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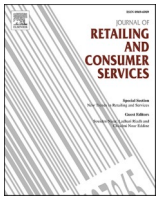

Examining the moderating effects of shopping orientation, product knowledge and involvement on the effectiveness of Virtual Reality (VR) retail environment

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ABSTRACT

The increasing affordability of Virtual Reality (VR) presents opportunities for retail innovation. While previous research highlighted the superiority of VR over traditional media in retailing application, this research shows that the advantage of VR retailing is contingent on consumer product knowledge, shopping orientation, and product involvement. Adopting an experimental between-subjects design across three studies, this research showed that VR does not necessarily outperform static pictures in facilitating mental imagery when consumers have high (vs. low) product knowledge. However, the negative impact of product knowledge is reduced when consumers engage in shopping for experiential rather than task-focused orientations. Moreover, high (vs. low) -involvement products also play a role in reducing the negative effect of product knowledge on VR effectiveness. This research address the gaps in the literature by demonstrating the efficacy of VR retailing in the context of product knowledge, shopping orientation, and product involvement. For marketers, this research shows that VR should be used with discretion, considering the product types, consumer shopping orientations, and product involvement.

1. Introduction

The application of Virtual Reality (VR) in the retailing and shopping industry has been experiencing rapid growth. For example, retail giants including Alibaba (VR platform Buy +), eBay (VR department store APP), and IKEA (VR kitchen showroom) have been dedicated to blending VR into their ecosystems and bringing an evolution to the retailing industry (Xi and Hamari, 2021). According to PwC's Global Consumer Insights Pulse Survey released in 2022, approximately one-third of the respondents have used VR channels, with 32% making purchases after exploring products on VR platforms (Read, 2022). To date, it has to be noted that only a few retailers have successfully implemented VR in their online or on-site retailing channels (Hilken et al., 2022). However, researchers believe that VR is a promising technology for the retailing industry due to its ability to solve limitations of time and space, enabling the replication and creation of shopping environments that allow consumers to interact with at any time and location, and enriching consumer shopping experiences (Hollebeek et al., 2020; Xi and Hamari, 2021).

Compared to other emerging media such as Augmented Reality (AR) and Mixed Reality (MR), which blend virtual and real environments, VR tunes out and replaces the physical reality with a fully immersive virtual environment. This suggests an opportunity for businesses to captivate consumers in a more engaging and innovative setting, potentially giving rise to groundbreaking marketing campaigns and transformative consumer experiences (Hoyer et al., 2020; Xi and Hamari, 2021). Furthermore, the recent development of the Metaverse reflects consumers' growing immersion in digital spaces where goods, services, and interpersonal communication take on virtual forms (Hadi et al., 2024). By fully immersing users in an entirely synthetic and digitally mediated environment while obstructing any view of the real world, VR is also seen as a crucial carrier of the Metaverse, compellingly generating and displaying digital representations of spaces, objects, and people (Hadi et al., 2024). Therefore, exploring VR retailing not only aligns with the

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increasing immersion and engagement of consumers in virtual environments but also provides insights into how consumers might respond to real-world products presented on rich new media within the future Metaverse.

Recent studies highlighted the advantages of VR over traditional online product presentations to improve customer shopping experiences by enhancing their immersion, presence, flow experience, and escapism (Alzayat and Lee, 2021; Cowan et al., 2021; Han et al., 2020; Loureiro et al., 2021). However, in our examination of the impact of VR on consumer mental imagery and purchase intention, we deviate from this standpoint as we contend that the effectiveness of VR diminishes in the presence of consumers' extensive product knowledge. More importantly, we posit that shopping orientation plays a significant role in attenuating the negative effects of product knowledge on the effectiveness of VR. We also explore whether product involvement mirrors shopping orientation in mitigating the impact of product knowledge on the VR retail environment. We elucidate these concepts further in the subsequent paragraphs.

While VR enhances customer shopping experiences, its effectiveness in facilitating the decision-making process remains a priority for businesses and retailers, as VR experiences could be perceived as mere entertainment, but fail to drive sales (Chi, 2023; Vidojevic, 2018). VR fosters imagination, which dramatically enhances consumer information processing and plays a significant role in facilitating behavioural outcomes (Cowan et al., 2021; Jung et al., 2021). As mental imagery is central to consumer imagination and fundamental to customer decision-making in different media environments (Elder and Krishna, 2021; Heller et al., 2019), it is essential to explore the mechanisms underpinning mental imagery in the context of VR retailing.

Mental imagery refers to the perceptual or sensory representation of objects and ideas in working memory (MacInnis and Price, 1987). The construal level theory (CLT) posits that direct experiences with products empower consumers' capability of generating more concrete mental imagery (Kim et al., 2021; Trope and Liberman, 2010). As the incentive of mental imagery, direct product experiences not only stem from outside stimuli, such as advertising, pictures, and VR, as illustrated by previous research (Jung et al., 2021; Skard et al., 2021), but also emerge from consumers' memory or past experiences (Elder and Krishna, 2021). This indicates the potential interaction between marketing stimuli and product knowledge during the construction process of mental imagery. Product knowledge refers to consumers' product-related experiences and accumulated information that relates to the familiarity, experience, expertise, and use of the products (Lacey et al., 2010). While VR-based product presentation has been recognized as a significant source of mental imagery (Jung et al., 2021; Skard et al., 2021), little is known about how consumer product knowledge may influence the relationship between VR presentation and mental imagery. Thus, this research fills the gap in the literature and argues that the effectiveness of VR may hinge on the level of consumer product knowledge, which explains why some consumers, arguably knowledgeable consumers, may be reluctant to adopt VR for product experience or purchase (Joshi, 2023; Rwizen Technologies, 2023).

More importantly, the potential negative effect of product knowledge may raise questions of the applicability of VR retailing. This is especially true for retailers of a wide range of common goods (e.g., toothpaste, food) that most consumers are familiar with and frequently use and purchase in their daily life. Previous studies have investigated the role of product knowledge in consumer decision-making (e.g., Nepomuceno et al., 2014; Park and Moon, 2003), but few have explored how to address the attenuation of the effectiveness of product presentation caused by product knowledge (i.e. the potential decreasing utility of product presentation for knowledgeable consumers), especially in the context of VR as an emerging product presentation technology and retailing channel.

Thus, this research aims to investigate shopping orientation as the boundary condition (i.e. specific conditions or constraints within which the study's findings can be applied) to mitigate the potential negative impact of product knowledge on the effectiveness of VR in terms of eliciting mental imagery and, subsequently, increasing intention (Busse et al., 2016). In simpler terms, boundary condition "kills" the effect of a predictor on an outcome variable. For example, Garg et al. (2007) examined the effect of nutritional information as the boundary condition on the relationship between consumer incidental affect (i.e. predictor) and consumption levels (i.e. outcome), such that the impact of incidental affect on consumption levels diminishes when nutritional information is presented (vs. absent) (i.e. the presence of nutritional information "kills" the effect of incidental affect on consumption levels). Although prior research has examined shopping orientation extensively in retail settings (Büttner et al., 2013; Eslami and Ghasemaghaei, 2018), little is known regarding how consumers respond to VR versus non-VR product presentation, depending on their shopping orientation. Consumer behaviour is influenced by motivational factors (Ajzen, 1991). As a consumer-related motivational factor, shopping orientation refers to individuals' mental framework for navigating the shopping environment to achieve personal goals (Baker and Wakefield, 2011). The mindset theory of action phases (Gollwitzer, 2012; Gollwitzer et al., 1990) depict that consumers with different orientations (i.e. task-focused vs. experiential) are likely to form different mindsets during their shopping, which may lead to different levels of reliance on new information provided by marketing stimuli and their product knowledge (Büttner et al., 2013). Consequently, varying shopping orientations and the ensuing mindsets could potentially reshape the consumer evaluation and decision-making process, resulting in diverse outcomes of VR retailing. To the best of our knowledge, however, the significant role of shopping orientation in VR retailing has not been studied.

Additionally, we also examine whether a product-related motivational factor, namely product involvement, exerts a comparable influence to shopping orientation. Product involvement represents consumers' interest in a product that is evoked by its inherent values, interests, and necessity (Zaichkowsky, 1994). High-involvement products, such as cars, typically entail higher prices and potential risks, prompting consumers to invest significant time and effort in evaluating product quality to ensure it aligns with their needs and preferences. In contrast, low-involvement products, like light bulbs, often have lower value, lower personal significance, and demand less extensive information search by consumers (Eslami and Ghasemaghaei, 2018; Kautish et al., 2022; Stewart et al., 2019). Underpinned by the Elaboration Likelihood Model (ELM) (Petty and Cacioppo, 1986), product involvement may also attenuate the impacts of product knowledge on the effectiveness of VR by shifting consumers' information processing routes (i.e. central versus peripheral route), thus implying changes in the significance of product knowledge (Chang et al., 2020; Rokonuzzaman et al., 2020). Similar to shopping orientation, to date, whether different levels of product involvement (i.e. high vs. low) might alter the effectiveness of VR-based product presentation still remains unknown as well.

Thus, this study fills a crucial gap in the literature by proposing three boundary conditions (i.e. product knowledge, shopping orientation, and product involvement) that may determine consumer responses to VR compared to other traditional media such as static product pictures as the most dominant form of product presentation in retailing. Specifically, this research investigates the joint impacts of product presentation (VR- and picture-based) and product knowledge on consumer mental imagery and purchase intention. Moreover, this research further explores shopping orientation and product involvement as the boundary conditions to mitigate the declining effects of VR-based product presentation for knowledgeable consumers. Fig. 1 shows the conceptual framework of the research.

As shown in Fig. 1, this study aims to address two research questions (1) How VR- (vs. picture-): based product presentation influences customers' mental imagery and purchase intention, depending on their product knowledge? And (2) How VR- (vs. picture-) facilitated mental

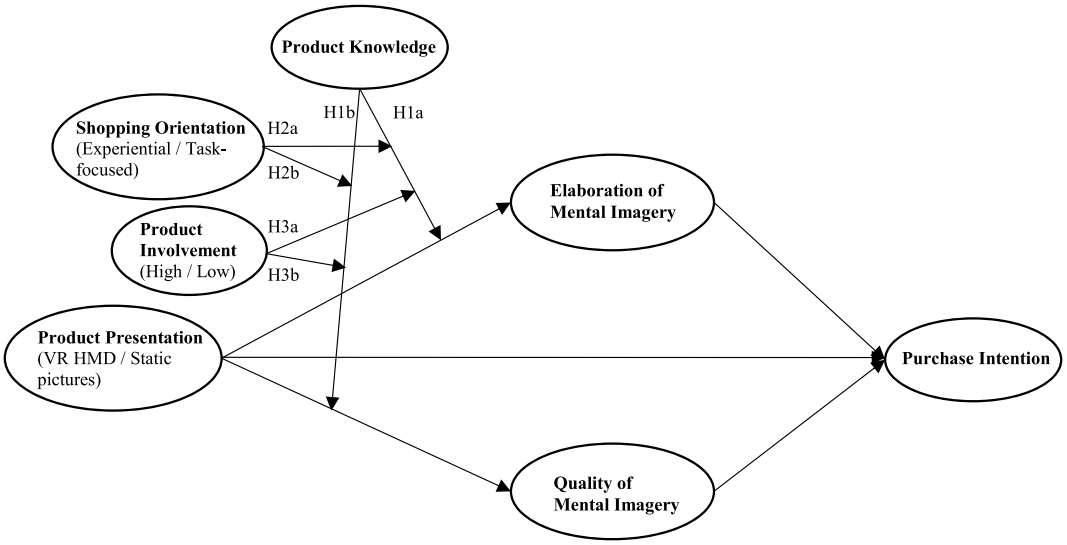

Fig. 1. Research framework.

imagery is impacted by the interaction between product knowledge, shopping orientation, and product involvement? This research contributes to current literature in several ways. Firstly, it critically analyses whether VR outperforms static pictures of product presentation in consumer decision-making, depending on prior product knowledge. Secondly, it delves into the significant roles of shopping orientation and product involvement in counterbalancing the adverse effects of product knowledge on VR's effectiveness. This offers critical insights into extending the applicability of VR to and enhancing the effectiveness of VR on consumers with significant product knowledge. By addressing the research questions mentioned above, the findings of this study provide significant practical implications for retailers to adapt their VR retailing strategies effectively for different types of consumers.

This paper is structured as follows. First, the literature review is presented alongside the hypotheses to be tested. The methodology section follows, detailing the data collection and analysis procedures. The results are then presented, accompanied by a thorough discussion of the findings and their implications for theory and practice. Finally, the study concludes with a discussion of the limitations and suggests directions for future research.

2. Literature review and hypotheses development

To clearly present the theoretical framework of this study, the literature review and hypotheses development are structured as follows. In Sections 2.1 and 2.2, we discuss VR-powered product presentation and consumer mental imagery. Moving forward to Section 2.3, we articulate the joint effect of product presentation and product knowledge, proposing that product knowledge weakens the impact of VR on the formation of customer mental imagery and, subsequently, purchase intention (H_1). In Sections 2.4, we focus on the effect of shopping orientation and argue which, as a consumer-related motivational factor, can potentially improve the impact of VR and mitigate the negative effect of product knowledge on the relationship between product presentation, mental imagery, and purchase intention (H_2). In Section 2.5, we hypothesize that similar to shopping orientation and as a product-related motivational factor, product involvement could also attenuate the negative effect of product knowledge as well (H_3).

2.1. VR-powered product presentation

What implications does VR hold for the future of shopping and retailing? VR provides opportunities to simulate brick-and-mortar shopping activities and thus, VR-powered presentations (e.g., VR Head-Mounted Displays, or VR HMDs for abbreviation) are often regarded as more vivid, sophisticated, interactive, and presence-inducing than simple, two-dimensional ones such as videos and pictures (Bogicevic et al., 2019; Cowan and Ketron, 2019). Effective product presentation in the retail environment not only elicits consumers' cognitive and affective responses but also influences their shopping experiences and outcomes in the absence of direct product experiences (Yoo and Kim, 2014). Empowered by VR, retailers could develop digitally simulated and enhanced three-dimensional retail environments featured with high-level immersive elements (Xi and Hamari, 2021). From the perspective of consumers, immersive VR HMDs enable them to be a part of a 360-degree virtual store or retail world, which, in turn, offers consumers a more exciting and unique shopping experience (Schnack et al., 2021). Empirical findings regarding consumer VR experiences are provided by previous literature (e.g., Han et al., 2020; Jung et al., 2021; Kim et al., 2021). For example, Pleyers and Poncin (2020) argued that compared to static pictures, VR improves customer experiences by increasing their sense of presence. An et al. (2021) also suggested that immersive VR drives individuals to enter a flow state and facilitates consumer enjoyment and long-lasting involvement in the virtual environment.

Another feature that distinguishes VR-powered shopping from traditional ones is its high interactivity (Kang et al., 2020). Think of how consumers could interact with products in a virtual environment using their own hands and in a way that is much more interactive than clicking mouse on a computer screen or touching the phone screen. The extent to which consumers are allowed to interact with products is essential to the formation of perceived informativeness and hedonism and behavioural responses (Kang et al., 2020). Compared to traditional online product presentations such as static images and videos, VR enables consumers to freely interact with products by rotating, zooming in and out, and modifying them to get a more detailed inspection (Cowan and Ketron, 2019; Kim et al., 2021). Thus, VR allows consumers to interact with products in a way that is similar to what they do in a physical shopping environment (Alzayat and Lee, 2021). These outlined technological attributes of VR indicate its potential to facilitate mental imagery, which is discussed in the next section.

2.2. Mental imagery

Think of mental imagery as a mind's movie, playing scenes from the past or imagined future. Through this process, consumers can relive past

experiences (re-experiencing) and envision scenarios they have never encountered (future consumption experiences) using mental imagery. As a type of mental activity that visualizes a concept or a relationship, mental imagery represents the process in which one's cognitive or perceptual experiences are represented in his or her working memory (MacInnis and Price, 1987). Several key factors of mental imagery are made explicitly by such definition. First, mental imagery is a prospective or future-oriented imagination, representing that the projections for imagery focus on the future, rather than the past or presence, and the imagination of future events is constructed rather than retrieved (Elder and Krishna, 2021). Moreover, the formation of mental imagery requires access to cognitive and perceptual resources. Consumers rely on cognitive and perceptual information stored in their working memory to construct an imaginative representation of a future event (Schacter and Addis, 2007). Given the multimodal nature of sensory stimuli, mental imagery could also be multisensory, leading to the emergence of visual, auditory, gustatory, olfactory, and haptic mental imagery (MacInnis and Price, 1987).

Ha et al. (2019) conceptualized mental imagery as the perception of being present in an imagined situation in the absence of appropriate direct contact. Similarly, Bogicevic et al. (2019) defined mental imagery as a visual simulation response to marketing stimuli. Previous research investigated consumer mental imagery facilitated by various stimuli or presentation formats (see Table 1). Since the two product presentation formats examined in this paper (i.e. VR and static pictures) mainly deliver visual stimulations, the focus is on visual mental imagery, which is a multidimensional construct that contains two aspects: elaboration and quality (Walters et al., 2007). Elaboration of mental imagery refers to the number of images formed and depicts the extent of one's involvement in the fantasy imagery (Ha et al., 2019). Quality of mental imagery, on the other hand, measures the vividness, intension, clearness, and sharpness of mental images (Bogicevic et al., 2019).

Building upon the conceptualization of mental imagery, the next section will discuss the formation of consumer mental imagery and its role in fostering purchase intention.

2.3. The interaction effect of product presentation and product knowledge

As mental imagery highly depends on image vividness and interaction with objects in the virtual environment (Skard et al., 2021), it is expected that VR would play an essential role in facilitating such consumption imagery. Highly immersive VR could tune out external environmental stimuli (i.e. physical environments). Thus, when products are presented in an immersive environment (e.g., VR) rather than a traditional 2D format (e.g., static pictures), the more direct, realistic, and concentrated experience with the virtual objects (e.g., products) leads customers to be able to engage in envisioning the presented product extensively and proactively (i.e. elaboration of mental imagery) with a higher quality (i.e. quality of mental imagery) (Bogicevic et al., 2019; Skard et al., 2021).

Mental imagery may also lead to a stronger intention to purchase. Consumers employ mental imagery to generate a representation in their mind's eye and visualize the product in relevant consumption scenarios, contributing to the decision-making (Heller et al., 2019). For example, consumers may visualize themselves playing badminton in the court when they are shopping a badminton racket. The depth and richness of their visualization or imagination, including the sensation of wielding the racket, the tactile feedback when striking the shuttlecock, and even sport performances and victories, could influence their likelihood of making a purchase decision. Wang et al. (2022) argued that the higher quality of mental imagery is, the more likely consumers purchase the product. It has also been claimed that both the elaboration and quality of mental imagery increase purchase intention by facilitating product sensory experiences (Yoo and Kim, 2014). Since immersive product presentation on VR provides more concrete and vivid product information cues that help consumers to construct mental representation of presented products, we can expect that VR could enhance both the elaboration and quality of mental imagery for consumers before they elect to make a purchase. Thus, mental imagery is proposed to mediate the relationship between product presentation and purchase intention.

While the merits of VR have been previously explored, a natural query emerges: Is the efficacy of VR uniform across all consumers? We argue that the effect of VR-based product presentation on mental imagery vary among customers with different levels of product knowledge. Consumers rely on well-rehearsed memory and knowledge to process information and make decisions (Sheth and Parvatlyar, 1995). With more knowledge of the presented products, consumers exhibit greater ease in envisioning product-related scenarios and expected outcomes based more on their prior experiences than on the information provided by external environments (e.g., VR) (Yim et al., 2020). In contrast, consumers possessing limited product knowledge might contend with higher risk and face greater difficulty envisioning the product's functioning and suitability for their needs. This prompts them to actively seek and rely more on supplementary information and external cues (Bearden and Shimp, 1982; Yim et al., 2020). Moreover, consumers with high product knowledge and experiences are more likely to rely on their existing knowledge structures to process product information at a deeper level, emphasizing the importance of processing and manipulating verbal representations of information (Alba and Hutchinson, 1987). This phenomenon might not hold true for consumers less acquainted with the product, as they lack both strong prior knowledge and a predisposed mode of information processing (Cowan et al., 2021; Yim et al., 2020). For these consumers, visual cues are more effective since they may face greater difficulty in forming initial impressions by processing complex verbal information (King et al., 2019). To illustrate, consider consumers shopping for digital cameras: photographers may emphasize verbal specifications of the camera and lens for performance assessment, whereas those with limited knowledge of cameras and photography may be attracted more by visual stimuli, such as product images in advertisements and their contextual surroundings. Thus, we posit that VR shopping plays a more effective role in engaging consumers with limited product knowledge.

Based on the discussions above, we therefore argue that high product knowledge may reduce the importance of and consumers' reliance on VR, thus, influencing elaboration and quality of mental imagery, and subsequently, purchase intention. It is hypothesized that:

H1a. When product knowledge is low, consumers experiencing VR (vs. static pictures) will generate higher (vs. lower) elaboration of mental imagery, leading to higher (vs. lower) purchase intention (moderated mediation). This effect will not occur when their product knowledge is high.

H1b. When product knowledge is low, consumers experiencing VR (vs. static pictures) will generate higher (vs. lower) quality of mental imagery, leading to higher (vs. lower) purchase intention (moderated mediation). This effect will not occur when their product knowledge is high.

The potential attenuating impact of product knowledge on the effectiveness of VR-based product presentation raises a significant and pertinent question: How can businesses aiming to offer innovative VR-based product experiences effectively leverage VR technology and make it appealing to knowledgeable consumers? The following section delves into this question through the lens of consumer-related motivational factors. It suggests that consumers with varying shopping orientations may exhibit differences in their reliance on product knowledge when exposed to VR retail environments, thereby mitigating the adverse moderating influence of product knowledge.

2.4. The moderating role of shopping orientation

Generating mental imagery depends on various stimuli in the

Table 1
A review of research in mental imagery and presentation formats.

References	Context	Stimuli	Process variables	Dependent variables	Boundary conditions	Key findings
Yoo and Kim (2014)	Retailing	Product presentation (pictures/texts)	Mental imagery (elaboration, quality)	Positive emotion, Purchase intention	Style of processing (visualizers/verbalisers)	• Product presentation incorporating a consumption-related context are more effective at eliciting mental imagery than those presented against a plain white background. This imagery fosters improved consumer behavioural intentions by evoking positive emotional responses to the product presentation. • Visualizers experience greater elaboration of mental imagery than verbalisers when presented with a product display featuring a concrete image.
Bogicevic et al. (2019)	Tourism	Preview mode (static images/360-degree tour/VR)	Mental imagery (elaboration, quality), Sense of presence	Tourism brand experience	None	• VR previews induce higher elaboration of mental imagery regarding the experience and a heightened sense of presence compared to both the 360° preview and image previews.
Heller et al. (2019)	Retailing	Augmented Reality (AR) mental imagery aspects (configuration, transformation)	Processing fluency, Decision comfort	Choice, Word-of-mouth (WOM)	Processing type, Product contextuality	• AR mental imagery (configuration, transformation) mimics cognitive processes, enhancing decision comfort, motivating positive word-of-mouth (WOM), and facilitating the choice of higher value products. This occurs through heightened processing fluency and decision comfort, mediating AR's impact on customer behaviour. • Customers' processing styles and product context set boundaries, where object-visualizers benefit more from AR-induced imagery, and the effect of processing fluency on decision comfort is moderated by product contextuality.
Liu et al. (2019)	Retailing	Pictures (2D/3D), Interaction (mid-air gesture/touchscreen gesture/mouse)	Mental imagery (haptic, spatial)	Product uncertainty	None	• Both 2D and 3D formats exert an impact on mental imagery within the context of virtual product experiences. • Gesture modes like mid-air and touchscreen gestures offer natural, intuitive interactions surpassing mouse-based ones, enhancing sensorial immersion and boosting consumers' virtual product experience.
Lee and Kim (2020)	Catering	Presentation format (description/narration/picture/video)	Mental imagery	Desire to eat	Cognitive style (visualizer/verbaliser)	• Mental imagery boosts eating desire, with presentation formats impacting imagery and cognitive style. Video menus yield the most imagery, followed by pictures, narration, and conventional menus. • Visualizers and verbalisers generate similar mental imagery with these presentation formats. Visual domain predominantly influences imagery and eating desire, with auditory stimuli also influencing them.
Mead et al. (2020)	Retailing	Product presentation font (Static/dynamic)	Dynamic mental imagery	Retailer visit intention, Purchase intention	Deal Proneness	• Fonts slanted to the right trigger vivid mental imagery of the promotion progressing ahead in time and concluding shortly • The dynamic mental imagery of a promotion moving away in time can affect behavioural motivations akin to explicit details about the duration of promotions, limited availabilities, and observed price patterns.
Alyahya and McLean (2021)	Tourism	Presentation format (VR/website)	Mental imagery (cognitive processing, quality), Sense of presence	Attitudes towards the destination, visit intention	Stimuli	• Varied degrees of sensory information in VR experiences result in significant differences in generated mental imagery, sense of presence,

(*continued on next page*)

Table 1 (*continued*)

References	Context	Stimuli	Process variables	Dependent variables	Boundary conditions	Key findings
						attitudes toward the destination, and visit intentions.
Cowan et al. (2021)	Retailing	Presentation media (360-VR/video)	Imagination	Brand attitudes, Purchase intentions	Product category knowledge, Haptic instructions	• The impact of 360-VR (vs. video) on consumer reactions hinges on product knowledge. High knowledge reduces responses, while low knowledge heightens them. • Haptic imagery lessens the influence of product category knowledge on media-induced presence, brand evaluations, and purchase intention.
Hilken et al. (2022)	Retailing	Display technology (VR/AR)	Mental imagery (product-focused, context-focused)	Brand attitudes, Purchase intentions	Sequencing of technologies (AR then VR/VR then AR)	• VR enhances brand attitudes by facilitating fluent context-focused mental imagery, whereas AR is more adept at boosting purchase intention through its support for fluent product-focused mental imagery. • By first using AR and then VR, the combination can enhance purchase intentions and brand attitudes, aligning with customers' experiential retail journey from online to offline.
McLean and Barhorst (2021)	Hospitality	Preview format (Static images/360-degree video/VR)	Authentic experience, Mental imagery (cognitive processing, quality), Immersion	Satisfaction, Learning, (Re) visit intention	Stimuli	• VR plays a pivotal role in effectively managing consumers' expectations by offering an authentic experience that stimulates the creation of intricate mental imagery before their physical visit.
Silva et al. (2021)	Retailing	Product environmental cues (pictorial information, verbal information)	Haptic imagery, Perceived product quality	Purchase intention	Need for touch	• In comparison to pictorial information, verbal information exerted a more potent impact on haptic imagery and subsequent behavioural reactions. • The need for touch did not moderate the connection between haptic imagery, perceived product quality, and the intention to purchase.
Skard et al. (2021)	Tourism	Presentation format (VR/2D)	Telepresence, Mental imagery, Predicted happiness	Purchase intention, Ticket purchase	Direct destination experiences	• Virtual Reality (VR) exerts a more pronounced influence on mental imagery compared to conventional channels, generating lifelike simulations of destination experiences. • The process of mental imagery aids consumers in foreseeing the emotional impact of visiting a particular destination and in gauging the potential happiness they might derive from their decision to travel there. • Increased levels of mental imagery and happiness prediction are linked to heightened travel intentions and purchasing choices.
Zhao and Xia (2021)	Retailing	Product presentation (joint/separate)	Consumption imagery, Psychological ownership	Product evaluation	Cognitive constraint, Product complementarity	• Presenting products together encourages mental visualization of product usage, resulting in heightened perceived psychological ownership and more favourable product assessment. • The impact of joint presentation on product evaluation is diminished when mental imagery is disrupted within combined presentation, amplified in the case of separate presentation, or when products lack synergy to evoke mental imagery of a unified consumption experience.
Cheng et al. (2022)	Retailing	Product presentation videos (appearance video/usage video)	Perceived diagnosticity, Mental imagery	Purchase intention	Product rating	• The video showcasing product usage exhibited a more potent impact on purchase intention compared to the video emphasizing product appearance. This influence was channelled through perceived diagnosticity and mental imagery.

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Table 1 (*continued*)

References	Context	Stimuli	Process variables	Dependent variables	Boundary conditions	Key findings
Petit et al. (2022)	Retailing	Product presentation format (packaged, served)	Perceived interactivity, Immersion, Mental simulation	Purchase intention	Visualization mode (AR/3D)	• High-rated products show stronger purchase intention improvement with the product usage video over the appearance video. Low-rated products see no significant difference in video impact on purchase intention. • AR visualization of served food amplifies the mental simulation of the eating experience, resulting in a favourable influence on purchase intention. • 3D visualization enhances packaged product purchase intention, whereas AR visualization proves more potent for served items. Interactivity and immersion mediate the effects of 3D on mental simulation for packaged products. • 3D visualization heightens purchase intention through mental simulation of eating outcomes when transparent packaging makes the food visible. AR visualization, however, doesn't show these distinctions.
This research	Retailing	Product presentation (VR/static pictures)	Mental imagery (elaboration, quality)	Purchase intention	Product knowledge, Product knowledge × Shopping orientation, Product knowledge × Product involvement	• VR does not necessarily outperform static pictures in facilitating mental imagery when consumers have high (vs. low) product knowledge. • As a consumer-related motivational factor, shopping orientation serves as a boundary condition to the negative impacts of product knowledge on the relationship between product presentation and mental imagery. Specifically, experiential-oriented consumers gain a greater advantage from VR-based rather than picture-based product presentation in constructing mental imagery, and consequently, in shaping purchase intention, irrespective of their level of product knowledge. • Functioning as a product-related motivational factor, product involvement establishes an additional boundary, whereby products with high involvement (compared to those with low involvement) - characterized by elevated prices and invoking deeper customer engagement in evaluation - prompt consumers to lean towards VR-based rather than picture-based product presentation for mental imagery construction and subsequent purchase decisions. This holds true regardless of their level of product knowledge.

immediate sensory environment (Hilken et al., 2022; Kang et al., 2020; Pizzi et al., 2020). Previous studies demonstrated that consumers process these stimuli in different ways under different circumstances, particularly so when they are driven by different shopping orientations (Büttner et al., 2013; Tang and Tsang, 2020). Consumers who view shopping as a task to be completed and aim to maximize their utilitarian shopping value are considered task-focused. In contrast, consumers who are driven by an experiential shopping orientation tend to see shopping as fun and enjoyment and seek to maximize hedonic value (Büttner et al., 2013; Murray et al., 2022).

Supported by the mindset theory of action phases (Gollwitzer, 2012; Gollwitzer et al., 1990), it has been argued that task-focused consumers are more likely to form an implemental mindset (e.g., initiating actions to implement the shopping goal), as they wish to reduce the time they spend in shopping and improving shopping efficiency (Büttner et al., 2013). Consumers with an experiential shopping orientation, however, cultivate and rely on a deliberative mindset (e.g., evaluating products and assessing alternative options) because they seek stimulation during the shopping process (Büttner et al., 2013). They are also believed to be more open to new information and willing to spend more time evaluating marketing promotions. However, task-focused consumers are more likely to rely on their experiences and are less receptive to new information (Büttner et al., 2014; Murray et al., 2022; Tang and Tsang, 2020). As an example, consumers engaged in their regular weekly grocery shopping for their families are inclined to adopt an implemental mindset. They may prioritize efficiency by adhering closely to their shopping list, allocating minimal attention to other products and information. On the other hand, individuals who approach shopping as an

enjoyable and leisurely activity are more likely to adopt a deliberative mindset. They would prefer to explore and gather information, seeking stimulation during their shopping experience.

Hence, when considering consumers participating in VR retailing, particularly those who possess substantial product knowledge, how does varying shopping orientation come into play? Our contention is that shopping orientation could potentially impact how product knowledge moderates the relationship between product presentation and mental imagery. As consumers with experiential shopping orientation are more likely to process information through a deliberative mindset, they would be intrinsically motivated to seek new insights and experiences delivered by marketing campaigns, which is the main source of enjoyment and entertainment, where their pre-acquired product knowledge may not act as an important catalyst to the formation of mental imagery (Büttner et al., 2013; Tang and Tsang, 2020). Since consumers generally find immersive VR retail environments more fun and exciting than traditional picture-based online shopping environments (Kang et al., 2020), the mental imagery formation process of experiential consumers may greatly benefit from VR environments rather than product knowledge.

For task-focused consumers who are more likely to activate an implemental mindset, by contrast, they would complete the shopping task efficiently with little inherent benefits derived from the shopping process itself (Büttner et al., 2013; Mimoun et al., 2022). Before making decisions, they would carefully evaluate the product itself in a due time and their product knowledge could be highly valued (Tang and Tsang, 2020). For task-focused knowledgeable consumers, hence, high immersion and presence-inducing product presentation medium (i.e. VR) may not outperform the low one (i.e. static pictures) in forming vivid mental imagery to support their decision-making. Therefore, it is hypothesized that:

H2a. When shopping orientation is task-focused, consumers experiencing VR (vs. static pictures) will generate higher (vs. lower) elaboration of mental imagery when their product knowledge is low (vs. high), leading to higher (vs. lower) purchase intention (moderated mediation). This moderating effect of product knowledge will not occur when shopping orientation is experiential.

H2b. When shopping orientation is task-focused, consumers experiencing VR (vs. static pictures) will generate higher (vs. lower) quality of mental imagery when their product knowledge is low (vs. high), leading to higher (vs. lower) purchase intention (moderated mediation). This moderating effect of product knowledge will not occur when shopping orientation is experiential.

In this section, we argued that consumers with an experiential shopping orientation tend to adopt a deliberative mindset, motivating them to be more receptive to new information and engage in thorough product evaluation. Conversely, those with a task-focused orientation are more likely to embrace an implemental mindset, which directs their focus towards predefined shopping goals, rendering them less open to new information. Building upon these discussions, we propose that consumers who prioritize shopping experiences are more likely to engage with the highly immersive new product presentation medium (i.e. VR) and rely less on their existing product knowledge. On the other hand, consumers driven by the goal of completing their shopping tasks are more likely to rely on their prior product knowledge and experiences, thus assigning less significance to the VR shopping environment.

In addition to shopping orientation, the next section explores the role of product involvement as a product-related motivational factor that can also potentially moderate the negative interaction effect of product presentation and product knowledge on mental imagery.

2.5. The moderating role of consumer product involvement

Product involvement refers to a consumer's interest in a product based on its inherent values, interests, and necessity (Zaichkowsky, 1994), thereby reflecting the consumer's focus on the product or its importance to that consumer (Peng et al., 2019). Typically, consumers spend more time and effort on evaluating high-involvement products (e.g., cars), which often entail high prices and misleading risks, indicating a greater monetary and emotional involvement in the purchasing process (Eslami and Ghasemaghaei, 2018; Peng et al., 2019). For low-involvement products (e.g., cleaning supplies), consumers spend less time and effort evaluating their quality due to their lower monetary value and risk, and hence, are more willing to make a purchase with a lower financial commitment (Eslami and Ghasemaghaei, 2018).

Consumer information processing and decision-making are linked to product involvement, as evident in previous research (e.g., Friedmann and Lowengart, 2019; Jia et al., 2021). Whether consumers process through the central or peripheral route depends on the depth of their cognitive information processing (Petty and Cacioppo, 1986). For high-involvement products, consumers tend to employ the central route, engaging in an extended decision-making process that involves in-depth analysis and comprehensive consideration (Chang et al., 2020; Rokonuzzaman et al., 2020). For low-involvement products, in contrast, consumers rely on the peripheral route, which involves limited problem-solving and requires less time and effort in processing relevant information (Chang et al., 2020; Rokonuzzaman et al., 2020).

In this case, how does product involvement mitigate the negative effects of product knowledge? VR retail environments offer consumers opportunities to closely inspect the functions of the product and estimate whether the product meets their specific needs, thereby suggesting the fit between VR and high-involvement products (Cowan and Ketron, 2019; Kang et al., 2020). More specifically, when evaluating high-involvement products such as consumer durables (e.g., a refrigerator), VR assists consumers in focusing on product information and forming a clearer functional mental simulation of how the product might work with less uncertainty and risk than static pictures do (Chang et al., 2020; Park and Yoo, 2020). Such an effect might hold true regardless of the level of product knowledge as new product information might be deemed more significant and persuasive (Lin and Chen, 2006; Petty and Cacioppo, 2018). For low-involvement products such as fast-moving consumer goods (e.g., toothpaste), however, consumers are more inclined to engage in peripheral route evaluation, which does not require much new information search and evaluation, and thus, product knowledge, rather than VR, may play a more dominant role in the mental imagery formation process (Petty and Cacioppo, 2018; Rokonuzzaman et al., 2020). We, therefore propose the following hypotheses:

H3a. When the low-involvement product is presented, consumers experiencing VR (vs. static pictures) will generate higher (vs. lower) elaboration of mental imagery when their product knowledge is low (vs. high), leading to higher (vs. lower) purchase intention (moderated mediation). This moderating effect of product knowledge will not occur when the high-involvement product is presented.

H3b. When the low-involvement product is presented, consumers experiencing VR (vs. static pictures) will generate higher (vs. lower) quality of mental imagery when their product knowledge is low (vs. high), leading to higher (vs. lower) purchase intention (moderated mediation). This moderating effect of product knowledge will not occur when the high-involvement product is presented.

3. Methodology

3.1. Ontological and epistemological backgrounds

The approaches of this study are considered through the lenses of its ontological and epistemological underpinnings, which in turn guide the specific methodology employed in the research (Saunders et al., 2012). Ontology refers to the study of being and aims to comprehend the constituents of reality (Soergel, 1999). Epistemology, on the other hand,

pertains to the exploration of knowledge and the process of knowing. The epistemological assumptions focus on how knowledge is generated, needed, and conveyed (Cohen et al., 2018). This research holds a positivist paradigm and adheres to the ontological perspective that reality exists externally and can be accurately described and causally explained (Bisman, 2010; Hunt, 1991). In terms of epistemology, a positivist philosophical stance posits that reality or research questions can be objectively uncovered (Hunt, 1991; McGregor and Murnane, 2010). Therefore, this study embraces a positivist paradigm and employs quantitative data collection and analysis methods to either support or refute potential evidence while seeking to comprehend, explain, and anticipate reality (Bisman, 2010; Guba and Lincoln, 1994).

Holding a positivist paradigm, this study formulates the aforementioned research hypotheses by drawing upon the empirical and theoretical insights from existing literature and prior research within the domain of VR and consumer research. Subsequently, a series of experiments is designed, accompanied by post-experiment surveys, followed by data analysis to ascertain the empirical validity of each research hypothesis. From the ontological perspective, these fresh empirical findings offer an avenue to objectively observe the social phenomena—consumer responses—in the context of VR retailing. From an epistemological standpoint, the elucidation of significant associations between variables in this study enables the introduction of a new empirical objective: to establish a knowledge foundation. This objective aligns with the broader epistemological goal within the realm of social sciences (Kim, 2022). Therefore, the ontological and epistemological foundations of this positivist research underscore its methodological unity—utilizing experiments and post-experiment surveys—to unearth and substantiate each research hypothesis.

3.2. Experimental stimuli

To understand the effectiveness of product presentations (i.e. VR and static pictures), we followed Kang et al.'s (2020) approach and created fictitious virtual shopping environments to present products. The outdoor camping chair was selected as the presented product for two reasons. First, it has been argued by previous studies that furniture goods (e.g., chairs and tables) fit the VR retail environment well due to salient attributes of the product (e.g., size and fit) corresponding to the strength of VR (Kang et al., 2020; Suh and Lee, 2005). Second, since product knowledge is a pivotal variable in our research, it's essential that consumers' knowledge about the presented products exhibits a certain level of heterogeneity. Consumers' knowledge of outdoor camping chairs is more likely to be evenly distributed and distinguished from each other compared to indoor products (e.g., sofas and beds), owing to their widespread familiarity among most consumers.

We conducted a pretest to verify this argument concerning the distribution of product knowledge. In experimental design, it is a common practice to use pretest to develop the stimuli and check manipulation. For example, Senecal and Nantel (2004) used a pretest to identify the most "experience" product (wine) and the most "search" product (calculator) among six different products. In a similar vein, Xie et al. (2024) performed a pretest to confirm whether the manipulation of chatbot-expressed humour was successful. We did not use pretest to examine the quality of measurement scales. This is because that all measurement scales in our research were developed and validated in previous studies, thereby are deemed reliable and applicable. It is also common in research employing validated measurement scales to forgo pretesting the instruments before main studies (e.g., Heller et al., 2019; McLean et al., 2022; Luangrath et al., 2022; Wang et al., 2023; Xie et al., 2024).

Consistent with this practice, although we did not conduct a pretest on the instruments, we had expert panels, comprising marketing experts and seasoned researchers, to evaluate the quality and potential social sensitivity of the survey before conducting the main studies. This ensured that the validated scales effectively conveyed the true meaning of the questions and revealed key information. Moreover, throughout the three main studies, there were no indications of anomalies or issues related to the quality or discrepancies of the scales. This was confirmed by satisfactory indices, including Cronbach's alpha (α), factor loading (FL), composite reliability (CR), average variance extracted (AVE), and the correlation matrix (see Appendix A and C). Therefore, despite not conducting a pretest on the instruments, they are valid, reliable, and have been extensively tested in previous studies, effectively delivering the true meaning of the questions and revealing key information in our research.

A pretest was conducted with 100 participants from China ($N_{male} = 22$, $N_{female} = 28$) and Australia ($N_{male} = 27$, $N_{female} = 23$). Respondents, irrespective of their gender, age, or physical appearance, were randomly approached (specifically, intercepting every third customer passing by) by two researchers at shopping malls in both countries, either as they were entering or exiting a furniture store, during a three-day period. They were provided with an introduction to the purpose of the pretest and informed that they would receive an incentive of $2 AUD or 10 RMB upon completing the pretest. Those aged 18 or older and expressed positive interest and intention were then recruited and asked to indicate their knowledge of beds ($M = 4.935$, $SD = 1.149$), sofas ($M = 4.728$, $SD = 1.041$), and outdoor camping chairs ($M = 3.725$, $SD = 1.396$) using a 4-item product knowledge measurement. This measurement, adapted from Lacey et al. (2010), utilized a 7-point Likert scale and included statements like "I have experience with", "am familiar with", "expertise with", and "regularly use the product". The outcomes revealed that the majority of scores for beds (81%) and sofas (78%) were at or above 4. In contrast, only 46% of participants scored 4 or above for the outdoor camping chair. This justified the selection of the outdoor camping chair as an appropriate item for this study.

The 3D VR environment was created using the software Unity 3D for VR-based product presentation. Meta Quest 2 was used as the VR HMD in Australia. Due to the inconvenience of using Meta devices in China, Pico Neo 3, which is a leading Chinese VR HMD that shares similar functions, was used in China. The two devices also exhibit similarities in terms of size (Meta: 191.5 mm × 102 mm × 142.5 mm; Pico: 190 mm × 112 mm × 135 mm), weight (Meta: 0.503 Kg; Pico: 0.610 Kg), field of view (Meta: 5.46 inch; Pico: 5.5 inch), resolution (Meta & Pico: 1832 × 1920 per-eye), and operation (Meta & Pico: two controllers). This parity ensures that the potential impact of different devices on the research results is minimized. In order to avoid potential interferences of VR environmental stimuli, the virtual product (i.e. outdoor chair) was placed without specific backgrounds. Clear instruction on how to engage with the product was also embedded in the VR environments. While stepping into the virtual environment, participants could see their virtual hands, change their visual perspectives, and virtually interact with the product with the controllers (see Fig. 2). To ensure consistency between the VR-based and picture-based product presentation, the products shown in the pictures were the same. In the 2D static pictures virtual shopping environment, the product was also displayed without specific backgrounds in the pictures (see Fig. 2). Across two countries, the product pictures were displayed on a 6.1-inch (diagonal) mobile phone screen.

3.3. Data collection and experiment procedures

As our experiments involve participants experiencing virtual products using VR HMDs, participants were recruited and the experiments were conducted offline. Xi and Hamari (2021) highlighted the significance of including participants from diverse cultural backgrounds to enhance the comprehension of VR shopping strategies targeting global consumers. Participants were recruited in two cities across two countries (i.e. Australia and China). This recruitment was carried out by two authors, one for each country. Prior to commencing the experiments, the authors communicated the subject, objectives, and context of the research and reached a consensus about the experiment details

Fig. 2. Product presented in VR (up) and static pictures (down).

including recruitment plans, sample size, and experiment procedures and settings. Throughout the data collection process, both authors maintained regular communication regarding experiment conditions, ensuring the consistency of data collection across the three studies conducted in two different countries.

We used the same data collection procedure for Study 1, 2, and 3. Identical to the pretest, we recruited participants in shopping malls from both countries in 2023, and potential participants were approached by the researchers when they were about to enter an outdoor furniture shop or after they had just left the shop. Specifically, we intercepted customers at the entrances of the shop, regardless of their gender, age, or physical appearance, using a systematically random sampling method (i.e. intercepting every third customer passing by). This strategic approach aimed to acquire data from participants with varied profiles and mitigate potential selection bias. Participants were asked about their interest in participating in our study, where they would experience a virtual outdoor camping chair shopping environment. Those who were aged 18 or older and expressed positive interest and intention were then recruited and randomly allocated to different conditions in a sequential manner, for example, participant 1 was assigned to condition 1, followed by participant 2 to condition 2, and so forth. As an expression of appreciation for their dedication of time and effort, participants were given a cash incentive of $2 AUD or equivalently 10 RMB upon the completion of the experiment upon successfully completing the experiment. Due to the relatively large sample size and the meticulous experimental procedures (as detailed in the subsequent paragraphs), the data collection process extended over a duration of 13 weeks.

To ensure the experiment effectiveness and reduce potential biases stemming from prior VR experiences, participants in the VR conditions were instructed to familiarize themselves with the VR HMD and controllers prior to the actual experiment. Participants were also made aware of potential physical discomfort, such as nausea and dizziness, and were allowed to interrupt their VR experiences at any time. They were also required to envision themselves engaging in online shopping by experiencing a virtual shopping environment in VR. For those being assigned to the static pictures conditions, they were asked to experience a virtual shopping environment and imagine that they were to browse multiple product pictures displayed on the phone while shopping online. Afterwards, all participants were required to partake in their designated experiments for a minimum of 2 min, with most completing the experiment within approximately 5 min.

Following the completion of the experiment, participants were asked to fill out a questionnaire containing items of the modelled constructs and demographic information. To gauge the potential social sensitivity of the survey and mitigate response bias, expert panels were applied in this research. Following the recommendation of De Jong et al. (2010) and consistent with prior research (e.g., Fernandes et al., 2021; Tandon et al., 2021), they were asked to assess and identify any elements within the questionnaire that might elicit feelings of shame or embarrassment. Specifically, the questionnaire underwent scrutiny by marketing experts and seasoned researchers to ensure the relevance and face validity of items and the omission of questions associated with social desirability, which could exert social pressures on participants and sway them towards providing responses they believe are socially favoured. No concerns were raised by the expert panels. Additionally, both the experimental design and the questionnaire received approval from the university's ethical committee. Moreover, despite briefing participants about the research's purpose, we deliberately withheld comprehensive details. As a result, participants were unaware of the broader context, including the existence of other experiment conditions they had not been assigned to, as well as the specific research model and hypotheses under examination. In line with previous research (e.g., Loureiro et al., 2021; Zhu et al., 2023), we excluded data from participants who encountered physical discomfort (like nausea and dizziness) in their VR experiences and chose not to proceed. This step was taken to account for the potential influence of their discomfort and reluctance, which might lead to extreme viewpoints in their survey responses, thus introducing an extreme response bias (Roster et al., 2017).

3.4. Measurements and data analysis

To measure the constructs in the conceptual model, we adapted the relevant constructs' items from prior research, as summarized in Appendix A. Items were measured on 7-point Likert-type scales. The measurement scale of product knowledge was adapted from Lacey et al. (2010) and examines consumers' level of experience, familiarity, usage, and expertise with the featured product category using 4 items, respectively. The measurements of elaboration of mental imagery and quality of mental imagery were adapted from Walters et al. (2007) to assess the two dimensions of consumers' consumption vision. Specifically, the 9-item scale of elaboration of mental imagery measures the extent to which the participants elaborated upon their visionary response to the products being presented in the virtual environment, including statements such as "The mental images that came to mind made me feel as though I was actually experiencing the product that featured in this virtual shopping environment" and "This virtual shopping environment made me fantasize about having the opportunity to experience the featured product". The 4-item scale of quality of mental imagery measures the quality of the images, including vividness (vague/vivid), clarity (unclear/clear), intensity (weak/intense), and sharpness (dull/sharp). The measurement scale of purchase intention ($\alpha = 0.930$) was adapted from Whang et al. (2021), measuring participants' intention to purchase the presented products.

Relevant demographic information was collected as covariates of this research. As illustrated, data was collected from two countries due to that different cultural and ethnic backgrounds may influence the way in which consumers adopt, perceive, and experience VR shopping (Xi and Hamari, 2021). Age and education level were also considered as potential factors influencing experimental outcomes, as younger and more educated consumers may find it easier to integrate VR tools into

their shopping experiences compared to their older and less educated counterparts (Farah et al., 2019; Xi and Hamari, 2021). Additionally, gender information was collected, recognizing female and male participants may acquire and appraise product information in distinct ways, potentially leading to different VR shopping experiences (Martínez-Molés et al., 2021).

Upon the completion of all experiments and questionnaires, PROCESS Macro was used as the data analysis method for hypotheses testing. Compared to the structural equation modelling (SEM), which often relies on larger sample sizes and may yield downward-biased standard errors in smaller samples, PROCESS proves more suited for relatively modest sample sizes (Hayes et al., 2017). Additionally, PROCESS typically generates the same data analysis results as an SEM program but with significantly less effort, even when working with a small sample. This underscores the robustness and reliability of the PROCESS Macro (Hayes and Rockwood, 2019; Hayes et al., 2017). Moreover, as a well-established analytical approach grounded in ordinary least square (OLS) regression, PROCESS has been extensively utilized across numerous prior studies exploring product presentation and VR retailing experiments (e.g., Alzayat and Lee, 2021; Luangrath et al., 2022; van Berlo et al., 2021). Thus, this research employs PROCESS as the primary data analysis tool.

3.5. Overview of studies

The hypotheses are tested across three experiment-based studies, each with distinct aims outlined as follows:

- Study 1 examines the effect of product presentation (VR vs. static pictures) as well as the mediating effect of mental imagery. More importantly, the moderating effect of product knowledge on the relationship between product presentation, mental imagery, and purchase intention is also tested (H_1).
- Study 2 investigates the role of shopping orientation as a moderator and the interaction with product knowledge that moderates the relationship between product presentation, mental imagery, and purchase intention (H_2).
- Study 3 investigates the role of product involvement as a moderator and the interaction with product knowledge, which moderates the relationship between product presentation, mental imagery, and purchase intention (H_3).

4. Study 1

In study 1, we tested how product presentation formats (VR vs. static pictures) influence consumer purchase intention and mental imagery in the first place, followed by the examination of mediating effects of mental imagery. Building upon these analyses, we conducted a moderation analysis to test whether and how product knowledge influences the impact of product presentation on consumer mental imagery and, subsequently, purchase intention (H_1).

4.1. Methods

4.1.1. Experimental design and participants

A randomized between-subjects experimental design varying one factor (product presentation) on two conditions (3D: VR versus 2D: static pictures) was conducted. A priori G*power analysis for the two experimental conditions ANOVA between factors design indicates that the desired sample size should be 108 with an effect size of 0.25 and a power of .90 at an alpha level of 0.05 (Faul et al., 2007). After excluding 16 participants who reported physical discomfort (e.g., nausea and dizziness) and 8 participants who withdrew from the survey halfway, a total number of 184 participants (89 male/95 female) were recruited. Participants were randomly distributed to the two conditions: VR (n = 90) and static pictures (n = 94). Demographic information was shown in Table 2.

Table 2
Participants' demographic information.

	Study 1	Study 2a	Study 2b	Study 3
Gender				
Male	89	148	271	165
Female	95	151	269	154
Age				
18 to 24	85	145	116	158
25 to 34	60	95	202	91
35 to 44	21	36	163	41
45 to 54	15	16	39	22
55 and above	3	7	20	7
Education level				
High school and less	28	41	111	34
Bachelor	108	190	227	211
Master and above	48	68	202	74
Country				
Australia	91	152	0	157
China	93	147	540	162
Total number	184	299	540	319

During the data collection process, while participants were randomly intercepted as discussed in the methodology section, it was observed that younger participants (e.g., Generation Z and millennial consumers) displayed more enthusiasm in participating in our experiments compared to their older counterparts. This observation aligns with the real-world trend where VR is increasingly being utilized in the retail industry to engage younger consumers, as they have shown the greatest interest among various generational cohorts in adopting VR (Carufel, 2022; Farah et al., 2019). Moreover, young consumers often represent a key target audience for outdoor product retailers. In Australia, individuals aged 15 to 34 make up the largest consumer group (40%) participating in outdoor activities (Bhat, 2023). Similarly, in China, the majority of outdoor activity enthusiasts are young, with approximately 46% aged between 30 and 39, and 40% even younger (Bi, 2022). Accordingly, the majority of the samples in our studies were young consumers. This outcome should be considered harmoniously aligns with the overarching landscape of the target consumers of VR retailing and outdoor products in the real world.

4.1.2. Procedures

As detailed in the methodology section, participants designated to the VR group were given explicit instructions and trainings to familiarize themselves with the VR HMD and the accompanying controllers prior to the commencement of the experiment. They were also instructed to envision themselves engaging in online shopping by experiencing a virtual shopping environment in VR. Participants allocated to the static pictures group were directed to simulate their involvement in an online shopping experience by browsing product images exhibited on a mobile phone screen, all within the context of a virtual shopping scenario. Subsequently, all participants were tasked with actively participating in the assigned experiment for a minimum duration of 2 min. It is noteworthy that the majority of participants successfully completed the experiment within an approximate timeframe of 5 min maximum. Afterwards, participants were asked to fill in a questionnaire regarding their pre-owned product knowledge, mental imagery, purchase intention, and demographic questions in a 7-point Likert scale format.

4.1.3. Measure validation

Prior to hypotheses testing, we assessed both reliability and validity. As shown in Appendix A, the Cronbach's alpha of product knowledge ($\alpha = 0.896$), elaboration of mental imagery ($\alpha = 0.923$), quality of mental imagery ($\alpha = 0.867$), and purchase intention ($\alpha = 0.901$) exceeded the required threshold of 0.70, indicating a good reliability (Hair et al., 2019). Our scrutiny of standardized factor loadings unveiled that each loading exceeded the critical value of 0.70, confirming the items' ability

to measure their corresponding constructs effectively (Bagozzi and Yi, 1988). The values of Composite Reliability (CR) and Average Variance Extracted (AVE) were all greater than the cut-off of 0.7 and 0.5, respectively (Hair et al., 2019). Thus, we confirm that our measures for testing the proposed model met the convergent validity criteria. As depicted in Appendix C (a), the square root values of AVE (on the diagonals) are greater than the inter-construct correlational values (on the left of the diagonals), thereby indicating that discriminant validity was verified (Fornell and Larcker, 1981).

4.1.4. Normality and homogeneity test of variance

Before delving into data analysis, it is essential to ensure that the fundamental statistical assumptions for Analysis of Variance (ANOVA) are met. These assumptions encompass normality and equal variances, as noted by Allen et al. (2014). Hair et al. (2022) suggested that skewness and kurtosis values within the range of −2 to 2 are indicative of a normal distribution. Our findings reflect these parameters, with skewness and kurtosis values of product knowledge (Skewness: 0.251, Kurtosis: 0.891), elaboration of mental imagery (Skewness: 0.246, Kurtosis: 0.287), quality of mental imagery (Skewness: 0.399, Kurtosis: 0.594), and purchase intention (Skewness: 0.087, Kurtosis: 0.518) residing within this designated range, affirming normal distribution. There should also be approximately the same amount of variance in each group of scores (Allen et al., 2014). Thus, we employed Levene's test for equality of error variances, focusing on the dependent variables (i.e. elaboration of mental imagery, quality of mental imagery, purchase intention) across the two conditions (i.e. VR and static pictures). The results showed that for elaboration of mental imagery ($p = 0.272$), quality of mental imagery ($p = 0.159$), and purchase intention ($p = 0.272$), the assumption of homogeneity of variances were not violated, signifying that the equal variance requirement was met.

4.1.5. Common method variance

We also estimated the common method variance. Given that our data originated from a single source, the prospect of common method bias was scrutinized (Quach et al., 2022). To this end, we employed a two-pronged approach. Firstly, Harman's single-factor test was applied, entailing unrotated exploratory factor analysis (EFA) on all measured variables (i.e. product knowledge, elaboration and quality of mental imagery, purchase intention). The results supported several factors while a single constrained factor accounted for 44.943% of the variance, less than the 50% threshold (Podsakoff and Organ, 1986). Secondly, following the approaches suggested by Malhotra et al. (2006) and Podsakoff et al. (2012), we added a single factor model and used an unmeasured latent method construct (ULMC) approach by adding an unmeasured latent variable to the measurement model and connected it to all observed items. As shown in Appendix B (a), the fit indices of the four-factor model conceptualized in this study (i.e. measurement model) were significantly better than a single-factor model, while were not significantly different from the five-factor model with an unmeasured latent variable. Thus, the results of these common method bias tests indicate that common method bias was not an issue in this study. Overall, these results suggest that we could proceed with hypotheses testing.

4.2. Results of study 1

4.2.1. Effects of product presentation

A MANOVA analysis was conducted to test the relationship between the independent variable (i.e. product presentation: VR and static pictures) and dependent variables including elaboration and quality of mental imagery and purchase intention. In accordance with hypotheses, the results supported that product presentation had a positive influence on elaboration of mental imagery ($M_{VR} = 4.889$, $SD_{VR} = 1.068$; $M_{static\ pictures} = 3.967$, $SD_{static\ pictures} = 1.182$; $F(1, 182) = 30.737$, $p < 0.001$, $\eta_p^2 = 0.144$), quality of mental imagery ($M_{VR} = 5.306$, $SD_{VR} = 1.240$; $M_{static\ pictures} = 4.303$, $SD_{static\ pictures} = 1.427$; $F(1, 182) = 25.764$, $p < 0.001$, $\eta_p^2 = 0.124$), and purchase intention ($M_{VR} = 4.541$, $SD_{VR} = 1.287$; $M_{static\ pictures} = 3.521$, $SD_{static\ pictures} = 1.448$; $F(1, 182) = 25.394$, $p < 0.001$, $\eta_p^2 = 0.122$).

To rule out alternative explanations, additionally, a MANCOVA analysis with participants' age, gender, country, and education level as covariates was performed. The results also supported that product presentation had a positive impact on elaboration of mental imagery ($M_{VR} = 4.889$, $SD_{VR} = 1.068$; $M_{static\ pictures} = 3.967$, $SD_{static\ pictures} = 1.182$; $F(1, 182) = 30.017$, $p < 0.001$, $\eta_p^2 = 0.144$), quality of mental imagery ($M_{VR} = 5.306$, $SD_{VR} = 1.240$; $M_{static\ pictures} = 4.303$, $SD_{static\ pictures} = 1.427$; $F(1, 182) = 25.402$, $p < 0.001$, $\eta_p^2 = 0.125$), and purchase intention ($M_{VR} = 4.541$, $SD_{VR} = 1.287$; $M_{static\ pictures} = 3.521$, $SD_{static\ pictures} = 1.448$; $F(1, 182) = 24.243$, $p < 0.001$, $\eta_p^2 = 0.120$). The results also showed that demographic attributes were not significant covariates for elaboration of mental imagery (age: $p = 0.565$; gender: $p = 0.611$; country: $p = 0.159$; education level: $p = 0.391$), quality of mental imagery (age: $p = 0.294$; gender: $p = 0.817$; country: $p = 0.400$; education level: $p = 0.734$), and purchase intention (age: $p = 0.602$; gender: $p = 0.717$; country: $p = 0.211$; education level: $p = 0.843$). Thus, the positive effects of product presentation on elaboration of mental imagery, quality of mental imagery, and purchase intention were established.

4.2.2. Mediating role of mental imagery

Mediation analysis was run using PROCESS Model 4 (Hayes, 2018). We took product presentation as the independent variable, purchase intention as the dependent variable, and elaboration of mental imagery and quality of mental imagery as parallel mediators (using 5000 bootstrap samples). The total effect of product presentation on purchase intention was significant ($b = 1.019$, $SE = 0.202$, $t = 5.039$, $p < 0.001$). The results showed that the indirect effect of product presentation, elaboration of mental imagery, and purchase intention was significant ($b = 0.476$, $SE = 0.113$, 95% CI: 0.269, 0.713), so was the indirect effect of product presentation, quality of mental imagery, and purchase intention ($b = 0.314$, $SE = 0.090$, 95% CI: 0.154, 0.507). However, the direct effect of product presentation on purchase intention was insignificant ($b = 0.230$, $SE = 0.172$, $t = 1.336$, $p = 0.183$).

We also ran another PROCESS Model 4 with demographic attributes as covariates. Similarly, the results showed a significant total effect of product presentation on purchase intention ($b = 1.004$, $SE = 0.204$, $t = 4.924$, $p < 0.001$), a significant indirect effect of product presentation, elaboration of mental imagery, and purchase intention ($b = 0.474$, $SE = 0.111$, 95% CI: 0.274, 0.708), a significant indirect effect of product presentation, quality of mental imagery, and purchase intention ($b = 0.319$, $SE = 0.092$, 95% CI: 0.156, 0.515), and an insignificant direct effect of product presentation on purchase intention ($b = 0.211$, $SE = 0.173$, $t = 1.222$, $p = 0.223$). Identical to the MANCOVA results, no covariates were significant ($p > 0.05$). Thus, it could be concluded that compared to static pictures, the product presented in VR boosts consumer mental imagery, leading to a stronger intention to purchase the product. The relationship between product presentation and purchase intention is fully mediated by elaboration and quality of mental imagery.

4.2.3. Moderating effects of product knowledge

We ran a PROCESS Model 7 with product presentation as the independent variable, elaboration and quality of mental imagery as mediators, purchase intention as the dependent variable, product knowledge as the moderator. Product knowledge did not differ in different product presentation mediums ($M_{VR} = 3.494$, $SD_{VR} = 1.708$; $M_{static\ pictures} = 3.700$, $SD_{static\ pictures} = 1.618$; $p = 0.404$, Cohen's $d = 0.124$) and there was no significant difference in variances ($p = 0.548$). As shown in Table 3a, the results revealed a significant direct effect of product presentation on elaboration of mental imagery ($b = 2.249$, $SE = 0.352$, $t = 6.387$, $p < 0.001$), a significant direct effect of product knowledge on elaboration of mental imagery ($b = 0.455$, $SE = 0.064$, $t = 7.122$, $p <$

Table 3
PROCESS Model analysis results (Study 1).

(a) Analysis without covariates

	Coeff	SE	t	p	95% LLCI	95% ULCI
Mediator (M1): Elaboration of mental imagery						
Constant	2.285	0.258	8.874	<0.001	1.777	2.793
Product presentation (X)	2.249	0.352	6.387	<0.001	1.554	2.943
Product knowledge (W)	0.455	0.064	7.122	<0.001	0.329	0.581
X × W	−0.353	0.089	−3.973	<0.001	−0.528	−0.178
Mediator (M2): Quality of mental imagery						
Constant	2.505	0.312	8.037	<0.001	1.890	3.120
Product presentation (X)	2.211	0.426	5.188	<0.001	1.370	3.052
Product knowledge (W)	0.486	0.077	6.290	<0.001	0.334	0.638
X × W	−0.317	0.108	−2.951	0.004	−0.530	−0.105
Result: Purchase intention						
Constant	0.126	0.324	0.390	0.697	−0.514	0.767
Product presentation (X)	0.230	0.172	1.336	0.183	−0.110	0.569
Elaboration of mental imagery (M1)	0.516	0.081	6.335	<0.001	0.355	0.677
Quality of mental imagery (M2)	0.313	0.069	4.566	<0.001	0.178	0.449

(b) Analysis with covariates

	Coeff	SE	t	p	95% LLCI	95% ULCI
Mediator (M1): Elaboration of mental imagery						
Constant	2.586	0.502	5.146	<0.001	1.594	3.577
Product presentation (X)	2.246	0.355	6.332	<0.001	1.546	2.946
Product knowledge (W)	0.452	0.065	6.991	<0.001	0.325	0.580
X × W	−0.352	0.089	−3.936	<0.001	−0.528	−0.175
Age	−0.051	0.074	−0.681	0.497	−0.197	0.096
Gender	−0.012	0.148	−0.082	0.935	−0.305	0.281
Country	0.114	0.151	0.758	0.450	−0.183	0.412
Education level	−0.112	0.103	−1.081	0.281	−0.316	0.092
Mediator (M2): Quality of mental imagery						
Constant	2.637	0.608	4.341	<0.001	1.438	3.836
Product presentation (X)	2.230	0.429	5.199	<0.001	1.383	3.076
Product knowledge (W)	0.491	0.078	6.282	<0.001	0.337	0.646
X × W	−0.320	0.108	−2.957	0.004	−0.533	−0.106
Age	−0.109	0.090	−1.213	0.227	−0.286	0.068
Gender	0.128	0.179	0.715	0.476	−0.226	0.482
Country	0.025	0.182	0.138	0.891	−0.335	0.385
Education level	−0.059	0.125	−0.473	0.637	−0.306	0.188
Result: Purchase intention						
Constant	−0.501	0.574	−0.873	0.384	−1.633	0.632
Product presentation (X)	0.211	0.173	1.222	0.223	−0.130	0.552
Elaboration of mental imagery (M1)	0.517	0.082	6.299	<0.001	0.355	0.680
Quality of mental imagery (M2)	0.318	0.069	4.605	<0.001	0.182	0.454
Age	0.112	0.079	1.412	0.160	−0.045	0.268

Table 3 (*continued*)

(b) Analysis with covariates

	Coeff	SE	t	p	95% LLCI	95% ULCI
Gender	0.103	0.158	0.656	0.513	−0.208	0.415
Country	0.081	0.160	0.508	0.612	−0.235	0.398
Education level	0.039	0.110	0.351	0.726	−0.179	0.256

0.001), and a significant negative interaction between product presentation and product knowledge (b = −0.353, SE = 0.089, t = −3.973, p < 0.001). Since product knowledge is a continuous variable, we followed the work of Spiller et al. (2013) and conducted the floodlight analysis. The Johnson-Neyman output (see Table 4a) showed that product knowledge at a value of 5.220 represented the split point of significant and insignificant impacts of product presentation on elaboration of mental imagery. While below 5.220, VR (vs. static pictures) led to a higher (vs. lower) level of elaboration of mental imagery, whereas such impact was insignificant when product knowledge was above 5.220.

Moreover, the results also indicated a significant direct impact of product presentation on quality of mental imagery (b = 2.211, SE = 0.426, t = 5.188, p < 0.001), a significant direct effect of product knowledge on quality of mental imagery (b = 0.486, SE = 0.077, t = 6.290, p < 0.001), and a significant negative interaction between product presentation and product knowledge (b = −0.317, SE = 0.108, t = −2.951, p = 0.004). The Johnson-Neyman result (see Table 4b) showed that product knowledge at a value of 5.354 represented the split point. While below 5.354, VR led to higher quality of mental imagery. However, such an impact was insignificant when product knowledge was above 5.354. Additionally, elaboration (b = 0.516, SE = 0.081, t = 6.335, p < 0.001) and quality (b = 0.313, SE = 0.069, t = 4.566, p < 0.001) of mental imagery were found significantly associated with purchase intention, while the direct effect of product presentation on purchase intention was insignificant (b = 0.230, SE = 0.172, t = 1.336, p = 0.183). The indices of moderated mediation effects also revealed that product knowledge is a significant moderator influencing the mediating effect of elaboration of mental imagery (b = −0.182, SE = 0.050, 95% CI: 0.285, −0.089) and quality of mental imagery (b = −0.099, SE = 0.039, 95% CI: 0.183, −0.029) on the relationship between product presentation and purchase intention, respectively.

We ran another PROCESS Model 7 with demographic attributes as covariates to rule out alternative explanations. As shown in Table 3b, the results indicated that apart from slight variations in the specific numerical values of each indicator (i.e. coefficient, standard error, t and p value, 95% confidence interval), the significance levels of all effects remain consistent with the model that includes covariates. The Johnson-Neyman result (see Table 4c) also showed that product knowledge at a value of 5.221 represented the split point for elaboration of mental imagery and 5.363 for quality of mental imagery (see Table 4d). The moderated mediating effects were also significant for elaboration (b = −0.186, SE = 0.051, 95% CI: 0.288, −0.089) and quality (b = −0.101, SE = 0.040, 95% CI: 0.188, −0.031) of mental imagery. Thus, this study indicated a significant moderating effect of product knowledge on the relationship between product presentation, mental imagery, and purchase intention. H_{1a} and H_{1b} are supported.

5. Study 2

In Study 2, we explored the moderating effect of shopping orientation on the interaction effect of product presentation mediums × product knowledge on mental imagery and, subsequently, purchase intention (H_2).

Table 4
Johnson-Neyman outputs (Study 1).

(a) Elaboration of mental imagery (analysed without covariates)

Product Knowledge	Effect	S.E.	t	p	LLCI	ULCI
1.000	1.896	0.274	6.921	0.000	1.355	2.436
1.300	1.790	0.252	7.108	0.000	1.293	2.287
1.600	1.684	0.231	7.299	0.000	1.229	2.139
1.900	1.578	0.211	7.483	0.000	1.162	1.994
2.200	1.472	0.193	7.641	0.000	1.092	1.852
2.500	1.366	0.177	7.735	0.000	1.018	1.715
2.800	1.260	0.163	7.713	0.000	0.938	1.583
3.100	1.154	0.154	7.511	0.000	0.851	1.458
3.400	1.049	0.148	7.075	0.000	0.756	1.341
3.700	0.943	0.147	6.395	0.000	0.652	1.233
4.000	0.837	0.151	5.529	0.000	0.538	1.135
4.300	0.731	0.160	4.576	0.000	0.416	1.046
4.600	0.625	0.172	3.637	0.000	0.286	0.964
4.900	0.519	0.187	2.775	0.006	0.150	0.888
5.200	0.413	0.205	2.020	0.045	0.010	0.817
5.220	0.406	0.206	1.973	0.050	0.000	0.812
5.500	0.307	0.224	1.372	0.172	−0.135	0.749
5.800	0.201	0.245	0.823	0.411	−0.281	0.684
6.100	0.095	0.266	0.358	0.720	−0.430	0.621
6.400	−0.010	0.289	−0.036	0.971	−0.581	0.560
6.700	−0.116	0.312	−0.373	0.710	−0.732	0.500
7.000	−0.222	0.336	−0.661	0.509	−0.885	0.441

(b) Quality of mental imagery (analysed without covariates)

Product Knowledge	Effect	S.E.	t	p	LLCI	ULCI
1.000	1.894	0.332	5.712	0.000	1.239	2.548
1.300	1.798	0.305	5.900	0.000	1.197	2.400
1.600	1.703	0.279	6.099	0.000	1.152	2.254
1.900	1.608	0.255	6.300	0.000	1.104	2.112
2.200	1.513	0.233	6.487	0.000	1.053	1.973
2.500	1.418	0.214	6.630	0.000	0.996	1.840
2.800	1.322	0.198	6.686	0.000	0.932	1.713
3.100	1.227	0.186	6.596	0.000	0.860	1.594
3.400	1.132	0.179	6.310	0.000	0.778	1.486
3.700	1.037	0.178	5.811	0.000	0.685	1.389
4.000	0.942	0.183	5.139	0.000	0.580	1.303
4.300	0.846	0.193	4.378	0.000	0.465	1.228
4.600	0.751	0.208	3.611	0.000	0.341	1.162
4.900	0.656	0.226	2.897	0.004	0.209	1.103
5.200	0.561	0.248	2.264	0.025	0.072	1.049
5.354	0.512	0.259	1.973	0.050	0.000	1.024
5.500	0.465	0.271	1.718	0.088	−0.069	1.000
5.800	0.370	0.296	1.251	0.213	−0.214	0.955
6.100	0.275	0.322	0.853	0.395	−0.361	0.911
6.400	0.180	0.350	0.514	0.608	−0.510	0.870
6.700	0.085	0.378	0.224	0.823	−0.661	0.830
7.000	−0.011	0.407	−0.026	0.979	−0.813	0.792

(c) Elaboration of mental imagery (analysed with covariates)

Product Knowledge	Effect	S.E.	t	p	LLCI	ULCI
1.000	1.894	0.276	6.862	0.000	1.349	2.439
1.300	1.788	0.254	7.047	0.000	1.288	2.289
1.600	1.683	0.233	7.237	0.000	1.224	2.142
1.900	1.577	0.213	7.420	0.000	1.158	1.997
2.200	1.472	0.194	7.576	0.000	1.088	1.855
2.500	1.366	0.178	7.671	0.000	1.015	1.718
2.800	1.261	0.165	7.652	0.000	0.935	1.586
3.100	1.155	0.155	7.455	0.000	0.849	1.461
3.400	1.049	0.149	7.027	0.000	0.755	1.344
3.700	0.944	0.148	6.358	0.000	0.651	1.237
4.000	0.838	0.152	5.501	0.000	0.538	1.139
4.300	0.733	0.161	4.559	0.000	0.416	1.050
4.600	0.627	0.173	3.628	0.000	0.286	0.968
4.900	0.522	0.188	2.773	0.006	0.150	0.893
5.200	0.416	0.206	2.022	0.045	0.010	0.822
5.221	0.409	0.207	1.974	0.050	0.000	0.817
5.500	0.310	0.225	1.379	0.170	−0.134	0.755
5.800	0.205	0.246	0.833	0.406	−0.281	0.690
6.100	0.099	0.268	0.371	0.711	−0.429	0.628
6.400	−0.006	0.291	−0.022	0.983	−0.580	0.567
6.700	−0.112	0.314	−0.356	0.722	−0.731	0.508
7.000	−0.217	0.338	−0.644	0.521	−0.884	0.449

(d) Quality of mental imagery (analysed with covariates)

Product Knowledge	Effect	S.E.	t	p	LLCI	ULCI
1.000	1.910	0.334	5.723	0.000	1.252	2.569
1.300	1.814	0.307	5.912	0.000	1.209	2.420
1.600	1.718	0.281	6.111	0.000	1.164	2.273
1.900	1.623	0.257	6.312	0.000	1.115	2.130
2.200	1.527	0.235	6.499	0.000	1.063	1.990
2.500	1.431	0.215	6.644	0.000	1.006	1.856
2.800	1.335	0.199	6.701	0.000	0.942	1.728
3.100	1.239	0.187	6.614	0.000	0.869	1.609
3.400	1.143	0.181	6.330	0.000	0.787	1.500
3.700	1.047	0.180	5.833	0.000	0.693	1.402
4.000	0.951	0.184	5.163	0.000	0.588	1.315
4.300	0.855	0.194	4.401	0.000	0.472	1.239
4.600	0.760	0.209	3.633	0.000	0.347	1.172
4.900	0.664	0.227	2.918	0.004	0.215	1.113
5.200	0.568	0.249	2.283	0.024	0.077	1.059
5.363	0.516	0.261	1.974	0.050	0.000	1.031
5.500	0.472	0.272	1.734	0.085	−0.065	1.009
5.800	0.376	0.297	1.264	0.208	−0.211	0.963
6.100	0.280	0.324	0.865	0.388	−0.359	0.919
6.400	0.184	0.351	0.524	0.601	−0.509	0.878
6.700	0.088	0.380	0.233	0.816	−0.661	0.838
7.000	−0.007	0.408	−0.018	0.985	−0.814	0.799

5.1. Methods (study 2a)

5.1.1. Experimental design and participants

A 2 (product presentation: 0 = Static pictures, 1 = VR) × 2 (shopping orientation: 0 = Task-focused, 1 = Experiential) randomized between-subjects experimental design was conducted. The G*power analysis for the four conditions ANOVA between factors design showed that the desired sample size should be 148 with an effect size of 0.25 and a power of 0.90 at an alpha level of 0.05 (Faul et al., 2007). After excluding 22 participants who reported VR sickness and 5 participants who withdrew the survey halfway, 299 participants were recruited (see Table 2) and were randomly distributed to one of the four conditions: VR × Task--focused (n = 75), VR × Experiential (n = 71), Static pictures × Task--focused (n = 78), Static pictures × Experiential (n = 75).

5.1.2. Shopping orientation manipulation and procedures

Prior to the experiment, participants were asked to imagine one of the two shopping scenarios, which were in accordance with previous studies (Büttner et al., 2014; Tang and Tsang, 2020). In the tasked-focused condition, participants were asked to imagine that they were shopping via a VR HMD or browsing product pictures to purchase an outdoor chair for an upcoming camping trip. In the experiential condition, participants were asked to imagine that they were going to kill time by experiencing a shopping environment via a VR HMD or browsing product pictures while waiting for a friend to go out (See Appendix D). Afterwards, they were asked to indicate their agreement on a seven-item shopping orientation measurement scale (α = 0.883) with four items measuring experiential orientation and three reverse-coded items measuring task-focused orientation adapted from Büttner et al. (2013). Next, they were assigned to one of the two product presentation conditions with their primed shopping orientation. The experiment process was identical to Study 1. A post-experiment questionnaire was then presented and completed.

5.1.3. Measure validation and tests of normality and equal variances

As shown in Appendix A, the Cronbach's alpha of shopping orientation (α = 0.883), product knowledge (α = 0.917), elaboration of mental imagery (α = 0.916), quality of mental imagery (α = 0.869), and purchase intention (α = 0.900) were all greater than 0.70. A comprehensive examination of standardized factor loadings, CR, and AVE statistics was concurrently conducted for measure validation. Every factor loading surpassed the critical threshold of 0.70. The computed values for CR and AVE notably surpassed the established criteria of 0.7 and 0.5 respectively, signifying robust convergent validity (see Appendix A). Moreover, the square root values of AVE (on the diagonals) are greater than the inter-construct correlational values (on the left of the diagonals), thereby indicating that discriminant validity was verified (see Appendix C (b)).

Our evaluation extended to the validation of the normality and equal variances assumptions. The skewness and kurtosis values of shopping orientation (Skewness: 0.348, Kurtosis: 0.133), product knowledge (Skewness: 0.624, Kurtosis: 0.448), elaboration of mental imagery (Skewness: 0.468, Kurtosis: 0.162), quality of mental imagery (Skewness: 0.171, Kurtosis: 0.513), and purchase intention (Skewness: 0.193, Kurtosis: 0.568) were situated within the range of −2 to 2, aligning with the criteria outlined by Hair et al. (2022) for normal distribution. The variances of dependent variables across two conditions (i.e. VR and static pictures) were tested using the Levene's test for equality of error variances. The results indicated that the assumption of homogeneity of variances was upheld for elaboration of mental imagery (p = 0.118), quality of mental imagery (p = 0.603), and purchase intention (p = 0.444). Overall, these results suggest that we could proceed with data analysis.

5.1.4. Common method variance

In a manner parallel to Study 1, a thorough examination of common method bias was conducted. The outcome of Harman's single-factor test, encompassing all the measured variables (i.e. shopping orientation, product knowledge, elaboration and quality of mental imagery, purchase intention) highlighted that the first factor exhibited the highest variance at 30.748%, which was less than 50%. Moreover, we conducted a comprehensive comparison between three models: the five-factor measurement model, the single-factor model, and the six-factor model introducing an unmeasured latent variable (ULMC). In this context, the fit indices of the five-factor model demonstrated significant improvement over the single-factor model, while the model with an unmeasured latent variable yielded similar fit indices (see Appendix B (b)). Thus, common method bias was not an issue in Study 2, allowing us to proceed with hypotheses testing.

5.2. Results of study 2a

5.2.1. Manipulation check

An independent *t*-test was conducted to examine whether shopping orientation was successfully manipulated. As expected, participants who had been assigned to the experiential condition reported a higher

shopping orientation score than those who had been assigned to the task-focused condition ($M_{experiential} = 4.537$, $SD_{experiential} = 0.935$; $M_{Task\text{-}focused} = 3.905$, $SD_{Task\text{-}focused} = 0.926$; $p < 0.001$, Cohen's $d = 0.650$) and there was no significant difference in variances between two conditions ($p = 0.531$). Thus, shopping orientation was successfully manipulated and primed.

5.2.2. Moderating effects of shopping orientation

We ran a PROCESS model 11 with product presentation as the independent variable, elaboration (M1) and quality of mental imagery (M2) as mediators, product knowledge ($M = 3.231$, $SD = 1.500$) as the first moderator (W), shopping orientation as the second moderator (Z), and purchase intention as the dependent variable. As shown in Table 5a, a significant three-way interaction between product presentation, product knowledge, and shopping orientation was found ($b = 0.426$, $SE = 0.158$, $t = 2.698$, $p = 0.007$) with a significant main effect of product presentation ($b = 1.904$, $SE = 0.429$, $t = 4.438$, $p < 0.001$), product knowledge ($b = 0.518$, $SE = 0.076$, $t = 6.811$, $p < 0.001$), and shopping orientation ($b = 1.013$, $SE = 0.380$, $t = 2.669$, $p = 0.008$). As expected, the results of conditional effects suggested that under the task-focused condition, the impact of product presentation on elaboration of mental imagery was insignificant with product knowledge being high ($b = 0.139$, $SE = 0.232$, $t = 0.601$, $p = 0.548$). However, for experiential orientation, the relationship between product presentation and elaboration of mental imagery was significant ($b = 0.868$, $SE = 0.237$, $t = 3.670$, $p < 0.001$). The result also revealed that the interaction of product knowledge × shopping orientation significantly moderated the mediating effect of elaboration of mental imagery ($b = 0.136$, $SE = 0.055$, 95% CI: 0.034, 0.249) on the relationship between product presentation and purchase intention.

For quality of mental imagery, however, an insignificant three-way interaction between product presentation, product knowledge, and shopping orientation was found ($b = 0.232$, $SE = 0.177$, $t = 1.309$, $p = 0.192$) with a significant main effect of product presentation ($b = 1.789$, $SE = 0.482$, $t = 3.713$, $p < 0.001$), product knowledge ($b = 0.488$, $SE = 0.085$, $t = 5.719$, $p < 0.001$), and shopping orientation ($b = 1.057$, $SE = 0.426$, $t = 2.481$, $p = 0.014$). This also reflected in the insignificant moderating effect of product knowledge × shopping orientation on the relationship between product presentation, quality of mental imagery, and purchase intention ($b = 0.065$, $SE = 0.058$ 95% CI: 0.034, 0.199). Identical to Study 1, elaboration ($b = 0.320$, $SE = 0.072$, $t = 4.466$, $p < 0.001$) and quality ($b = 0.280$, $SE = 0.066$, $t = 4.244$, $p < 0.001$) of mental imagery were found significantly associated with purchase intention, while the direct effect of product presentation on purchase intention was insignificant ($b = 0.148$, $SE = 0.139$, $t = 1.060$, $p = 0.290$).

We also conducted an alternative PROCESS Model 11 analysis including demographic attributes as covariates. Similar to Study 1, the findings revealed that aside from minor discrepancies in the exact numerical values of each indicator, the significance levels of all effects remain in accordance with the model that did not incorporates covariates (see Table 5b). None of the demographic attributes was significant covariate either. The moderated-moderated mediating effects were also significant for elaboration of mental imagery ($b = 0.124$, $SE = 0.053$, 95% CI: 0.029, 0.236) while insignificant for quality of mental imagery ($b = 0.070$, $SE = 0.058$, 95% CI: 0.029, 0.203) of mental imagery. Therefore, H_{2a} is supported whereas H_{2b} is not supported.

To bolster the statistical power of the moderation effect of shopping orientation, we conducted a replication of Study 2a. For this purpose, we employed an online experimental design in a single-country context, resulting in Study 2b. This approach allowed us to augment the sample size, bolster internal validity, and fortify the overall robustness of the findings in Study 2a, thus instilling greater confidence in our research outcomes.

5.3. Methods (study 2b)

5.3.1. Experimental design and participants

Similar to the methodology in Study 2a, A 2 (product presentation: 0 = Static pictures, 1 = VR) × 2 (shopping orientation: 0 = Task-focused, 1 = Experiential) randomized between-subjects experimental design was conducted. We employed an online experimental design with participants drawn exclusively from one country (i.e. China) to enhance the internal validity of the study and to reevaluate the findings of Study 2a. For data collection, we utilized online surveys for both the VR and Static pictures experiments, which were hosted on the well-known China-based online survey platform, WJX. This platform boasts a substantial user base, ensuring access to a large number of potential respondents. Participants, aged 18 or above, with an interest in outdoor products, had the opportunity to self-select for participation in the experiment. Additionally, ownership of a VR HMD was a prerequisite for participation in VR experiments. A total number of 540 participants were recruited (see Table 2). Those who self-selected to participate in VR experiments were randomly assigned to one of two conditions: VR × Task-focused ($n = 136$) or VR × Experiential ($n = 135$). Participants in the Static pictures experiments were similarly randomized into two conditions: Static pictures × Task-focused ($n = 135$) and Static pictures × Experiential ($n = 134$). Each participant received a 5 RMB incentive upon completing the experiment.

5.3.2. Shopping orientation manipulation and procedures

We followed a procedure closely resembling that of Study 2a. In the tasked-focused condition, participants were instructed to imagine themselves using VR or viewing product images with the intent to purchase an outdoor chair for an upcoming camping excursion. Conversely, in the experiential condition, participants were tasked with imagining they were engaging in a VR shopping environment or viewing product images while waiting for a friend to go out (See Appendix D). Subsequently, they were asked to express their level of agreement on their shopping orientation. Following this, they were directed to immerse themselves in the VR environment or browse product images with their primed shopping orientation. A post-experiment questionnaire was presented and duly completed. To ensure the integrity of the online experiment, two validation questions were incorporated. These questions served to ascertain whether respondents had genuinely experienced the stimuli. The first question inquired about the product seen in the virtual shopping environment (i.e. "Which product did you see in the virtual shopping environment?"), while the second question tested their attention to the questionnaire (i.e. "Which number indicates 'fully agree'?"). Data from participants who failed to answer the first question correctly (i.e. outdoor chair) or the second question (i.e. 7) were excluded (32 participants).

5.3.3. Measure validation and tests of normality and equal variances

As depicted in Appendix A, the Cronbach's alpha coefficients of shopping orientation ($\alpha = 0.919$), product knowledge ($\alpha = 0.929$), elaboration of mental imagery ($\alpha = 0.934$), quality of mental imagery ($\alpha = 0.873$), and purchase intention ($\alpha = 0.875$) were all higher than 0.70. Each factor loading exceeded the critical threshold of 0.70. Additionally, the computed values for CR and AVE significantly surpassed the criteria of 0.7 and 0.5, respectively (see Appendix A). The discriminant validity was also achieved, as the square root values of AVE were greater than the inter-construct correlations (see Appendix C (b)).

To assess the normality assumption, we examined the skewness and kurtosis values of various variables, including shopping orientation (Skewness: 0.263, Kurtosis: 0.806), product knowledge (Skewness: 0.008, Kurtosis: 0.254), elaboration of mental imagery (Skewness: 0.119, Kurtosis: 0.994), quality of mental imagery (Skewness: 0.255, Kurtosis: 1.023), and purchase intention (Skewness: 0.059, Kurtosis: 0.967). These values fell within the range of −2 to 2, which aligns with the criteria established by Hair et al. (2022) for a normal distribution.

Table 5
PROCESS Model analysis results.

(a) Analysis without covariates (Study 2a)

Mediator (M1): Elaboration of mental imagery	Coeff	SE	t	p	95% LLCI	95% ULCI
Constant	2.608	0.289	9.013	<0.001	2.039	3.178
Product presentation (X)	1.904	0.429	4.438	<0.001	1.059	2.748
Product knowledge (W)	0.518	0.076	6.811	<0.001	0.368	0.667
X × W	−0.373	0.119	−3.132	0.002	−0.607	−0.139
Shopping orientation (Z)	1.013	0.380	2.669	0.008	0.266	1.760
X × W × Z	0.426	0.158	2.698	0.007	0.115	0.736

Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Shopping Orientations (coded as: 0 = Task-focused, 1 = Experiential)

Product knowledge	Shopping orientation	**Effect**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
1.731 (M - 1SD)	Task-focused	1.258	0.251	5.022	<0.001	0.765	1.752
1.731 (M - 1SD)	Experiential	0.710	0.217	3.273	0.001	0.283	1.137
3.231 (M)	Task-focused	0.699	0.162	4.303	<0.001	0.379	1.019
3.231 (M)	Experiential	0.789	0.166	4.766	<0.001	0.463	1.115
4.731 (M + 1SD)	Task-focused	0.139	0.232	0.601	0.548	−0.317	0.596
4.731 (M + 1SD)	Experiential	0.868	0.237	3.670	<0.001	0.403	1.334

Mediator (M2): Quality of mental imagery	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	2.878	0.325	8.858	<0.001	2.239	3.518
Product presentation (X)	1.789	0.482	3.713	<0.001	0.840	2.737
Product knowledge (W)	0.488	0.085	5.719	<0.001	0.320	0.656
X × W	−0.286	0.134	−2.142	0.033	−0.549	−0.023
Shopping orientation (Z)	1.057	0.426	2.481	0.014	0.219	1.896
X × W × Z	0.232	0.177	1.309	0.192	−0.117	0.580

Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Shopping Orientations (0 = Task-focused, 1 = Experiential) are not applicable due to the insignificant three-way interaction.

Result: Purchase intention	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	1.318	0.299	4.406	<0.001	0.729	1.907
Product presentation (X)	0.148	0.139	1.060	0.290	−0.127	0.422
Elaboration of mental imagery (M1)	0.320	0.072	4.466	<0.001	0.179	0.462
Quality of mental imagery (M2)	0.280	0.066	4.244	<0.001	0.150	0.41

(b) Analysis with covariates (Study 2a)

Mediator (M1): Elaboration of mental imagery	Coeff	SE	t	p	95% LLCI	95% ULCI
Constant	3.327	0.498	6.685	<0.001	2.347	4.306
Product presentation (X)	1.864	0.429	4.341	<0.001	1.019	2.709
Product knowledge (W)	0.509	0.076	6.679	<0.001	0.359	0.659
X × W	−0.359	0.119	−3.009	0.003	−0.594	−0.124
Shopping orientation (Z)	0.961	0.381	2.525	0.012	0.212	1.711
X × W × Z	0.408	0.158	2.585	0.010	0.097	0.719
Age	0.002	0.059	0.035	0.972	−0.114	0.118
Gender	−0.206	0.116	−1.771	0.078	−0.434	0.023
Country	−.094	0.117	−0.804	0.422	−0.324	0.136
Education level	−0.077	0.085	−0.911	0.363	−0.244	0.090

Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Shopping Orientations (coded as: 0 = Task-focused, 1 = Experiential)

Product knowledge	Shopping orientation	**Effect**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
1.731 (M - 1SD)	Task-focused	1.243	0.251	4.955	<0.001	0.749	1.736
1.731 (M - 1SD)	Experiential	0.719	0.217	3.312	0.001	0.292	1.147
3.231 (M)	Task-focused	0.704	0.163	4.313	<0.001	0.383	1.025
3.231 (M)	Experiential	0.793	0.166	4.787	<0.001	0.467	1.120
4.731 (M + 1SD)	Task-focused	0.165	0.233	0.707	0.480	−0.294	0.624
4.731 (M + 1SD)	Experiential	0.867	0.237	3.654	<0.001	0.400	1.335

Mediator (M2): Quality of mental imagery	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	2.611	0.560	4.661	<0.001	1.508	3.713
Product presentation (X)	1.803	0.483	3.730	<0.001	0.852	2.754
Product knowledge (W)	0.495	0.086	5.766	<0.001	0.326	0.664
X × W	−0.289	0.134	−2.150	0.032	−0.553	−0.024
Shopping orientation (Z)	1.088	0.429	2.539	0.012	0.244	1.931
X × W × Z	0.240	0.178	1.351	0.178	−0.110	0.590
Age	0.056	0.066	0.847	0.398	−0.074	0.187
Gender	0.155	0.131	1.189	0.235	−0.102	0.413
Country	0.063	0.132	0.477	0.634	−0.196	0.322
Education level	−0.060	0.095	−0.633	0.528	−0.248	0.128

Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Shopping Orientations (0 = Task-focused, 1 = Experiential) are not applicable due to the insignificant three-way interaction.

Result: Purchase intention	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	1.088	0.547	1.990	0.047	0.012	2.164
Product presentation (X)	0.168	0.140	1.205	0.229	−0.107	0.443

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Table 5 (*continued*)

(b) Analysis with covariates (Study 2a)

Mediator (M1): Elaboration of mental imagery	Coeff	SE	t	p	95% LLCI	95% ULCI
Elaboration of mental imagery (M1)	0.303	0.073	4.169	<0.001	0.160	0.447
Quality of mental imagery (M2)	0.293	0.067	4.396	<0.001	0.162	0.425
Age	0.002	0.066	0.025	0.980	−0.129	0.132
Gender	−0.206	0.133	−1.546	0.123	−0.467	0.056
Country	0.047	0.132	0.356	0.722	−0.213	0.307
Education level	0.150	0.096	1.574	0.117	−0.038	0.338

(c) Analysis without covariates (Study 2b)

Mediator (M1): Elaboration of mental imagery	Coeff	SE	t	p	95% LLCI	95% ULCI
Constant	4.099	0.054	75.806	<0.001	3.993	4.206
Product presentation (X)	0.688	0.108	6.358	<0.001	0.475	0.900
Product knowledge (W)	0.284	0.042	6.747	<0.001	0.201	0.366
X × W	−0.278	0.084	−3.305	0.001	−0.443	−0.113
Shopping orientation (Z)	0.128	0.108	1.181	0.238	−0.085	0.340
X × W × Z	0.390	0.168	2.320	0.021	0.060	0.721

Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Shopping Orientations (coded as: 0 = Task-focused, 1 = Experiential)

Product knowledge	Shopping orientation	**Effect**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
3.119 (M - 1SD)	Task-focused	1.142	0.202	5.653	<0.001	0.745	1.539
3.119 (M - 1SD)	Experiential	0.951	0.229	4.150	<0.001	0.501	1.401
4.411 (M)	Task-focused	0.532	0.153	3.481	0.001	0.232	0.832
4.411 (M)	Experiential	0.845	0.153	5.514	<0.001	0.544	1.146
5.703 (M + 1SD)	Task-focused	−0.079	0.234	−0.336	0.737	−0.538	0.381
5.703 (M + 1SD)	Experiential	0.739	0.200	3.693	<0.001	0.346	1.132

Mediator (M2): Quality of mental imagery	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	4.677	0.058	80.366	<0.001	4.562	4.791
Product presentation (X)	0.937	0.116	8.047	<0.001	0.708	1.165
Product knowledge (W)	0.114	0.045	2.522	0.012	0.025	0.203
X × W	−0.181	0.091	−2.001	0.046	−0.359	−0.003
Shopping orientation (Z)	0.482	0.116	4.140	<0.001	0.253	0.710
X × W × Z	0.138	0.181	0.761	0.447	−0.218	0.493

Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Shopping Orientations (0 = Task-focused, 1 = Experiential) are not applicable due to the insignificant three-way interaction.

Result: Purchase intention	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	1.820	0.239	7.611	<0.001	1.351	2.290
Product presentation (X)	0.187	0.120	1.558	0.120	−0.049	0.424
Elaboration of mental imagery (M1)	0.437	0.044	9.946	<0.001	0.351	0.523
Quality of mental imagery (M2)	0.155	0.042	3.664	<0.001	0.072	0.238

(d) Analysis with covariates (Study 2b)

Mediator (M1): Elaboration of mental imagery	Coeff	SE	t	p	95% LLCI	95% ULCI
Constant	4.241	0.275	15.427	<0.001	3.701	4.781
Product presentation (X)	0.689	0.108	6.365	<0.001	0.477	0.902
Product knowledge (W)	0.281	0.042	6.671	<0.001	0.199	0.364
X × W	−0.284	0.084	−3.376	0.001	−0.450	−0.119
Shopping orientation (Z)	0.104	0.109	0.956	0.340	−0.110	0.318
X × W × Z	0.370	0.169	2.196	0.028	0.039	0.702
Age	0.062	0.053	1.168	0.243	−0.042	0.167
Gender	−0.014	0.108	−0.126	0.900	−0.226	0.198
Education level	−0.083	0.055	−1.516	0.130	−0.190	0.025

Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Shopping Orientations (coded as: 0 = Task-focused, 1 = Experiential)

Product knowledge	Shopping orientation	**Effect**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
3.119 (M - 1SD)	Task-focused	1.124	0.202	5.560	<0.001	0.727	1.521
3.119 (M - 1SD)	Experiential	0.989	0.230	4.298	<0.001	0.537	1.441
4.411 (M)	Task-focused	0.518	0.153	3.385	0.001	0.217	0.819
4.411 (M)	Experiential	0.862	0.154	5.598	<0.001	0.559	1.164
5.703 (M + 1SD)	Task-focused	−0.088	0.235	−0.373	0.709	−0.548	0.373
5.703 (M + 1SD)	Experiential	0.734	0.201	3.662	<0.001	0.340	1.128

Mediator (M2): Quality of mental imagery	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	4.450	0.296	15.048	<0.001	3.869	5.031
Product presentation (X)	0.931	0.116	7.988	<0.001	0.702	1.159
Product knowledge (W)	0.112	0.045	2.460	0.014	0.022	0.201
X × W	−0.192	0.091	−2.120	0.034	−0.370	−0.014
Shopping orientation (Z)	0.469	0.117	4.002	<0.001	0.239	0.700
X × W × Z	0.131	0.181	0.724	0.470	−0.225	0.488
Age	0.079	0.057	1.382	0.167	−0.033	0.192
Gender	0.125	0.116	1.074	0.283	−0.103	0.353

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Table 5 (*continued*)

(d) Analysis with covariates (Study 2b)						
Mediator (M1): Elaboration of mental imagery	Coeff	SE	t	p	95% LLCI	95% ULCI
Education level	−0.046	0.059	−0.780	0.436	−0.161	0.070
Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Shopping Orientations (0 = Task-focused, 1 = Experiential) are not applicable due to the insignificant three-way interaction.						
Result: Purchase intention	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	1.689	0.373	4.532	<0.001	0.957	2.422
Product presentation (X)	0.186	0.121	1.538	0.125	−0.051	0.423
Elaboration of mental imagery (M1)	0.439	0.044	9.953	<0.001	0.353	0.526
Quality of mental imagery (M2)	0.156	0.043	3.664	<0.001	0.072	0.239
Age	−0.037	0.056	−0.663	0.508	−0.147	0.073
Gender	0.095	0.113	0.843	0.400	−0.126	0.316
Education level	0.019	0.057	0.337	0.736	−0.093	0.131

The results of Levene's test for equality of error variances also indicated that assumption of homogeneity of variances was also met for elaboration of mental imagery ($p = 0.526$), quality of mental imagery ($p = 0.242$), and purchase intention ($p = 0.569$).

5.3.4. Common method variance

In a manner parallel to Study 2a, we assessed the potential presence of common method bias. The outcome of Harman's single-factor test revealed that the first factor accounted for 30.727% of the total variance, a percentage significantly below the 50% threshold commonly indicative of substantial common method bias. Moreover, we performed a comparison among three distinct models: the five-factor measurement model, the single-factor model, and the six-factor model introducing an unmeasured latent variable (ULMC). The fit indices of the five-factor model exhibited marked improvement when compared to the single-factor model, while the model incorporating an unmeasured latent variable yielded similar fit indices (refer to Appendix B (b)). Thus, common method bias was not a significant concern.

5.4. Results of study 2b

5.4.1. Manipulation check

We also conducted an assessment to verify the successful manipulation of shopping orientation within the online experimental setting. Similar to Study 2a, participants who had been assigned to the experiential condition reported a higher shopping orientation score than those who had been assigned to the task-focused condition ($M_{experiential} = 4.779$, $SD_{experiential} = 1.325$; $M_{Task\text{-}focused} = 4.030$, $SD_{Task\text{-}focused} = 1.330$; $p < 0.001$, Cohen's $d = 0.564$) and there was no significant difference in variances between two conditions ($p = 0.599$). Thus, shopping orientation was successfully manipulated and primed.

5.4.2. Moderating effects of shopping orientation

We ran a PROCESS model 11 with product presentation as the independent variable, elaboration (M1) and quality of mental imagery (M2) as mediators, product knowledge as the first moderator (W), shopping orientation as the second moderator (Z), and purchase intention as the dependent variable. As depicted in Table 5c, we identified a significant three-way interaction between product presentation, product knowledge, and shopping orientation ($b = 0.390$, $SE = 0.168$, $t = 2.320$, $p = 0.021$) with a significant main effect of product presentation ($b = 0.688$, $SE = 0.108$, $t = 6.358$, $p < 0.001$). Under the task-focused condition, the impact of product presentation on elaboration of mental imagery was insignificant when product knowledge was high ($b = -0.079$, $SE = 0.234$, $t = -0.336$, $p = 0.737$). Conversely, under the experiential condition, a significant relationship between product presentation and elaboration of mental imagery was observed ($b = 0.739$, $SE = 0.200$, $t = 3.693$, $p < 0.001$). Consistent with the findings in Study 2a, the result also showed that the interaction between product knowledge and shopping orientation significantly moderated the mediating effect of elaboration of mental imagery ($b = 0.171$, $SE = 0.080$, 95% CI: 0.017, 0.337) on the relationship between product presentation and purchase intention.

Regarding quality of mental imagery, similar to the findings in Study 2a, an insignificant three-way interaction involving product presentation, product knowledge, and shopping orientation was found ($b = 0.138$, $SE = 0.181$, $t = 0.761$, $p = 0.447$) with a significant main effect of product presentation ($b = 0.937$, $SE = 0.116$, $t = 8.047$, $p < 0.001$). The insignificant moderating effect of product knowledge × shopping orientation on the relationship between product presentation, quality of mental imagery, and purchase intention ($b = 0.021$, $SE = 0.032$, 95% CI: 0.042, 0.089) was also revealed. Elaboration ($b = 0.437$, $SE = 0.044$, $t = 9.946$, $p < 0.001$) and quality ($b = 0.155$, $SE = 0.042$, $t = 3.664$, $p < 0.001$) of mental imagery were significantly linked to purchase intention, while the direct effect of product presentation on purchase intention was insignificant ($b = 0.187$, $SE = 0.120$, $t = 1.558$, $p = 0.120$).

We also conducted an alternative PROCESS Model 11 analysis including demographic attributes as covariates. The results showed that, while there were slight variations in the specific numerical values for each indicator, the significance levels of all effects remained consistent with the model that did not incorporate covariates (refer to Table 5d). Furthermore, none of the demographic attributes were found to be significant covariates. The moderated-moderated mediating effects were also observed to be significant for elaboration ($b = 0.163$, $SE = 0.080$, 95% CI: 0.008, 0.325) but insignificant for quality ($b = 0.020$, $SE = 0.032$, 95% CI: 0.041, 0.090) of mental imagery. This confirms, as in Study 2a, that H_{2a} is supported whereas H_{2b} is not supported.

In summary, the results from Study 2b reinforce the conclusions drawn in Study 2a, underscoring that an experiential (vs. task-focused) shopping orientation significantly enhances the impact of VR (vs. static pictures) on the quantity (i.e. elaboration) of mental imagery of the presented product in knowledgeable consumers.

6. Study 3

Study 3 examines whether product involvement moderates the interaction effect of product presentation mediums × product knowledge on mental imagery and, subsequently, purchase intention (H_6). Participants were primed with one of the two product involvement (high versus low) and how such manipulation impacts the effect of product presentation on consumers with different product knowledge was explored.

6.1. Methods

6.1.1. Experimental design and participants

A 2 (product presentation: 0 = Static pictures, 1 = VR) × 2 (product involvement: 0 = Low, 1 = High) randomized between-subjects experimental design was conducted. 319 participants were recruited from Australia and China (see Table 2). 25 participants who reported VR

dizziness and 11 participants who quitted the survey halfway were excluded. Participants were randomly distributed to the four conditions: VR × Low involvement (n = 77), VR × High involvement (n = 79), Static pictures × Low involvement (n = 79), Static pictures × High involvement (n = 84).

6.1.2. Product involvement manipulation and procedures

Previous studies usually manipulated product involvement using different product categories (e.g., laptop and cup). However, different types of products could differ in attributes (e.g., functional versus experiential utility), leading to different importance at product involvement levels (Friedmann and Lowengart, 2019). Some previous studies used products within the same category to manipulate product involvement (e.g., Tassiello et al., 2021). Compared to low-involvement products, high-involvement products are more durable and expensive, thereby leading to a higher risk associated with the purchase (Eslami and Ghasemaghaei, 2018). Products with a higher value and misleading risk are regarded as high involvement, which encourages consumers' information seeking and highlights product description (Jia et al., 2021; Peng et al., 2019). Therefore, this study uses the same product (i.e. outdoor camping chair) and manipulates product involvement by offering different product descriptions and prices.

It is essential to note that distinguishing between high- and low-involvement products depends not only on their absolute monetary value but also on their monetary value relative to the product category. In other words, product involvement is connected to the price level of the product compared to the price level of the typical product within the same product category targeting the mass market. An illustrative example is provided by Tassiello et al. (2021), who classified different food and beverage products as either low (basic pizza, juice) or high involvement (gourmet pizza, birthday cake, champagne). Despite not having a high absolute monetary value, customers considered the latter products more involved due to their higher value relative to typical food and beverage goods like basic pizza and juice.

Moreover, we contend that differentiating between high- and low-involvement products is also dependent on the utilitarian (use) value of the product. Involvement arises when crucial values are engaged or brought to the forefront by a decision situation (Crosby and Taylor, 1983). Higher utilitarian value prompts consumers to generate a greater number of thoughts and engage in more elaborate processing based on the information gathered (Celsi and Olson, 1988; Ferreira and Coelho, 2015). Considering mobile phones as an example, customers are likely to exhibit higher involvement in evaluating a smartphone, even if it is relatively inexpensive (e.g., AUD$200), compared to a basic feature phone with a similar price but lacking "smart" functions (e.g., internet connection, multitasking, installation of third-party apps, etc.). This heightened involvement results from the former offering more functions and greater utilitarian value than the latter, making it more effective in capturing customers' involvement in the evaluation process.

Hence, product involvement was primed following the above discussion prior to the experiment. The majority of outdoor camping chairs in Australia typically range from $20 to AUD$60 (as indicated by Amazon au), while in China, the price varies from RMB¥50 to RMB¥200 (equivalent to AUD$10 to AUD$40, as indicated by Alibaba Taobao). Therefore, we consider the chair priced at AUD$10 (RMB¥50) to be a low-involvement product and the chair priced at AUD$100 (RMB¥500) to be a high-involvement product. Introducing a camping chair with a much higher price, such as AUD$500 or more, may raise participants' concerns regarding the authenticity and existence of the product, potentially leading to issues like unconvincing manipulation and participant scepticism. Additionally, an outdoor camping chair featuring premium and durable 600D Oxford cloth and ergonomic design signifies a higher utilitarian value compared to a typical chair with regular Oxford cloth and a common aluminium alloy frame. Thus, in the low involvement condition, participants were told that the chair that was going to present was made of ordinary oxford cloth (a typical fabric) with an ordinary aluminium alloy bracket at a price of AUD$10 (RMB ¥50). In the high involvement condition, participants were told that the chair was made of prestige and durable 600D oxford cloth with an ergonomic design, equipped with a high-strength carbon fibre bracket with a price of AUD$100 (RMB¥500) (See Appendix B). Afterwards, they were asked to indicate their agreement on the ten-item product involvement scale adapted from Zaichkowsky (1994). They were then assigned to one of the two product presentation conditions with their primed product involvement. The experiment process was identical to Study 1 and 2. A post-experiment questionnaire was then provided and completed.

6.1.3. Measure validation and tests of normality and equal variances

As shown in Appendix A, the Cronbach's alpha of product involvement (α = 0.918), product knowledge (α = 0.891), elaboration of mental imagery (α = 0.913), quality of mental imagery (α = 0.852), and purchase intention (α = 0.864) were higher than the critical value of 0.70, so were all the factor loadings. The values of CR and AVE were also greater than the cut-off of 0.7 and 0.5 respectively, indicating a good convergent validity. Moreover, the square root values of AVE (on the diagonals) were greater than the inter-construct correlational values (on the left of the diagonals), thus indicating that discriminant validity was verified (see Appendix C (c)).

We also tested potential violations of the normality and equal variances assumptions. The skewness and kurtosis values of product involvement (Skewness: 0.323, Kurtosis: 0.232), product knowledge (Skewness: 0.197, Kurtosis: 0.846), elaboration of mental imagery (Skewness: 0.204, Kurtosis: 0.460), quality of mental imagery (Skewness: 0.380, Kurtosis: 0.423), and purchase intention (Skewness: 0.152, Kurtosis: 0.751) fell within the range of −2 to 2, as suggested by Hair et al. (2022), indicating that they should be considered normally distributed. The variances of dependent variables across two conditions (i.e. VR and static pictures) were tested using the Levene's test for equality of error variances. The results also showed that the homogeneity of variances for elaboration of mental imagery (p = 0.183), quality of mental imagery (p = 0.418), and purchase intention (p = 0.430) were not violated.

6.1.4. Common method variance

Similar to Study 1 and Study 2, we conducted an assessment of common method bias. The results of Harman's single-factor test applied to all measured variables (i.e. product involvement, product knowledge, elaboration and quality of mental imagery, purchase intention) indicated that the first factor accounted for the largest variance at 37.473%, which fell below the 50% threshold. Additionally, we compared the fit indices of three models: the five-factor measurement model, the single-factor model, and the six-factor model with an additional unmeasured latent variable (ULMC). The fit indices of the five-factor model were significantly superior to those of the single-factor model, and they were not significantly different from the model incorporating the unmeasured latent variable (see Appendix B (c)). Thus, common method bias was not an issue in Study 2, allowing for the subsequent execution of hypothesis testing.

6.2. Results of study 3

6.2.1. Manipulation check

The results suggested that participants in the high product involvement condition reported a higher product involvement score than those who had been assigned to the low product involvement condition ($M_{high\ involvement} = 4.831$, $SD_{high\ involvement} = 0.977$; $M_{low\ involvement} = 4.246$, $SD_{low\ involvement} = 1.097$; $p < 0.001$, Cohen's $d = 0.563$) and there was no significant difference in variances across two conditions (p = 0.107). Therefore, product involvement was successfully manipulated and primed by product descriptions and prices, as suggested by previous studies (Eslami and Ghasemaghaei, 2018; Jia et al., 2021; Peng et al.,

2019).

6.2.2. Moderating effects of product involvement

A PROCESS model 11 was conducted with product presentation as the independent variable, elaboration (M1) and quality of mental imagery (M2) as mediators, product knowledge (M = 3.570, SD = 1.474) as the first moderator (W), product involvement as the second moderator (Z), and purchase intention as the dependent variable. As illustrated in Table 6a, A significant three-way interaction between product presentation, product knowledge, and product involvement was revealed (b = 0.376, SE = 0.136, t = 2.758, p = 0.006) with a significant main effect of product presentation (b = 1.370, SE = 0.361, t = 3.792, p < 0.001) and product knowledge (b = 0.488, SE = 0.063, t = 7.703, p < 0.001) and an insignificant effect of product involvement (b = 0.304, SE = 0.354, t = 0.858, p = 0.391). In line with H_{6a}, the conditional effects suggested that when product knowledge was high, product presentation had an insignificant effect on elaboration of mental imagery for participants in the low product involvement condition (b = 0.207, SE = 0.209, t = 0.990, p = 0.323). However, a positive and significant relationship between product presentation and elaboration of mental imagery was found for participants who were in the high product involvement condition (b = 1.230, SE = 0.191, t = 6.434, p < 0.001). The interaction of product knowledge × product involvement was also found significantly moderated the relationship between product presentation, elaboration of mental imagery, and purchase intention (b = 0.196, SE = 0.081, 95% CI: 0.038, 0.357).

Additionally, a significant three-way interaction of product presentation × product knowledge × product involvement was also found (b = 0.405, SE = 0.170, t = 2.384, p = 0.018) in the same model with a significant main effect of product presentation (b = 1.420, SE = 0.450, t = 3.155, p = 0.002) and product knowledge (b = 0.483, SE = 0.079, t = 6.125, p < 0.001) and an insignificant effect of product involvement (b = 0.511, SE = 0.441, t = 1.158, p = 0.248) on quality of mental imagery. In line with H_{6b}, the conditional effects confirmed that when product knowledge was high, product presentation had an insignificant effect on quality of mental imagery for participants in the low product involvement condition (b = 0.199, SE = 0.260, t = 0.763, p = 0.446). However, a positive and significant relationship between product presentation and elaboration of mental imagery was found for participants who were in the high product involvement condition (b = 1.295, SE = 0.238, t = 5.435, p < 0.001) (see Table 6a). A significant moderating effect of product knowledge × product involvement on the relationship between product presentation, quality of mental imagery, and purchase intention (b = 0.109, SE = 0.053, 95% CI: 0.019, 0.224) was also discovered. Moreover, elaboration (b = 0.521, SE = 0.069, t = 7.546, p < 0.001) and quality (b = 0.269, SE = 0.059, t = 4.544, p < 0.001) of mental imagery were found significantly associated with purchase intention, while the direct effect of product presentation on purchase intention was insignificant (b = 0.178, SE = 0.123, t = 1.446, p = 0.149), thereby echoing the findings in Study 1 and Study 2.

In a parallel manner to Study 1 and 2, we performed an alternative analysis using PROCESS Model 11 by excluding demographic attributes as covariates. The outcomes, as presented in Table 6b, also showed that the significance levels of all effects remained consistent with the model that includes covariates, with some slight variations in the specific numerical values of each indicator. Demographic attributes were not significant covariates either. The moderated-moderated mediating effects were also significant for elaboration (b = 0.198, SE = 0.078, 95% CI: 0.045, 0.354) and quality (b = 0.110, SE = 0.052, 95% CI: 0.024, 0.227) of mental imagery. Hence, H_{3a} and H_{3b} are supported.

7. General discussion

Our research provides valuable insights from three studies, highlighting the significance of VR in the retail landscape. In the first study, we found that VR has a stronger impact on evoking mental imagery and purchase intention compared to static images, especially for consumers with limited product knowledge. This result aligns with previous research that suggests knowledgeable consumers tend to rely on VR for enhanced mental imagery (Cowan et al., 2021; Elder and Krishna, 2021). Building on the findings of the first study, the second study delved into the role of shopping orientation. Interestingly, experiential consumers, regardless of their product knowledge, leaned on VR to create mental imagery, leading to an increase in purchase intentions. In contrast, task-focused consumers exhibited this behaviour only when they had limited product knowledge. This observation may be seen as a reflection of different consumer mindsets (i.e., deliberative and implemental mindsets) suggested by previous studies (Büttner et al., 2013; Mimoun et al., 2022). However, it is important to note that this distinction only applied to the elaboration of mental imagery, not its quality. In our third study, we found that product involvement also played a similar role. Consumers exposed to high-involvement products showed a strong preference for VR, regardless of their product knowledge. This preference may be rooted in differing information processing patterns influenced by product involvement, which is in line with the Elaboration Likelihood Model (Chang et al., 2020; Rokonuzzaman et al., 2020). As the retail landscape continues to evolve, understanding these nuances is crucial for marketers seeking to harness the potential of VR.

8. Implications

8.1. Theoretical implications

Our research provides multiple theoretical implications. It augments the existing understanding of the impact of VR-based product presentation by revealing its diminished effectiveness when moderated by consumer product knowledge. Beyond this discovery, a notable achievement lies in investigating conditions that could mitigate the negative impact of consumers' product knowledge, thereby advancing research on the applicability of VR in retail environments. In this regard, our research makes a substantial contribution to identifying the role of shopping orientation as a consumer-related motivational factor in enhancing the effectiveness of VR for knowledgeable consumers. This underscores the potential of VR as a powerful channel not only for uninformed customers but also for those well-versed in product knowledge. While a great number of current studies have acknowledged VR's superiority over traditional mediums in engaging consumers (e.g., Alzayat and Lee, 2021; Kim et al., 2022; Meißner et al., 2020; Pizzi et al., 2019), our research, spanning three sub-studies, indicates that VR does not necessarily outperform traditional 2D presentations (e.g., pictures) when consumers possess extensive knowledge about the presented product and, more importantly, illustrates that even well-informed consumers can elicit heightened VR-induced mental imagery when their shopping orientation leans toward experiential rather than task-oriented. This insight complements prior explorations of VR retailing and shopping orientation. Despite the pronounced role of shopping orientation as a fundamental and inherent shopping driver that shapes consumers' engagement with marketing stimuli (Büttner et al., 2013), its impact on the effectiveness of VR retailing remains underexplored. This study fills this void, unravelling the mechanics behind elevating the reliance of knowledgeable consumers on VR for enriched mental imagery and consequent purchase intention. By demonstrating that the deliberative mindset of experiential-oriented consumers bolsters their preference for direct product VR experiences over relying solely on product knowledge, this research also contributes to the facilitation of a greater overall understanding of VR retailing and consumer behavioural intention.

In a similar vein, this study also underscores how high-involvement products, acting as a product-related motivational factor, induce consumers to actively immerse themselves in product evaluation through the central route. This, in turn, amplifies the effectiveness of VR and diminishes the reliance of informed consumers on their existing product

Table 6
PROCESS Model analysis results (Study 3).

(a) Analysis without covariates

Mediator (M1): Elaboration of mental imagery	Coeff	SE	t	p	95% LLCI	95% ULCI
Constant	2.465	0.235	10.491	<0.001	2.002	2.927
Product presentation (X)	1.370	0.361	3.792	<0.001	0.659	2.080
Product knowledge (W)	0.488	0.063	7.703	<0.001	0.363	0.612
X × W	−0.231	0.096	−2.402	0.017	−0.420	−0.042
Product involvement (Z)	0.304	0.354	0.858	0.391	−0.393	1.001
X × W × Z	0.376	0.136	2.758	0.006	0.108	0.645

Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Product Involvements (coded as: 0 = Low, 1 = High)

Product knowledge	Product involvement	**Effect**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
2.096 (M - 1SD)	Low	0.887	0.193	4.586	<0.001	0.506	1.267
2.096 (M - 1SD)	High	0.801	0.208	3.843	<0.001	0.391	1.210
3.570 (M)	Low	0.547	0.143	3.825	<0.001	0.265	0.828
3.570 (M)	High	1.015	0.140	7.258	<0.001	0.740	1.291
5.044 (M + 1SD)	Low	0.207	0.209	0.990	0.323	−0.204	0.617
5.044 (M + 1SD)	High	1.230	0.191	6.434	<0.001	0.854	1.606

Mediator (M2): Quality of mental imagery	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	2.741	0.293	9.361	<0.001	2.165	3.317
Product presentation (X)	1.420	0.450	3.155	0.002	0.534	2.306
Product knowledge (W)	0.483	0.079	6.125	<0.001	0.328	0.639
X × W	−0.242	0.120	−2.024	0.044	−0.478	−0.007
Product involvement (Z)	0.511	0.441	1.158	0.248	−0.357	1.380
X × W × Z	0.405	0.170	2.384	0.018	0.071	0.740

Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Product Involvements (coded as: 0 = Low, 1 = High)

Product knowledge	Product involvement	**Effect**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
2.096 (M - 1SD)	Low	0.912	0.241	3.787	<0.001	0.438	1.387
2.096 (M - 1SD)	High	0.814	0.260	3.136	0.002	0.303	1.325
3.570 (M)	Low	0.555	0.178	3.119	0.002	0.205	0.906
3.570 (M)	High	1.055	0.174	6.049	<0.001	0.712	1.398
5.044 (M + 1SD)	Low	0.199	0.260	0.763	0.446	−0.313	0.710
5.044 (M + 1SD)	High	1.295	0.238	5.435	<0.001	0.826	1.764

Result: Purchase intention	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	0.482	0.240	2.007	0.046	0.009	0.955
Product presentation (X)	0.178	0.123	1.446	0.149	−0.064	0.420
Elaboration of mental imagery (M1)	0.521	0.069	7.546	<0.001	0.385	0.657
Quality of mental imagery (M2)	0.269	0.059	4.544	<0.001	0.153	0.386

(b) Analysis with covariates

Mediator (M1): Elaboration of mental imagery	Coeff	SE	t	p	95% LLCI	95% ULCI
Constant	2.908	0.396	7.342	<0.001	2.128	3.687
Product presentation (X)	1.340	0.363	3.688	<0.001	0.625	2.054
Product knowledge (W)	0.487	0.064	7.642	<0.001	0.362	0.612
X × W	−0.222	0.097	−2.302	0.022	−0.412	−0.032
Product involvement (Z)	0.282	0.357	0.791	0.430	−0.420	0.985
X × W × Z	0.375	0.137	2.734	0.007	0.105	0.645
Age	−0.044	0.048	−0.904	0.367	−0.139	0.051
Gender	−0.084	0.100	−0.837	0.403	−0.280	0.113
Country	−0.094	0.101	−0.935	0.350	−0.293	0.104
Education level	−0.029	0.077	−0.378	0.706	−0.180	0.122

Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Product Involvements (coded as: 0 = Low, 1 = High)

Product knowledge	Product involvement	**Effect**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
2.096 (M - 1SD)	Low	0.874	0.194	4.498	<0.001	0.491	1.256
2.096 (M - 1SD)	High	0.796	0.210	3.797	<0.001	0.384	1.209
3.570 (M)	Low	0.546	0.143	3.808	<0.001	0.264	0.828
3.570 (M)	High	1.021	0.140	7.267	<0.001	0.745	1.298
5.044 (M + 1SD)	Low	0.218	0.210	1.041	0.299	−0.194	0.630
5.044 (M + 1SD)	High	1.246	.192	6.493	<0.001	0.868	1.623

Mediator (M2): Quality of mental imagery	**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant	2.901	0.493	5.879	<0.001	1.930	3.872
Product presentation (X)	1.466	.453	3.240	0.001	0.576	2.357
Product knowledge (W)	0.495	0.079	6.234	<0.001	0.339	0.651
X × W	−0.253	0.120	−2.105	0.036	−0.490	−0.017
Product involvement (Z)	0.577	0.445	1.297	0.196	−0.299	1.453
X × W × Z	0.418	0.171	2.447	0.015	0.082	0.754
Age	0.004	0.060	0.068	0.946	−0.114	0.122
Gender	−0.132	0.124	−1.062	0.289	−0.377	0.113

(*continued on next page*)

Table 6 (*continued*)

(b) Analysis with covariates

Mediator (M1): Elaboration of mental imagery		Coeff	SE	t	p	95% LLCI	95% ULCI
Country		0.145	0.126	1.157	0.248	−0.102	0.392
Education level		−0.071	0.096	−0.744	0.457	−0.260	0.117
Conditional Effects of Product Presentation at Low (M - 1SD), Medium (M), and High (M + 1SD) Levels of Product Knowledge and Different Product Involvements (coded as: 0 = Low, 1 = High)							
Product knowledge	Product involvement	Effect	SE	t	p	95% LLCI	95% ULCI
2.096 (M - 1SD)	Low	0.935	0.242	3.865	<0.001	0.459	1.411
2.096 (M - 1SD)	High	0.812	0.261	3.110	0.002	0.298	1.326
3.570 (M)	Low	0.562	0.179	3.146	0.002	0.210	0.913
3.570 (M)	High	1.055	0.175	6.028	<0.001	0.711	1.400
5.044 (M + 1SD)	Low	0.188	0.261	0.722	0.471	−0.325	0.702
5.044 (M + 1SD)	High	1.298	0.239	5.429	<0.001	0.828	1.768
Result: Purchase intention		**Coeff**	**SE**	**t**	**p**	**95% LLCI**	**95% ULCI**
Constant		0.076	0.438	0.174	0.862	−0.786	0.938
Product presentation (X)		0.183	0.124	1.479	0.140	−0.060	0.426
Elaboration of mental imagery (M1)		0.528	0.070	7.593	<0.001	0.391	0.665
Quality of mental imagery (M2)		0.262	0.060	4.384	<0.001	0.145	0.380
Age		−0.024	0.055	−0.435	0.664	−0.131	0.084
Gender		0.044	0.113	0.385	0.701	−0.180	0.267
Country		0.155	0.114	1.361	0.175	−0.069	0.380
Education level		0.048	0.086	0.552	0.581	−0.122	0.218

knowledge. While prior research has acknowledged the impact of product involvement on product evaluation within the realms of online websites and augmented reality (AR) retailing (e.g., Park and Yoo, 2020; Sun et al., 2022), the extent of its contribution to enhancing the effectiveness of VR-based product presentation, particularly for consumers inclined to lean on their pre-acquired product knowledge, has remained unexplored. Thus, this finding complements our understanding in this domain, unveiling the alignment between consumers' inclination to process products via the central route and the empowerment facilitated by VR-based product presentation (Jung et al., 2021; Kim et al., 2021).

Overall, we build on previous research by examining concepts that have not been investigated together before by identifying the negative interactions between product presentation and product knowledge in the context of VR retailing and, more importantly, exploring how to mitigate it from the perspective of consumer- (i.e. shopping orientation) and product- (i.e. product involvement) related consumer shopping motivations, thereby complementing extant literature and providing a more comprehensive understanding of the underlying psychological processes of VR shopping consumers.

8.2. Practical implications

This study also offers significant practical implications. While the adoption of VR technology in the retail sector has been emphasized by previous studies (Hollebeek et al., 2020; Kim and Choo, 2023; Xi and Hamari, 2021), it is crucial to recognize that such a strategy can entail substantial costs. These expenses, including the procurement of VR equipment, the development of virtual environments, and the data conversion from conventional computer-aided design (CAD) to VR, pose a significant adoption barrier for businesses, especially small and medium-sized enterprises (SMEs) (Brettschuh et al., 2022). With over 75% of companies on Forbes' World's Most Valuable Brands list having developed some forms of the reality-virtuality technology (e.g., VR, AR) to deliver an immersive and interactive experience to customers, it is important to note that their adoption may not be feasible for SMEs due to factors like limited programming skills, resource constraints, and heightened competition from large companies heavily investing in this technology (Blagojević, 2023; Brettschuh et al., 2022; Kim et al., 2022). Therefore, rather than advocating for the widespread adoption and implementation of VR technology across the retail industry, this research suggests that VR is particularly effective for consumers with a low level of product knowledge. Thus, individuals who are less familiar with products and have limited experience may find VR a compelling tool for forming their initial impressions and gaining a better understanding of the products presented. Retail practitioners can leverage this finding in several ways. Firstly, considering that VR does not offer a significant advantage over traditional picture-based product presentations for knowledgeable consumers, retailers, particularly those dealing in common goods with constrained financial resources (e.g., SMEs), may not experience substantial benefits from adopting VR. Thus, it is advisable for them to continue using traditional product pictures for presenting their products. Secondly, for retailers aiming to use VR as a means to gain a competitive edge, it is recommended to integrate VR environments into their platforms or channels to showcase niche and specialty products that are relatively unfamiliar to consumers. This recommendation extends to the introduction and presentation of new products, as consumers are more likely to rely on vivid visual representation to obtain an initial product impression (King et al., 2019). With the assistance of big data and AI-based customer profiling, retailers could also identify or predict consumers' product knowledge based on their online behavioural metrics (e.g., browsing and purchase history), thereby indicating a chance to provide personalized and accurate VR services.

Based on the finding that knowledgeable customers with an experiential shopping orientation gain greater advantages from the VR retail environment compared to those with a task-focused approach, retailers preferring to incorporate VR into their channels and aiming to cater to knowledgeable consumers, especially those dealing in common goods, are advised to focus on attracting experiential shoppers or enhancing the shopping experience to be engaging and stimulating. This could involve making the act of shopping enjoyable and captivating for this particular consumer group. To engage knowledgeable consumers who have specific shopping goals (e.g., consumers conducting routine shopping), retailers are suggested to offer more streamlined and efficient methods (e.g., presenting their products in the form of pictures) to cater to consumers' implemental shopping mindset. Given that experiential consumers, irrespective of their product knowledge, are inclined to utilize VR, retailers specializing in providing experiential retail environments, like brand experience stores, should consider integrating VR technologies to captivate consumers seeking a delightful shopping encounter. For instance, IKEA launched its VR application "IKEA Virtual Interior Designer" to offer consumers an experiential home design experience, fostering their creativity and imagination. Even traditional stores aiming to assist consumers in their shopping goals and simplify the purchase

process could also leverage VR to enhance consumers' decision-making for products they may not be familiar with, such as new products or existing products featuring new attributes.

Moreover, recognizing that high product involvement could reduce or even offset the negative effect of product knowledge, it is also advisable to integrate VR technology into online retail platforms for engaging consumers interested in high-involvement products (e.g., jewellery, computers, home entertainment systems). This strategy applies universally, irrespective of consumers' level of product knowledge, as high-involvement products typically lead individuals to engage in a central route evaluation process. The expectation is that VR-based product presentation, offering clear and comprehensive details along with interactive features, will facilitate consumers' mental imagery and enhance their purchase intention for high-involvement products. For example, the automobile manufacturer Volvo introduced a VR application called "Volvo Reality" to showcase the design and capabilities of their vehicles. For retailers dealing with low-involvement products (e.g., cleaning supplies, daily foods and necessities), it's crucial to factor in consumers' familiarity with the showcased items. In cases where knowledgeable consumers are targeted, employing images could effectively stimulate engagement and align with their cognitive processing through the peripheral route. By analysing relevant behavioural indices (e.g., time spent browsing a particular product), consumers' involvement in a specific product could also be identified, thereby presenting opportunities to communicate with consumers with personalized digital shopping experiences.

9. Limitations and future research

This research has some limitations. First, this study was performed in a controlled experimental setting and the product presented in VR and pictures was artificial rather than realistic. Although such settings would increase internal controls across our studies, this may not fully represent real-life retail scenarios. Field experiments are therefore appealed to be considered by future research to enhance the external validity of this study. Second, we focused solely on one specific type of product (i.e. outdoor furniture) in our study. This limited scope may raise concerns about the generalizability of our findings to other product categories. Examining outdoor furniture as well as other types of products could enhance the reliability and validity of this research. Third, participants of this study were recruited from two countries. Although no significant result was revealed in terms of the country differences, such an approach could raise concerns about internal validity. Future studies are recommended to enhance internal validity by recruiting participants from a single country. Similarly, although we engaged and recruited participants of different ages, participants in our study were mostly young consumers. More heterogeneity in the sample is therefore suggested for future research.

Additionally, this study did not examine the relationship between the two dimensions of mental imagery, which presents an avenue for future research. Although this research ruled out the possibility that VR-facilitated mental imagery and purchase intention are influenced by participants' demographic attributes including age, gender, country, and education level, future studies are also encouraged to rule out the potential impacts of other individual characteristics such as VR novelty and prior VR experience, online retailing familiarity, and consumer preferences. Moreover, this study investigated shopping orientation and product involvement through a manipulation method. Future studies could research them from an inherent perspective, that is, how consumers' inherent orientation and involvement influence their imagination as well as other cognitive, emotional, and behavioural responses to the VR retail environment. Further exploration is warranted into the role of shopping orientation in VR retailing and its influence on consumers' novel VR experiences, encompassing aspects like magical thinking, primed identities, fixed or growth mindsets, among others. Additionally, investigating the reciprocal relationship, such as the impacts of different VR settings (e.g., environmental design, multisensory input) on shopping orientation, could substantially enhance our understanding of the dynamics in VR retailing. Since consumers often rely on emerging technologies to elevate both the functional and experiential dimensions of their shopping experiences, future research is also recommended to further explore the mechanism of shopping orientation in VR retailing (e.g., how VR may contribute to different outcomes for shoppers with different shopping orientations and goals). What different types of mental imagery might be evoked under different situations could also be an interesting direction to explore. Finally, the findings of this study build upon the comparison between VR and static pictures, which are two distinct product presentation formats that significantly differ in terms of vividness and immersivity. More online retail formats (e.g., product videos) need to be investigated and how they collaborate and compete with VR-based retail environments is of significance to investigate.

CRediT authorship contribution statement

Yunen Zhang: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Wei Shao:** Supervision. **Sara Quach:** Supervision. **Park Thaichon:** Supervision. **Qianmin Li:** Software, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jretconser.2024.103713.

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