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Short Paper

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Abstract

Virtual-reality (VR) technology seems to be an efficient tool for consumer-brand relationship management since it could affect individuals' psychological distance by enhancing their presence experiences. However, the effects of VR on individuals' psychological distance are inconsistent. Based on the customer experience framework and construal level theory, these inconsistent effects could be attributed to the two aspects, namely, internal components of presence experience (i.e., immersive presence and realistic presence) and different impacts of vividness modes (i.e., modeling mode and panoramic mode). To address the above research gap, this study plans to investigate the relationships among consumers' self-brand distance, presence experiences, vividness modes, and interactivity. An experiment will be conducted to collect empirical data in the VR-simulated shopping environment. The analysis of covariance could be used to examine the hypotheses. This research could offer implications to the literature and practice related to VR shopping and consumer-brand relationship management.

Keywords: Virtual reality (VR), psychological distance, presence experience, vividness modes, consumer-brand relationship management

Introduction

Consumers' Self-brand distance, i.e., their psychological distance regarding how far a brand is from themselves (Choi and Winterich 2013), has been considered as an essential approach in consumer-brand relationship management because most of consumer-brand relationship constructs largely implicate the idea of close and proximal psychological distance (Connors et al. 2021; MacInnis and Folkes 2017). Given the enormous potential of virtual reality (VR) technology in consumer relationship management by enhancing consumer experience (Hoyer et al. 2020; Libai et al. 2020), particularly in the experience of presence (Harz et al. 2022), VR is probably more efficient in bridging psychological distance (Breves and Schramm 2021). In comparison with less-presence media (e.g., picture and video), VR mediums might exhibit higher vividness and interactivity (Barhorst et al. 2021; Yim et al. 2017), and these advantages can enable VR to affect individuals' psychological distance more efficiently in various contexts, such as environment protection (Raja and Carrico 2021), tourism (Kang 2020) and social media (Pena et al. 2021).

Yet despite the fact that VR has been considered as an essential technique in affecting individuals' psychological distance, the effects of VR on individuals' psychological distance are inconsistent (Breves and Schramm 2021; Raja and Carrico 2021). For instance, while VR can lessen users' psychological distance by

enhancing their identifiability (Pena et al. 2021), previous research indicates that VR results in higher perceived social distance (Kalyanaraman et al. 2010), which is the essence of self-brand distance (Connors et al. 2021). Based on the framework of customer experience (Becker and Jaakkola 2020) and research on psychological distance (Connors et al. 2021; Trope and Liberman 2010), these inconsistent effects could mostly be attributed to two significant aspects, namely, the different components of presence experiences and vividness modes.

In the VR literature (Hilken et al. 2017; Weber et al. 2021), "presence" is one of the predominant consumer experiences and a critical maintain affecting consumers' decision-making and perceptions. As VR simulation can provide consumers with a high-level presence experience by moving them and their avatar to another environment, the consumers can perceive a nearer hypothetical distance (Kang 2020). However, current research (Breves and Schramm 2021) shows that the impact of perceived presence on psychological distance is nonsignificant. We believe that these mixed results are partly because existing literature on presence experience primarily focuses on the immersive component (Miller et al. 2021; Peukert et al. 2019) and neglects its realistic component (Scavarelli et al. 2021; Weber et al. 2021), whereas the consumers' feeling of authenticity is vital to maintain the consumer-brand relationship (Heinberg et al. 2020). Moreover, existing VR research has yet empirically investigated the relationship between the consumers' presence experience on their social distance, whereas the self-brand distance is one kind of social distance (Connors et al. 2021). To address this gap, this study aims to examine, firstly, the following question:

> **RQ1**: Does consumers' self-brand distance change by different components of presence experience (i.e., immersive and realistic presence)?

Vividness has long been acknowledged as a prominent technological variable in affecting individuals' presence experience when using VR technology (Peukert et al. 2019; Steuer 1992; Wang et al. 2021), but there remains an adverse impact on consumers' presence experience (Hilken et al. 2017; Miller et al. 2021). Considering that vividness depends on the technical characteristics of the medium (Steuer 1992), these opposite results could be attributed mainly to the two different vividness modes (Ritter and Chambers 2022), namely, modeling mode and panoramic mode. In practice, online housing platforms (e.g., 58, Anjuke, Beike, and Lianjia) adopt panoramic VR to give consumers a more realistic visualization of new housing estates and resold apartments. Automobile brands (e.g., BYD, Chevrolet, Ford, GAC, and Honda) often exhibit their new cars using 3D models. That said, 3D models can also exhibit new housing estates, and the new vehicles can be shown by panoramic VR. Since the panoramic mode is based on photorealistic images of a real environment (Park et al. 2021), the panoramic mode seems more realistic than the modeling mode. On the contrary, users could be more likely to be immersed in modeling mode, considering that users are less distracted in experiencing modeled simulation (Ritter and Chambers 2022). Nevertheless, the above relationships and arguments have yet to be empirically examined since most studies focus on the level (high vs. low) of vividness (Harz et al. 2022; Miller et al. 2021) rather than the different technical modes of vividness. For these reasons, we examine the following:

> **RQ2**: How consumers' presence experiences are affected by two of the vividness modes of VR (i.e., modeling mode and panoramic mode)?

In addition, given that interactivity has also long been considered as another critical technical variable in influencing presence experience (Peukert et al. 2019; Steuer 1992), the above effects could be moderated by interactivity. Besides, previous studies have supported the positive impacts of interactivity on consumers' presence experience (Shafer et al. 2019; Wang et al. 2021). In this context, consumers can generate different presence experiences using differentiated vividness modes within high or low interactivity. Thus, this research attempts to investigate:

> **RQ3**: How the impacts of vividness modes on presence experiences are moderated by interactivity?

To address these research gaps, this study develops a conceptual model based on the customer experience framework (Becker and Jaakkola 2020) and psychological distance literature (Connors et al. 2021; Trope and Liberman 2010). Specifically, we develop a moderated mediation model that consumers' self-brand distance can be affected by the vividness modes of VR, which is mediated by consumers' presence experiences. Besides, the interactivity might moderate the relationship between the vividness modes of VR and presence experiences. To investigate the relationships among consumers' self-brand distance, presence experiences, vividness modes, and interactivity, an experiment will be conducted to collect empirical data in the VR shopping environment. The analysis of covariance (ANCOVA) could be used to examine our

hypotheses. This research could contribute to the literature on VR and consumer-brand relationship. Specifically, by clarifying the different roles of two vividness modes in affecting consumers' presence experiences, we can better understand how to improve consumer experience in a VR-simulated marketing context. Also, this research enriches the knowledge of consumer-brand relationship management by uncovering the impacts of two presence experiences on bridging consumers' self-brand distance. Moreover, this study can offer insights into VR design by confirming the moderating role of interactivity.

Theoretical Foundation

Self-Brand Distance and Virtual-Reality

While existing studies have investigated many consumer-brand relationship constructs (Fang et al. 2021; Huang and Liu 2021), most consumers avoid developing close relationships with brands (Connors et al. 2021). One possible reason for this is that the nature of many consumer-brand relationship constructs (e.g., relationship quality) typically originated from social psychological theories that related to close relationships (e.g., family members), whereas it may not be well-suited to predict such less-intimate relationships as consumer-brand relationship (Breivik and Thorbjornsen 2008). By contrast, self-brand distance can apply to both close and weak relationships between consumers and brands since it reflects the consumers' psychological distance that a specific brand is close or far away from themselves (Choi and Winterich 2013; Trope and Liberman 2010). Moreover, self-brand distance is embedded in the core of all major consumer-brand relationship constructs, as these constructs explicitly or implicitly reflect the closeness of self-brand distance (Connors et al. 2021; MacInnis and Folkes 2017). Accordingly, this study focuses on the roles of self-brand distance in consumer-brand relationship management.

According to the construal level theory (Trope and Liberman 2010), psychological distance can be reduced by low-level construal (Zhang and Wang 2009) and concrete stimuli (Connors et al. 2021). In comparison with less-presence media, VR can exhibit higher visualization and automated-tracking capabilities (Harz et al. 2022), and these advantages can enable VR to affect psychological distance more efficiently in various contexts, such as online tourism services (Kang 2020) and immigration management (Pena et al. 2021). However, the influence of VR on psychological distance is unstable (see Table 1). For instance, qualitative investigation suggests that VR can decrease psychological distance (Raja and Carrico 2021), but empirical evidence only supports its reduction effect on temporal distance (Breves and Schramm 2021). Unexpectedly, VR can expand users' social distance (Kalyanaraman et al. 2010). Recent research also indicates that VR can reduce and enhance psychological distance (Pena et al. 2021). These inconsistent effects could be attributed mainly to the different effects between the components of consumers' presence experiences and two types of vividness modes.

Reference	Context	Theory Base	Method (Sample)	Antecedents	Psychological Distance			
					Social	Spatial	Temporal	Hypothetical
Kalyanaraman et al. (2010)	Healthcare	Sensory Richness	Experiment (112)	VR Simulation	+	n.e.	n.e.	n.e.
Pena et al. (2021)	Social Media	Ingroup Identity	Experiment (217)	VR Avatar Customization	-/+	n.e.	n.e.	n.e.
Raja and Carrico (2021)	Environment Protection	Construal Level	Qualitative (31)	Environmental VR Use	-	-	×	×
Kang (2020)	Tourism	Construal Level	Experiment (89)	VR Medium, Presence	n.e.	n.e.	n.e.	-
Breves and Schramm (2021)	Environment Protection	Construal Level	Experiment (112)	Immersiveness and Presence	n.e.	×	-	×
Note: -, negative effect; +, positive effect; ×, nonsignificant; n.e., not examine								
Table 1. Antecedents of Psychological Distance in the VR Literature								

Presence Experience and Self-Brand Distance

According to the customer experience framework (Becker and Jaakkola 2020), consumer experience, i.e., the direct responses toward brand stimuli, is the core mediating mechanism of evoking marketing outcomes. In the VR context, "presence" is the predominant consumer experience and critical mediating mechanism affecting consumer decision-making (Hilken et al. 2017; Weber et al. 2021). It refers to the phenomenon of the individuals feeling as if they (or virtual products) are physically present in the simulated environment (or real-world) (Nah et al. 2011). In this vein, Harz et al. (2022) indicate that the presence experience covers both internal and external components, namely (1) immersive presence and (2) realistic presence.

Immersive presence can be described as an individual's compelling sense of being immersed in a mediated environment, also called perceptual and psychological immersion (Lombard and Ditton 1997; Saunders et al. 2011). The terms "presence" and "immersion" are sometimes used interchangeably in the VR context (Scavarelli et al. 2021). By providing consumers with high-level vividness, they are probably immersed in the VR-powered e-commerce environment (Yim et al. 2017). Thus, as the internal component of the users' presence experience (Harz et al. 2022), immersive presence represents the degree to which senses are simulated via interactions with the VR-powered simulation.

As for realistic presence, it can be described as the consumers' psychological state in which virtual objects and simulated environment are experienced as actual objects and the real world (Harz et al. 2022; Saunders et al. 2011). When bringing an individual into a virtual space, the individuals often feel as if they are actually present in a virtual environment (Lombard and Ditton 1997). Thus, presence experience generally refers to the degree to which an individual believes a virtual world is real (Scavarelli et al. 2021), which largely resembles the concept of perceived realism. Recent studies (Harz et al. 2022; Jung and Lindeman 2021; Weber et al. 2021) also support that perceived realism is the component of presence.

However, the impacts of consumers' perceived presence on their psychological distance are mixed (see Table 1). Given that the consumer' feeling of authenticity is vital to maintain the consumer-brand relationship (Heinberg et al. 2020), these mixed results could be attributed to the fact that presence research largely neglects realistic presence (Scavarelli et al. 2021; Weber et al. 2021). More importantly, there is an absence of empirical evidence on the relationship between the consumers' presence experience on their self-brand distance, which belongs to the social dimension of psychological distance (Connors et al. 2021). Hence, to justify the investment in VR, it is necessary to empirically examine the relationships between presence experiences and the consumers' self-brand distance.

Vividness Modes, Interactivity, and Presence Experience

According to vividness research (Barhorst et al. 2021; Steuer 1992), vividness is the technological ability to represent a sensorially rich mediated environment, which resembles the concepts of media richness and environmental embedding (Hilken et al. 2018). By providing consumers with vivid objects, they can feel that virtual objects become part of their physical world (or if they are present in the real world), increasing their presence (Wang et al. 2021). Yet despite the positive impact of vividness, there remain adverse consequences. For instance, the environmental embedding decreases the consumers' perceived presence, which resembles the concept of vividness (Hilken et al. 2018). Prior research also shows that the relationship between immersion and vividness is nonsignificant (Miller et al. 2021). We surmise that these mixed effects could be attributed mainly to the different technical modes of visualization, considering that vividness depends entirely upon the medium's technical characteristics (Steuer 1992). Particularly, the media effectiveness of VR technology mainly resulted from visual appeal (De Ruyter et al. 2020). In the VR domain, there are two primary modes for generating vividness: modeling and panoramic modes. Table 2 summarizes the technical differences between the two modes.

In the modeling mode (Ritter and Chambers 2022), VR can simulate products and shopping environments by restructuring them into virtual 3D models and virtual space based on computer-aided design (CAD) or other visualization software. By using panoramic mode (Harz et al. 2022), VR can also simulate products and shopping environments from a first-person perspective based on 360-degree panoramic images of the actual world. On the one hand, the panoramic mode seems more realistic than the modeling mode, considering that the panoramic mode is based on photorealistic images of a real environment (Park et al. 2021). On the other hand, users could be more likely to become immersed in the modeling mode of VR, given that users are less distracted in experiencing modeled simulation (Ritter and Chambers 2022). Thus,

we expected that panoramic mode (vs. modeling mode) would activate higher realistic presence but lower immersive presence.

	Panoramic Mode of VR	Modeling Mode of VR
Approach	Taking 360° panoramic photo/image of actual object/environment	3D modeling based on CAD or other visualization software
Panoramic Image	Indispensable	Dispensable
Representation	Photorealistic Rendering	Quasi-Photorealistic Rendering
Set-up Time	Low	Relatively High
Develop Speed	Fast	Relatively Slow
Computational Cost	Relatively Low	High
Support Devices	HMD/Desktop/Mobile Devices	HMD/Desktop/Mobile Devices

Table 2. Technical Differences between Panoramic and Modelling Mode

Interactivity can be conceptualized as two complementary aspects (Barhorst et al. 2021): technical variable and the users' perception. Steuer (1992) emphasizes the technical feature of interactivity that can affect presence after experiencing immersive technologies. From the perception perspective, interactivity can be conceptualized as the outcome of immersive technology (Yim et al. 2017). Specifically, the users' participation and control can lead to an absorbing state of mind when using the interactive features of immersive technology (Barhorst et al. 2021). Considering that previous studies have supported the positive impacts of interactivity on users' psychological outcomes (Barhorst et al. 2021; Xu et al. 2022), particularly for presence experience (Shafer et al. 2019; Wang et al. 2021), we believe that the interactivity can moderate the relationship between vividness modes and consumers' presence experiences.

Research model and hypotheses

Based on the customer experience framework (Becker and Jaakkola 2020) and psychological distance literature (Connors et al. 2021; Trope and Liberman 2010), this study develops the following model (Figure 1). We propose five hypotheses to examine the relationship among self-brand distance, presence experiences, vividness modes, and interactivity. To improve internal validity, this study plans to include the demographic (e.g., age and gender) as control variables. In addition, given that social influence might affect various consumers' perceptions (Xu et al. 2022), this study includes it as a control variable.

According to the construal level theory (Connors et al. 2021), consumers are psychologically closer when interacting with low-construal stimuli. When consumers are immersed in VR simulation, they probably generate a lower construal, reducing their psychological distance. Besides, current research (Breves and Schramm 2021) indicates that higher immersiveness can lessen consumers' temporal distance by increasing their perceived presence. Analogously, a higher immersive presence might reduce consumers' self-brand distance. Therefore, we propose the following hypothesis:

H1: Consumers' immersive presence might decrease their self-brand distance.

Considering that the high-level familiarity and similarity reduce consumers' psychological distance (Zhou and Jia 2018), they are probably perceived to be psychologically closer when experiencing highly realistic stimuli of VR. Also, previous studies suggest that higher presence leads to a nearer hypothetical distance between VR simulation and themselves (Kang 2020). Based on the distance-on-distance effects of psychological distance (Trope and Liberman 2010), immersive presence could also help to reduce other types of psychological distance, e.g., self-brand distance. Therefore, we state the following hypothesis:

H2: Consumers' realistic presence might decrease their self-brand distance.

Based on the nature of the modeling mode, all of its simulations are computer-generated objects that provide consumers with a novel experience, which makes consumers need to be more focused on experiencing modeled virtual environment (Ritter and Chambers 2022). Consumers may become more immersed in modeling mode rather than panoramic mode. On the contrary, in the panoramic mode (Harz

et al. 2022), consumers can experience simulated products and shopping environments derived from 360-degree panoramic images of the actual world. Given that its visual information mainly comes from photorealistic images of the natural environment (Park et al. 2021), consumers tend to believe it is more realistic. Taken together, we expected that panoramic mode (vs. modeling mode) would activate a higher realistic presence but a lower immersive presence. Hence, we offer the following hypothesis:

H3a: The modeling mode might lead to a higher immersive presence than the panoramic mode.

H3b: The panoramic mode might lead to a higher realistic presence than the modeling mode.

Since interactivity is essential in improving presence (Peukert et al. 2019; Yim et al. 2017), consumers tend to perceive a higher immersive presence and realistic presence when experiencing two modes of vividness. For instance, by providing multiple degree-of-freedom motion tracking systems (Lee et al. 2021), consumers can obtain more freedom of choice in both modes of vividness, which exhibits a more positive effect on users' feeling of presence (Ferguson et al. 2020). Thus, we hypothesize as follows:

H4: Interactivity strengthens the relationship between vividness modes (panoramic or modeling) and presence experiences (immersive or realistic).

Figure 1. Research Model
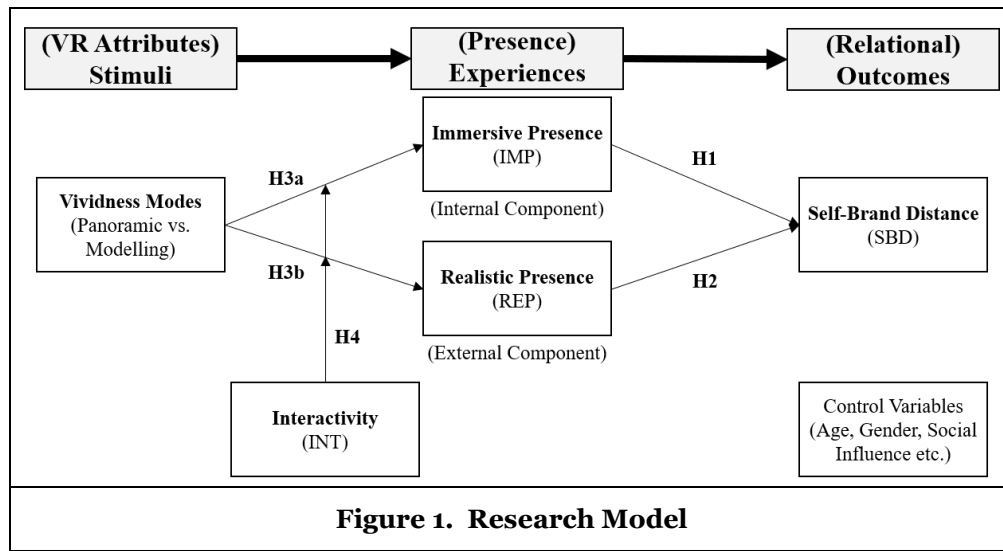
Research Method

Design and Procedure

Given that vehicle is wildly adopted as stimuli in VR literature (Smith et al. 2023; Tran et al. 2021), and automobile brands often exhibit vehicles using both 3D model and panoramic VR, we adopt this industry as the empirical setting. To examine the research model, we plan to conduct a laboratory experiment within 2 (modeling vs. panoramic mode) × 2 (high vs. low interactivity) between-subjects design in the VR-supported automobile store. This study plans to recruit about 240 participants from online crowdsourcing platforms in exchange for endowment or other rewards. Some participants could be removed due to incomplete responses. All participants are randomly assigned to 8 conditions, resulting in 60 participants per condition. Across all groups, the procedure is the same for all participants. Initially, participants need to familiarize themselves with the experimental task and the VR environment by watching an introductory video showing the demo task (the same task, but with an anonymous brand and product). Next, the participants should indicate whether they felt confident about using VR. If yes, then the actual task will start. To reduce the potential bias of brand knowledge and previous experience, we will create a hypothetical new automobile brand name, "Woake." This approach is adopted by previous brand research (Choi and Winterich 2013). All groups must visit the same branded automobile store in VR simulation, and the main differences between the conditions are the modes of vividness and interactivity.

The modes of vividness are manipulated by the technical difference of visualization, namely, panoramic mode and modeling mode. Meanwhile, all characteristics of the branded products are identical among

groups. In panoramic mode, we create a VR-simulated automobile store based on 360-degree panoramic images of an offline automobile store. In modeling mode, the automobile store is generated by 3D modeling software (and the inner design is in line with panoramic mode). To ensure that the only difference is the modes of vividness, all VR simulations have the same refresh rate (60HZ) adopted by previous research (Peukert et al. 2019) to provide users with a vivid experience. Thus, the participants will be divided into panoramic and modeling groups. In addition, we plan to collect real-world data from VR-supported platforms (e.g., 3D shopping in Tabao) to enhance the findings' generalizability further.

Manipulation, Measures, and Data Analysis

We plan to adopt the technical differences in degree-of-freedom to achieve the desired manipulations of interactivity. To achieve a highly interactive environment, multiple degree-of-freedom motion tracking systems have been widely developed for several decades in the VR domain (Lee et al. 2021). Given that interactivity refers to the degree to which users can influence the form or content of the mediated environment (Peukert et al. 2019), the level of interactivity could be classified according to the degree of freedom of VR simulation. Thus, all participants of both the panoramic group and modeling group are further divided into high and low interactivity groups according to the number of degree-of-freedom.

In the beginning, participants need to report demographics. After visiting the VR shopping environment, participants should complete a questionnaire of all measures. At first, participants are asked to complete a one-item measure of self-brand distance using Inclusion-of-Other-in-the-Self (IOS) zipper scale (Connors et al. 2021); i.e., "Please indicate which circles below best describes the psychological distance between yourself and [brand]"). Then, participants needed to complete a 3-item measure of immersive presence (e.g., "The simulation immersed my senses") and a 3-item measure of realistic presence (e.g., "The visual depiction of the store was realistic"), both of which were adopted the by Harz et al. (2022). At the end of the questionnaire, participants should complete the manipulation check for their perceived level of interactivity. We will also control consumers' simulator sickness (Peukert et al. 2019), prior experience with VR (Yim et al. 2017), and demographic information. All measures are captured on a 1-7 scale.

Finally, drawing on prior research (Arthur et al. 2021; Hilken et al. 2017; Peukert et al. 2019), we will test the hypotheses using a combined approach covering the analysis of covariance (ANCOVA) and covariance-based structural equation modeling (SEM). Firstly, we will adopt the univariate ANCOVA to estimate the effects of vividness modes on presence experiences. Then, we will examine the entire model using SEM based on a two-step process (Xu et al. 2022; Yoo et al. 2020). Four criteria will be used to assess the reliability and convergent validity: Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), and item loadings. The Fornell-Larcker test will check the discriminant validity. We will also assess the overall model fit using four indices: root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), Tucker-Lewis Index (TLI), and comparative fit index (CFI).

Expected contributions and implications

Although this research is still in progress, it will provide several implications for the literature and practice. Theoretically, this study could enrich our knowledge of consumer-brand relationship management (Connors et al. 2021) by leveraging VR technology to bridge consumers' self-brand distance. Specifically, the empirical examination of the relationships among two different vividness modes, immersive presence, realistic presence, and self-brand distance, will offer an understanding of how the technical differences of VR affect consumer experiences and hence change their psychological distance between brands and themselves. Besides, our findings will contribute to the literature on VR shopping (Harz et al. 2022) by clarifying the differentiated effects of vividness modes on consumers' immersive presence and realistic presence. Also, this study will enrich our understanding of interactivity by examining its moderating role in the relationship between VR attributes and consumer experiences.

In addition, from the practical perspective, this study will offer managerial implications for VR simulation designers and brand managers. Specifically, the designer will better understand what and how to adopt two different vividness modes (panoramic or modeling modes) to improve consumers' perceived presence in experiencing VR simulation. Moreover, our findings might offer brand managers some managerial suggestions on bridging consumers' self-brand distance by developing a VR-simulated store-simulated shopping environment within different levels of interactivity and vividness modes.

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