246 ($R = 0.530$, $R^2 = 0.280$, $Adj.R^2 = 0.246$, $F = 8.182$, $p < 0.01$). Therefore, H1 is supported.

Differences in visual attention according to consumer fashion involvement

Visual attention on the store environment according to consumer fashion involvement

Hypothesis 2 predicts a positive influence of fashion involvement on visual attention toward the area of the store environment. To test H2, two linear regression analyses were performed with fashion involvement as an independent variable, and TFD and TFC of the store AOI as the dependent variables for each model. First, fashion involvement's influence on participants' TFD toward the store AOI was marginally significant ($R = 0.398$, $R^2 = 0.159$, $Adj.R^2 = 0.119$, $F = 3.964$, $p = 0.06$). When the TFC toward the store AOI was entered as the dependent variable, the influence of fashion involvement was insignificant ($R = 0.330$, $R^2 = 0.109$, $Adj.R^2 = 0.066$, $F = 2.564$, $p = 0.12$). This result implies that fashion involvement did not affect how many times the participants saw the store area. However, the higher the fashion involvement, the longer the participant paid attention to the store-area within the VR store environment.

Additionally, the moderating impacts of shopping motivation between fashion involvement on TFD and TFC of store AOI were tested using the SPSS Macro Process (Hayes, 2012) Model 1 with 95% confidence intervals and 5,000 bootstrap samples (Hayes, 2012; Preacher & Hayes, 2004). The shopping motivation was entered as a moderator (searching = 0, browsing = 1), and the consumer's prior VR experience level was entered as a covariate. The results showed the moderating effect of shopping motivation on both TFD and TFC of the store AOI is not significant, revealing that consumers' fashion involvement positively impacts visual attention toward store-area of the VR fashion store regardless of their shopping motivation.

Note: TFD = Total Fixation Duration; sec. = second; TFC = Total Fixation Count; no. = number

Fig. 4 The effect of fashion involvement level on product (**a**) TFD and (**b**) TFC

Visual attention on the products according to consumer fashion involvement

Hypothesis 4 predicts the effect of fashion involvement on visual attention toward the product-area as well as the moderating role of shopping motivation. When two linear regression analyses were performed with TFD and TFC of the product AOI as the dependent variables, the influence of fashion involvement was insignificant in both models. To test H4, simple moderation models were analyzed using the SPSS Macro Process (Hayes, 2012) Model 1 with 95% confidence intervals and 5,000 bootstrap samples (Hayes, 2012; Preacher & Hayes, 2004).

First, the model with fashion involvement was examined as an independent variable, shopping motivation (searching = 0, browsing = 1) as a moderator, and TFD of the product AOI as a dependent variable. The consumer's prior VR experience level was also included as a covariate. The analysis showed that the interaction effect between fashion involvement and shopping motivation on TFD of the product AOI was marginally significant ($p = 0.069$), whereas the direct effects of fashion involvement and shopping motivation on the product TFD were insignificant. In the searching condition, participants showed a tendency to pay more attention to the products when the fashion involvement level is higher, while in the browsing condition, the higher fashion involvement resulted in shorter attention to the products area. When the TFC of the product AOI was entered as a dependent variable, the interaction term had a marginally significant effect on the product TFC ($p = 0.064$). A similar tendency was also observed for the product TFC (see Fig. 4).

To explore the difference in visual attention according to the participants' fashion involvement level in more detail, the heat map of their gaze movement was extracted by dividing all participants into two groups on the basis of their fashion involvement level. As shown in Fig. 5, participants with relatively high fashion involvement showed richer visual attention than participants with relatively low fashion involvement. Low involvement participants generally focused on the products, high involvement participants gazed more at various areas in the store environment, such as the ceiling, lights, a mirror on the wall, and the floor.

(a) Gaze heat map of low fashion involvement group

(b) Gaze heat map of high fashion involvement group

Fig. 5 The heat map of participants with **a** low and **b** high fashion involvement

Effect of visual attention on consumer satisfaction

Effect of visual attention to the store environment on consumer satisfaction

To test H3, which predicts the positive effect of visual attention toward the store on consumer satisfaction, two linear regression analyses were conducted. In the first analysis, the store TFD was entered as an independent variable and satisfaction as the dependent variable. The result showed that the effect of TFD toward the store AOI on satisfaction was significant ($R = 0.645$, $R^2 = 0.416$, $Adj.R^2 = 0.389$, $F = 14.986$, $p < 0.01$). When the TFC toward the store AOI was entered as the independent variable, the effect of the store TFC on satisfaction was also significant ($R = 0.510$, $R^2 = 0.260$, $Adj.R^2 = 0.225$, $F = 7.379$, $p < 0.05$), supporting H3. Thus, the time and frequency of participants' gaze toward the store environment area positively influenced their satisfaction with the VR store experience.

Additionally, the moderating impacts of shopping motivation between TFD and TFC of the store AOI on satisfaction were tested using the SPSS Macro Process (Hayes, 2012) Model 1 with 95% confidence intervals and 5,000 bootstrap samples
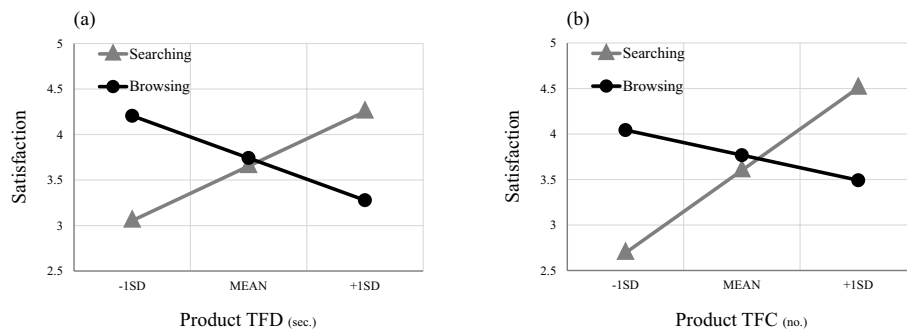
Note: TFD = Total Fixation Duration; sec. = second; TFC = Total Fixation Count; no. = number

Fig. 6 The effect of product (**a**) TFD and (**b**) TFC on satisfaction

(Hayes, 2012; Preacher & Hayes, 2004). The shopping motivation was entered as a moderator (searching = 0, browsing = 1), and the consumer's prior VR experience level was entered as a covariate. The results showed the moderating effect of shopping motivation is not significant in both conditions, thus the results showed that consumers' visual attention to the store-area positively impacts satisfaction toward the VR fashion store experience regardless of their shopping motivation.

Effect of visual attention to the products on consumer satisfaction

Lastly, H5 tested the effect of visual attention toward the area of the product on satisfaction as well as the moderating role of shopping motivation. When two linear regression analyses were performed with TFD and TFC of the product AOI as the independent variables, the effects of product TFD and TFC on satisfaction were insignificant in both models. To test H5, two simple moderation model analyses were conducted using the SPSS Macro Process (Hayes, 2012) Model 1 with 95% confidence intervals and 5,000 bootstrap samples (Hayes, 2012; Preacher & Hayes, 2004).

The first model includes product TFD as an independent variable, shopping motivation (searching = 0, browsing = 1) as a moderator, and satisfaction as a dependent variable. The consumer's prior VR experience level was entered as a covariate. The analysis showed that the interaction effect between product TFD and shopping motivation on satisfaction was significant ($p < 0.05$), with significant direct effects of product TFD ($p < 0.05$) and shopping motivation ($p < 0.05$) on satisfaction. Specifically, the effect of product TFD on satisfaction was significant when the participants' motivation was searching ($p < 0.05$), but not for browsing ($p = 0.15$). Therefore, for the participants with searching motivation, the longer duration of visual attention on the products area leads to higher satisfaction with the VR store experience. When the TFC of the product AOI was entered as an independent variable, the same results were obtained. The interaction term significantly affected satisfaction ($p < 0.05$), with significant direct effects of product TFC ($p < 0.05$) and shopping motivation ($p < 0.05$) on satisfaction. For participants with searching motivation, the more they gazed at the product area, the higher their satisfaction with the VR store experience, but not for the participants with browsing motivation. Therefore, H5 is supported (see Fig. 6).

Conclusions

Our results further understanding of the visual behavior of fashion consumers in an immersive virtual store using eye-tracking technology. This study sheds light on this area and provides insights into understanding consumers in the emerging shopping channel in the metaverse era. Overall, this study reveals that consumers with a high fashion involvement showed rich visual attention, observing more diverse areas of the store-area than consumers with low fashion involvement. However, low involvement consumers exhibited a more sustained focus on product areas than high involvement consumers. This tendency was more pronounced when consumers had browsing motivation. Our study also lends insight into how the effect of consumers' visual attention on experience satisfaction differed depending on consumers' shopping motivation. Consumers with searching motivation tended to be more satisfied with the VR store experience as their visual attention to the product area was higher, whereas those with browsing motivation tended to have higher experience satisfaction as their visual attention to the product area was lower.

Given that the retail experience is more important to consumers than ever before, and one of the VR system's unique characteristics is the ability to provide hedonic experiences, this study extends the current literature by explaining the visual attention mechanism of consumers on store and product areas, separately. According to the cue utilization theory and based on the consumer-decision-making theory in the retail context, consumers in a store use store- and product-related cues individually or in combination to draw inferences and decisions about products and stores (Chan & Wong, 2012; Sen et al., 2002). In previous research about the impact of the physical store environment, Baker et al., (1994, 2002) showed that consumers' inferences about products based on product-related cues in the store environment may be a more significant antecedent of overall store image (i.e., perception of the store) formation and store patronage intention. With regard to consumers with searching motivation, our findings revealed results consistent with previous studies on the important role of the product-area. However, by considering both the fashion involvement level of consumers and their shopping motivation, this study further revealed that attention toward not only the product-area but also the store-area can play a vital role in forming consumers' evaluation of the store experience, especially for high fashion involvement consumers and browsers. As a new kind of retail channel, VR stores are usually used for experiential purposes for fashion consumers who want to explore novel brand experiences (i.e., with browsing motivation). This finding has meaningful implications for retail practitioners that presenting rich store-related cues can be an effective strategy for developing VR fashion stores if their target consumer group has high fashion involvement.

Surprisingly, when the gaze movement of participants was examined using a heat map, we discovered that the participants frequently looked at the floor while exploring the VR fashion store, possibly to confirm their location within the virtual space. Another possible explanation is the weight and size of the VR headset device. Consumers may have looked down to endure heavy VR headsets or to reposition the headset for more vivid vision while shopping. Technology is advancing, and VR headsets are become more lightweight convenient. If consumers tend to place visual attention toward the floor, we suggest further study to investigate what areas in the

virtual store are effective for dispersing information. Furthermore, if consumers are frequently distracted during the VR shopping experience by checking the floor, it is necessary to investigate the effect of the type, amount, and content of information presented in the virtual store on consumers' concentration and the subsequent behavioral consequences.

As companies, such as Google, Facebook (i.e., Meta), Snapchat, and EE, continue to advance their respective VR hardware and devices, smart glasses with VR displays are evolving (Gibbs, 2022). These devices may evolve from being niche gadgets, to serving functions consumers now fulfill with their smartphones. Moreover, the VR store itself also continues to evolve, as evidenced by beauty brand Charlotte Tilbury bringing online shopping into the metaverse by adding a social shopping feature called "Shop With Friends" as well as a game feature to find hidden keys in the VR online store (Flora, 2021). Thus, the changes in consumer behavior created by the physical and technological characteristics of newly emerging devices and VR systems must be continually investigated.

This study has some limitations, such as small sample size and a research subject limited to young consumers. The marginally significant results may be attributed to the small sample size. Therefore, the results should be confirmed with a larger sample size. In addition, to generalize the findings of this study, future research should be conducted with a broader age range, gender, and consumer preferences related to fashion and technology. While more study is needed to determine what kind of behavior consumers engage in when shopping in virtual reality, and whether it differs from behavior in a physical store, this study can be used as a baseline to promote the understanding of consumer behavior in VR store environments and to develop strategies for the planning and creation of VR store environments.

Abbreviations
VR   Virtual reality
AOI   Area of interest
TFD   Total fixation duration
TFC   Total fixation count

Authors' information
Dr. Ju Yeun Jang is a research assistant professor in the School of Fashion and Textiles at The Hong Kong Polytechnic University. Her primary research focuses on digital marketing communication especially using advanced technology such as virtual reality and its impact on consumer responses for developing creative business strategies.

IRB approval information
This research was conducted under the approval and supervision of Seoul National University Institutional Review Board (IRB Approval No: 1808/001-009) regarding ethical issues including consent to participate.

Authors' contributions
JJ is the single author of the manuscript and has written the whole paper. The author designed the study and developed the theoretical framework, besides analyzing data. JJ also conducted the experiment design, data collection, analyses, and writing of the manuscript. The author contributed to the formatting and editing of the manuscript, and the final manuscript was read and approved by the author.

Availability of data and materials
The data will not be shared with the reason that authors are seeking further research.

Declarations

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