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Furnishing your home? The impact of voice assistant avatars in virtual reality shopping: A neurophysiological study

Enrique Bigne *, Carla Ruiz, Rafael Curras-Perez

Department of Marketing and Market Research, University of Valencia, Valencia, Spain

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ABSTRACT

This study provides insights into the informational cues consumers use in virtual reality (VR)-based retail shopping experiences. The aim of the study is to identify the number and type (extrinsic versus intrinsic) of informational cues that most attract consumers' visual attention, and that are most important in their purchase decision-making in a VR store, with special emphasis on the role of voice assistant (VA) avatars. A sample of 152 Spanish consumers participated in a laboratory-based 2 × 2 between-subjects experiment. The study's main stimulus was a recreation, in both 2D and VR, of a living room in a home. The participants were asked to view the recreation using either a computer screen (2D) or a head-mounted display (HMD). Clickstream data, neurophysiological measures (eye-tracking and GSR) and self-reported measures were used to test the hypotheses. We found that consumers used more informational cues in the product choice process in the 2D online store than in the VR store, but that the VR store generated higher flow state; that the type of cue used depended on the type of platform and that the presence of VA avatars did not influence the number of informational cues consumers used but made them pay more visual attention to the products, and evoked higher arousal.

1. Introduction

Virtual reality (VR), a multi-sensory immersive and interactive experience, is acknowledged as being helpful to retailers in promoting products and services (Farah, Ramadan, & Harb, 2019; Flavián, Ibáñez-Sánchez, & Orús, 2019; Hilken et al., 2022; Wedel, Bigné, & Zhang, 2020). Immersive technologies, such as VR, are expected to change the way consumers seek information; companies are investing in easy-to-wear VR devices, and the market is growing (De Amorin et al., 2022). Retailers have improved the customer experience by gradually adopting VR, which enables shoppers to interact with products in innovative ways. For instance, Ikea (https://www.youtube.com/watch?v=Zd7ZWgVqslo) and Swarovski (https://www.youtube.com/watch?v=ntYlLGTLrDE) provide immersive settings that allow customers to interact with objects. Immersive VR makes consumers feel physically present in mediated environments (Martínez-Navarro, Bigné, Guixeres, Alcañiz, & Torrecilla, 2019). The level of immersion ranges from fully immersive, with 3D images (e.g., head-mounted-displays, HMDs), computer automatic virtual environments (CAVE), semi-immersive (e.g., video wall system) and 2D images in low-immersive (desktop PC) systems (Martínez-Navarro et al., 2019; Xu, Siegrist, & Hartmann, 2021).

According to cue utilization theory (Olson & Jacoby, 1972), in their shopping journeys, consumers use informational cues to form perceptions of products that ultimately lead to product and brand choices. Companies and researchers are working to understand how the content included in VR settings influences consumers' shopping behaviours, given that research on how consumers choose products using multiple informational cues in immersive shopping environments is limited. Although many e-commerce studies have investigated the effects of intrinsic and extrinsic quality cues on consumers' purchasing decisions based on signaling theory (for a review, see Choi 2018), research gaps remain, which opens avenues for further investigation in the domain. First, most of the extant literature has focused heavily on extrinsic cues, especially on eWOM; few have focused on both extrinsic and intrinsic cues, although consumers use both to assess product quality (Choi, Ko, Medlin, & Chen, 2018; Kakaria, Simonetti, & Bigne, 2023). Second, dependent measures of the informational cues in these studies are limited to factors that measure purchase intentions, rather than actual purchases. Therefore, research is needed to identify the number and types of informational cues consumers use in their decision-making in immersive retail settings. This study compares, using clickstream data,

* Corresponding author.
E-mail addresses: enrique.bigne@uv.es (E. Bigne), carla.ruiz@uv.es (C. Ruiz), rafael.curras-perez@uv.es (R. Curras-Perez).

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consumer product choices made based on informational cues displayed in an VR store and choices made in a website, where both environments had the same layout.

The advent of voice assistant (VA) avatars is a strong reason to conduct research into the customer's experience in both VR stores and websites. VA avatars are a type of voice-enabled artificial intelligence (AI). The number of VAs in use is expected to triple by the end of 2023, reaching around eight billion units. Regarding the level of use across functions, 82% of regular VA users employ them to obtain information (e.g., news, weather, recipes, advice), 67% for playing music/streaming videos, 36% for accessing customer services and 35% for buying products (e.g., groceries, home care, clothes) (Capgemini, 2018). The present study proposes that VAs will enjoy high future growth and highlights their potential for establishing strong consumer-company relationships (Hernandez-Ortega & Ferreira, 2021). When users concentrate strongly on their voice interactions with their VAs their experience becomes satisfying, and product information becomes more accessible and diagnostic (Poushneh, 2021). However, a research gap exists as to whether consumers' interactions with VA assistants alter the number and types of informational cues they seek out before making a purchase decision.

Part of the growing interest in avatars has focused on emotions (Etienne, Leclercq, Remacle, Dessart, & Schyns, 2023; Gall, Roth, Stauffert, Zarges, & Latoschik, 2021; Radiah, Roth, Alt, & Abdelrahman, 2023; Vanderburg, Welch, Beard, Gilbert, & Loveland, 2023). Recent VR-based research has looked at how different approaches to avatar embodiments influence emotions (Gall et al., 2021), the effects of avatars on psychological distress (Vanderburg, Welch, Beard, Gilbert, & Loveland, 2023), how users perceive the levels of emotional valence and arousal of avatars (Etienne et al., 2023) and how the avatar's appearance affects user emotions (Radiah et al., 2023). While how the avatar's appearance affects users' emotions in VR is understood, no comprehensive investigation has been undertaken into how avatars elicit the consumer's arousal during the purchase decision-making process in shopping environments with different degrees of immersion (VR stores versus online stores). As avatars affect sense of presence it is expected that VAs will have differential effects on emotions in shopping environments with different degree of immersion. We address this research gap by exploring, using neurophysiological measures, how the presence or absence of avatars affect the arousal experienced by consumers in a VR store.

During the shopping and decision-making process, consumers visually pinpoint, and cognitively process, relevant visual cues; the most pertinent are used to make purchase decisions (Huddleston, Coveyou, & Behe, 2023; Olson & Jacoby, 1972). Clear connections have been noted between the visual attention consumers pay and their search and purchase behaviours (Orquin & Wedel, 2020). Neurophysiological tools, such as eye-tracking (ET), have been shown to measure visual attention accurately (Orquin & Wedel, 2020). The present study aims to analyse which informational cues attract greater visual attention on VR-based shopping platforms, with a particular focus on the role of VA avatars.

The specific goals of this research are: (i) to analyse the number and types of cues consumers use in their decision-making in VR stores and 2D online stores; (ii) to analyse the influence of VA avatars on the number of cues consumers use in their flow state and product choice in VR stores and online stores; (iii) to identify which types of informational cues attract greater visual attention in VR-based retail settings; (iv) to analyse the influence of the use of VA avatars on the visual attention paid to product informational cues in VR-based retail settings; (v) to analyse the influence of VA avatars on the arousal of consumers in VR-based retail settings.

To fulfil these goals, this study combines survey, neuropsychological and behavioural data. While neurophysiological data capture unconscious responses, behavioural data provide accurate information on actual decision-making, including purchases (Bucklin et al., 2002).

2. Literature review

This study seeks to gain specific knowledge about consumers' decision-making in VR environments. Drawing on cue utilization theory, media richness theory (Daft & Lengel, 1986) and the accessibility-diagnosticity theoretical framework (Feldman & Lynch, 1988), we examine the individual and interaction effects of intrinsic and extrinsic information cues on consumers' purchase behaviour for two distinct product categories, search and experience. Media richness theory has been used to explain the higher informative value of immersive content. VR delivers a direct, rich sensory experience that is more useful for consumer decision-making than the experience provided by websites. VAs enrich the customer's experience in VR stores and 2D stores. The accessibility-diagnosticity theoretical framework (Feldman & Lynch, 1988) has been shown to be useful in analysing the types and number of informational cues that an individual needs to evaluate a product and make a judgement about whether or not to make a purchase.

2.1. Purchase decision-making and clickstream data

Clickstream data provides researchers with a record of a website visitor's journey on the site; this data can be used to predict purchases (Guo & Sismeiro, 2020). One theme apparent in clickstream-focused literature is the simultaneous examination of clicks and sales conversions in a two-stage model. In their seminal work, Montgomery, Li, Srinivasan, and Liechty (2004) modelled online browsing in book retailer websites. They found that, after six viewings, future purchases can be predicted with greater than 40% accuracy, which compares favourably with the 7% accuracy achieved without click history information. Moe (2006) used clickstream data from a nutritional product retailer to develop an empirical two-stage model where consumers used different decision rules to decide on which products to view and which products to purchase. Decision rules include consumers' consideration of products' attributes and brands. Choudhary et al. (2017) explored the link between the size of the consumer's consideration set and his/her purchase set. Gao, Currim, and Dewan (2022) demonstrated that consumer clickstream data from a hotel search engine identified two hidden information processing stages: first, the consumer eliminates options, then (s)he chooses. Kukar-Kinney, Scheinbaum, Orimoloye, Carlson, and He (2022) investigated online consumer behaviour using clickstream data, with a focus on shopping cart abandonment. These authors found that viewing a large number of product reviews increased cart abandonment, while browsing product pages decreased cart abandonment. However, clickstream data has not been extensively applied to VR settings, with some exceptions (Pfeiffer, Pfeiffer, Meißner, & Weiß, 2020).

2.2. Information search behaviours in VR settings and online stores

2.2.1. Cue utilization theory

Cue utilization is the process by which consumers collect and use information from the shopping environment to assess product quality (Olson & Jacoby, 1972). Product quality information cues are associated with customers' perceptions of whether a product will conform to their expectations (Narwal & Nayak, 2020). Retailers use a variety of intrinsic product information marketing cues, such as colour, technical information, brand name and price tags to attract customers' visual attention. Consumers can access extrinsic product information through social media. These cues can be either directly controlled by the marketer (prices, product specifications etc.), that is, intrinsic product cues, or not controlled by the marketer, that is, extrinsic cues (e.g., online consumer reviews). Nevertheless, the relative usefulness value of intrinsic versus extrinsic information cues provided by online information sources has received scarce research attention.

Signaling theory has been used as a framework for analysing the

impact of information cues on consumer behaviour (for a review, see Kakaria, 2023a). Signaling theory (see Kirmani & Rao, 2000) posits that information asymmetry can exist between the two parties to a transaction, that is, a seller can have more information than a buyer, and that various 'signals' can reduce the gap. Among these signals, intrinsic cues are characterised as being related to factual, "search" type information, such as prices and product specifications, while extrinsic cues tend to be more related to personal, "experience" based qualities, and personal evaluations (e.g. online reviews) (Grant et al.,. 2007).

2.2.2. Media richness theory

Media richness theory (Daft & Lengel, 1986) conceptualises online media richness as a "set of objective characteristics such as feedback and communication capability, language variety, and personal focus, which determine a medium's ability to communicate the richness of information" (Maity, Dass, & Kumar, 2018, p. 36). In other words, media is "rich" when it provides multiple information cues, immediate feedback and uses very varied language. The richness of the medium is likely to increase as marketers adopt VR and VAs to engage with customers. Virtual stores provide immersive media content, thus, VR's media richness can increase sense of presence (De Amorim, Guerreiro, Eloy, & Loureiro, 2022) and enhance the consumer's perceptions of the argument quality of the information provided by the VR store during the purchase process.

2.2.3. Accessibility-diagnosticity framework

The accessibility-diagnosticity theoretical framework (Feldman & Lynch, 1988) postulates that the probability that an informational cue will be used as input in an evaluation or the formulation of a judgement is a function of: (i) how accessible the information is in the individual's memory (i.e., accessibility); and (ii) the significance that the information has to him/her (i.e., diagnosticity). Any factor that increases (e.g., the size or location of the cue in a VR store) or decreases (e.g., interference) the accessibility of an informational cue will influence whether it is chosen. Feldman and Lynch (1988) argued that the accessibility of pieces of information stored in memory is a zero-sum game, that is, when the accessibility of one piece increases, that of another decreases. On the other hand, for the individual, information is diagnostic in making a judgement, evaluation or decision if it fulfils the purpose underlying the decision (e.g., choosing a product). Thus, the diagnosticity of an informational cue is subjective, not objective.

2.3. Hypotheses development

2.3.1. Number and type of information cues

Based on media richness theory we posit that VR stores provide richer information that 2D online stores. The novelty and richness of the information provided by VR stores evoke curiosity in the viewer that leads to positive affect and interest (Schutte, 2020). Maity et al. (2018) compared the level of media richness (high versus low) provided by laptops and mobile phones and showed that enhanced media richness reduced the cost of information search and increased the number of options that consumers considered when making choices. Therefore, we propose the following hypothesis:

H1a. The number of informational cues that consumers use in the product choice process is greater in a VR store than in a 2D online store.

Signaling theory proposes that information cues, based on the predictive value and the confidence value of the cue, provide consumers with utility (Kirmani & Rao, 2000). Predictive value has been defined as the degree to which consumers associate a given cue with product quality, while confidence value has been defined as the degree to which consumers have confidence in their ability to use and judge a cue accurately (Miyazaki, Grewal, & Goodstein, 2005; Kakaria, 2023a). When intrinsic product attributes are not readily available, or when consumers are not confident in their ability to assess these attributes, salient extrinsic cues help them make evaluations. Taking the above discussion into account, and on the basis that VR stores provide richer information about intrinsic product cues than do online websites, we posit that extrinsic cues will be more influential in online websites than in VR stores.

H1b. Intrinsic informational cues (price, technical information, delivery time, environmental friendliness, brand name) are more influential than extrinsic cues (reviews, star ratings) when consumers make product choices in VR stores than when they make product choices in 2D online stores.

The accessibility-diagnosticity framework (Feldman & Lynch, 1988) proposes that, given two pieces of information with similar accessibility, individuals will use the more diagnostic. In our study we posit that VA avatars, because the information they provide is very accessible, positively affect the diagnosticity of information provided in immersive settings. In other words, we propose that the presence of an avatar can have a positive interaction effect with a more immersive VR store than in an online store, since the accessibility and diagnosticity of the information provided to the user in this scenario are increased. In consequence, we posit the following hypotheses:

H2a. VA avatars positively influence the number of informational cues consumers use in their product choices in immersive stores (VR and 2D online stores).

H2b. The use of VA avatars in VR stores has a positive interaction effect, based on platform type (VR vs online store), on the number of informational cues consumers use in their product choice.

2.3.2. Flow state

To complement the interpretation of the number and form of informational cue drawn on by the user based on platform type and presence/absence of avatars, an analysis of the role of the user's self-perception of the flow state generated by both independent variables was incorporated. Flow is a state of immersion in a challenging activity and is associated with control, fun and curiosity, accompanied by a loss of self-consciousness and by time distortion (Novak, Hoffman, & Duhachek, 2003). Shin (2019) conceptualised flow experience in the context of virtual reality as the mental state where complete involvement and enjoyment are accompanied by the loss of one's sense of time and space. Media richness theory (Daft & Lengel, 1986) led us to posit that the consumer's experience in VR settings would have higher impact on their flow state than it would in website stores due to the higher argument quality provided by the media richness of more immersive VR stores. We posit that the presence (vs. absence) of an avatar will induce higher levels of flow because they provide significant interactivity and informativeness (Kim, Jin, & Shin, 2022). Thus, we propose the following hypotheses:

H3a. The flow state experienced by the consumer during the product choice is greater in a VR store than in a 2D online store.

H3b. The flow state experienced by the consumer during the product choice is greater in the presence (vs. absence) of an avatar.

2.3.3. Visual attention

Previous research has linked visual attention to actual purchases in retail environments (see Huddleston, Behe, Driesener, & Minahan, 2018, for a review). In the retail environment, the consumer needs to pay some attention when making a purchase, attention being the collection and assessment of stimuli provided by the senses (visual stimuli being, generally, the most important) for use in cognitive processing based on the needs of the moment (Huddleston et al., 2018). For the retailer, the essential task is to capture and direct consumer attention to informational cues that might ultimately lead him/her to make a purchase. Visual attention is very effectively measured by eye-tracking (Orquin & Wedel, 2020). Eye-tracking fixation measures such as

fixation duration, number of revisits and number of fixations have been used as proxies for interest and intensity of information processing.

Consumers pay visual attention to extrinsic and intrinsic cues in parallel when evaluating products (Huddleston et al., 2023). When intrinsic cues are difficult to access, or are scarce, salient extrinsic cues help consumers make evaluations (Miyazaki et al., 2005). Early studies found that intrinsic cues have a more significant effect on perceived product quality than do extrinsic cues (Olson & Jacoby, 1972; Szybillo & Jacoby, 1974). Huddleston et al. (2023), in a study based on retail greenhouses, showed that the most frequently accessed cues were intrinsic. Wedel and Pieters' (2008) theory of visual attention posited that the consumer's goals (intrinsic motivation) and the saliency of marketing stimuli (extrinsic stimuli) combine to establish attentional priorities within the store environment: visual attention is dominated by the intrinsic relevancy of information to the individual ('informativeness') and drives both goal/task-related and browsing behaviours. Therefore, we propose,

H4. Intrinsic informational cues (price, technical information, delivery time, environmental friendliness, brand name) attract more visual attention than do extrinsic cues (reviews, star rating) in consumers' product choice in VR stores.

The use of VA avatars is novel. Lee, Lee, and Jeong (2021) found evidence that media richness increases the consumer's desire to search for more information. Further, in the social media context, the addition of online banners has not been seen to affect the processing of informational cues (Bigne, Simonetti, Ruiz, & Kakaria, 2021). Therefore, we posit that using VA avatars may motivate people to pay more (longer) visual attention to product informational cues during the purchase process than they would to cues in VR stores operating without avatars. Therefore, we propose,

H5. Consumers pay more (longer) visual attention to informational cues during the product choice process in a VR store with a VA avatar than they do in a VR store without an avatar.

2.3.4. Arousal evoked by VA avatars

Previous studies have suggested that virtual reality can elicit emotions using HMD headsets that display objects in 3D (Gorini, Capideville, De Leo, Mantovani, & Riva, 2011). Modulating emotional responses to virtual stimuli is a fundamental goal of many immersive environments (Gall et al., 2021). Recent studies have shown that avatars evoke emotions (Radiah et al., 2023), positive affect (Oh, Bailenson, Krämer, & Li, 2016), higher arousal, dominance and more intense emotional valence (Gall et al., 2021). VA avatars can reduce anxiety through sense of voice presence (Rus-Calafell et al., 2020). Etienne et al. (2023) found that avatars can trigger arousal even when carrying out non-verbal behaviours. Torre et al. (2022) demonstrated that avatars' faces can transmit valence information and their voices can evoke arousal. Ben Saad and Choura (2023) confirmed that VAs have a positive influence on perceived enjoyment, which is positively associated with online impulse buying. Drawing on media richness theory (Daft & Lengel, 1986), due to the higher argument quality provided by immersive VR stores, we propose that consumers shopping in online stores featuring voice avatars will feel higher sense of presence and will experience more enjoyment than consumers shopping in website stores. We posit that consumers will be more physiologically aroused in retail environments which feature VA avatars than in environments without avatars.

H6. Consumers are more aroused during the product choice process in a VR store with a VA avatar than in a VR store without an avatar.

Based on cue utilization theory, media richness theory and the accessibility-diagnosticity framework, we propose the research framework depicted in Fig. 1.

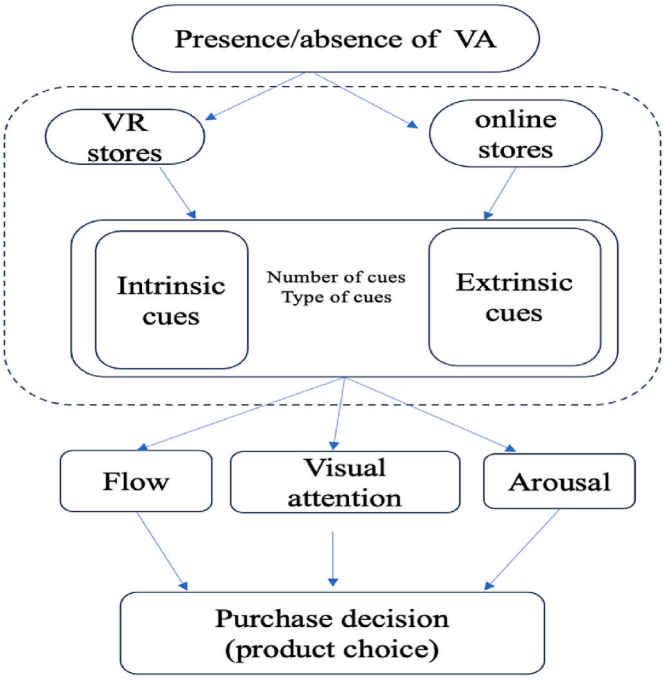

Fig. 1. Schematic representation of research framework.

3. Methodology

3.1. Overview

The empirical study was carried out in April–May 2022. A 2 (interface/retailing type: 2D vs. VR) X 2 (voice avatar: presence vs. absence) between-subjects experimental design was applied. 152 participants, recruited by a market research company, could make two product choices, between two TV sets and two sofas that they could view in a simulated living room. They could make these choices based on data provided by five intrinsic informational cues (price, technical information, delivery time, environmental friendliness, brand name) and two extrinsic cues (reviews, star rating). The participants had to access at least one informational cue in each product but could choose to access from one cue to seven cues.

In a mixed-methods approach, the data were gathered from three sources: (i) behavioural clickstream data (Guo & Sismeiro, 2020); (ii) neurophysiological data (eye-tracking and galvanic skin response measurements); (iii) online questionnaire. We measured viewing behaviours through eye-tracking. Previous research has shown that eye movements are well suited for capturing information search behaviours and consumer choices in VR environments (Bigne, Llinares, & Torrecilla, 2016; Pfeiffer et al., 2020).

3.2. VR environment and stimuli

Two versions of a simulated store were designed, both having the same layout, but differing in level of immersion: a highly immersive setting was displayed in an immersive headset and a non-immersive setting was displayed through a computer screen. One was a VR-based version of a store, created through 3D modelling with Unity software; this was viewed through an HTC Vive Pro Eye 2 HMD, featuring a built-in eye-tracking system. The other version depicted the environment viewed on a web browser, with images displayed in 2D through a computer screen. The participants were placed in front of a desktop monitor (23 inches, 1920 × 1080 pixels) fitted with a built-in Tobii Pro X2-30 Compact eye-tracking device (sampling rate of 30 Hz). We performed vision calibration for each participant before conducting the

experiment. The participants could interact with the products in both environments by clicking buttons (more information provided below, see Fig. 2). To allow generalisation of the results across different product categories, the participants were asked to "purchase" two products (rather than one) for their living rooms, a sofa (experiential product) and a smart TV (search product). We selected a smart TV as the search product because this type of purchase is more likely to be strongly driven by functional product aspects (Maier & Dost, 2018), which can be researched remotely, and previous research has classified household electronics as search goods (Jourdan, 2000; Maier & Dost, 2018). We selected a sofa as the experience good because this type of purchase is driven by a combination of functional and hedonic aspects (e.g. design, fabric), and some of these characteristics can only be recognised after purchase (e.g., a consumer can't assess the design of the sofa, or if the fabric is soft and comfortable, unless they try it).

Fifty percent of the participants viewed a store with a VA avatar, and 50% viewed it without a VA. In the no-avatar condition, the participants read the text of the informational cues that they had requested. In the with-avatar condition, the avatar guided the participant through the purchase process, providing the requested information orally (in addition, the participant could read the information in text form).

For each product, the participants had access to seven informational cues (i.e., price, technical information, delivery time, sustainability, brand name, customer reviews and star ratings), chosen based on a literature review and online research. The informational cues were presented as buttons, of the same size and colour, that the subjects had to click to receive product information. To ensure that the informational cues were balanced in their accessibility within the VR store setting, they were randomly located in a top menu bar for each participant and for each scenario. The definitions of the informational cues are shown in Table 1. As can be seen, fictitious brands were used to mitigate the effect of prior brand knowledge (Chen, Kim, & Lin, 2015), and very similar purchase criteria were defined for each cue, to isolate the effect of the type (not the content) of informational cue needed to make the purchase, and their effects on visual attention and arousal. Technical information and consumer reviews, by their very nature, contain more words than other cues. Each cue was defined as a specific area of interest (AOI), for subsequent visual analysis.

3.3. Recruitment and participants

The participants were asked to imagine they had been wanting to buy a sofa and a smart TV for some time, and that they have visited a physical store where they are invited to explore the products in a virtual reality environment. For each product, they were offered informational cues on two different models, which they had to assess before making their purchase decisions. After viewing the information in the cues they had chosen, the participants could decide to buy a product, or consult informational cues about the alternative model; but, once the purchase was made, they couldn't change their decisions. The participants had sufficient time to complete the task, and sufficient budget to buy both a smart TV and a sofa. Once the task was finished (the user had selected a sofa model and a Smart TV model to purchase), they self-reported in an online questionnaire their flow state during the purchase experience. We measured five dimensions of flow -curiosity, enjoyment, focused immersion, temporal dissociation, and perceived control-using a 13-item 7-point Likert scale adapted from Agarwal and Karahanna (2000). The sample of participants was balanced by gender and age (between 30 and 60 years), reflecting the population of the local urban area of more than 1,000,000 inhabitants. The experimental sample was 152, with 61% men and with a mean age of 44.7 years. After the participants arrived at the Neuromarketing and Virtual Reality Lab of University X[1], they filled out consent forms and were randomly assigned to one of the four scenarios.

3.4. Data gathering

The study used three data sources: neurophysiological data to record visual attention and emotional responses, behavioural data obtained through clickstreams and self-reported data obtained through a questionnaire. Table 2 details the types of data obtained. The clickstream data were recorded either through mouse clicks or controllers using a Matlab routine. The neuropsychological data were collected through eye-tracking and galvanic skin responses (for a review, see Casado-Aranda et al., 2023; Kakaria, Bigné, Catrambone, & Valenza, 2023). The two links https://youtu.be/I6MWaLWkBOg for the website with avatar, and https://youtu.be/G6wKNPftzfM for the VR without avatar, illustrate the recordings of each cue for one participant in the two conditions: a website with an avatar, and a VR with no avatar.

The metrics used are common in eye-tracking studies (Bigne, Ruiz-Mafé, & Badenes-Rocha, 2023). Dwell time refers to the amount of time spent looking at a specific element; dwell time indicates the aggregate fixation time given to a specific element: revisit count (fixation dwells) shows the number of times that the eye comes back to a specific element; fixation count refers to revisits to the same object; and time to first fixation (TTFF) indicates the time elapsed before the viewer

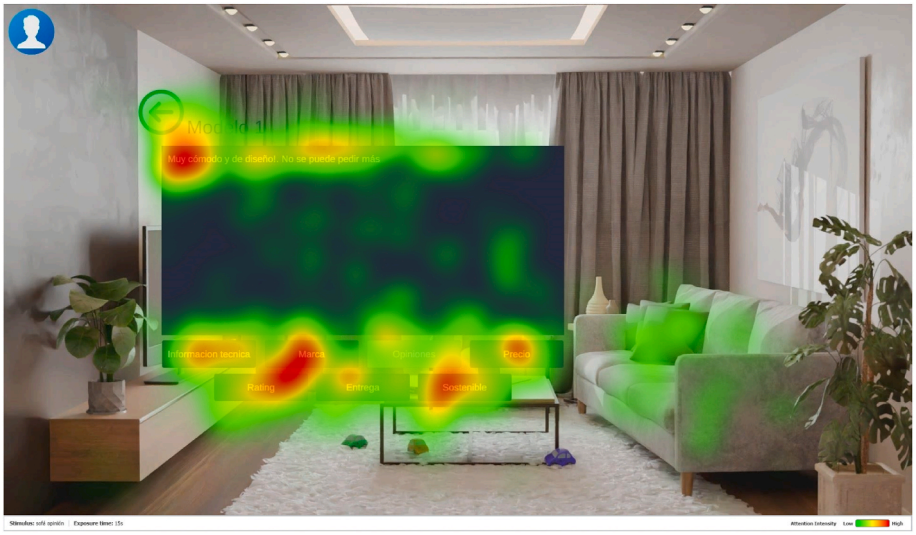

Fig. 2. Example of the heatmap for the website setting with an avatar. Note: The avatar was located in the top left-hand side of the image, while the seven cues were at the bottom.

Table 1
Information cues employed in the study.

Model	Price	Technical information	Star rating	Consumer reviews	Brand name	Delivery time	Sustainability (environmental friendliness)
Sofa 1	599.00 €	220 × 90 × 74 cm; Wooden frame and legs; Extra-large seats. Available in all colours	5,0	Very comfortable and well designed! You cannot ask for more	Bofors	7 days	83%
Sofa 2	589.00 €	225 × 86 × 74 cm; Eucalyptus wood frame and legs; easy to assemble Available in all colours	4,7	I am very happy with this sofa. It is a pleasure to watch TV sitting on it	Hansen	8 days	79%
SmartTV1	499.00 €	LCD; 8 K; 48″	5,0	The design of this TV is very beautiful and I love the product	Oyten	6 days	83%
SmartTV2	489.00 €	LCD; 8 K; 48″	4,8	This TV is just the one I was looking for to go into my living room!	Henai	7 days	79%

Table 2
Summary of data source and data analysis.

H	IV	DV	Data	Device/instrument	Analysis
H1a	Interface retailing type: Online 2D vs. VR	Number of informational cues	*Behavioural* Clickstream: Clicks on each cue	Matlab	Independent *t*-test
H1b	Interface retailing type: Online 2D vs. VR	Type of informational cues (intrinsic vs. extrinsic)	*Behavioural* Clickstream: Clicks on each cue; order of clicks	Matlab	Independent *t*-test
H2a	Presence/absence of Avatar	Number of informational cues	*Behavioural* Clickstream: Clicks on each cue; Order of clicks	Matlab	Independent *t*-test
H2b	Presence/absence of Avatar Interface retailing type: Online 2D vs. VR	Number of informational cues	*Behavioural* Clickstream: Clicks on each cue; Order of clicks	Matlab	Univariate linear model
H3a	Interface retailing type: Online 2D vs. VR	Flow state	*Self-reported*	Online survey	Independent *t*-test
H3b	Presence/absence of Avatar	Flow state	*Self-reported*	Online survey	Independent *t*-test
H4	VR stores	Metrics of visual attention paid to types of informational cues +	*Neurophysiological* Eye tracking	Tobii X2-30	Descriptive
H5	Presence/absence of Avatar	Metrics of visual attention paid to informational cues +	*Neurophysiological* Eye tracking	Tobii X2-30	Independent *t*-test
H6	Presence/absence of Avatar	Metrics of arousal++	*Neurophysiological* Galvanic skin response	Empatica E4 wristband	Independent *t*-test

IV: Independent variable; DV: Dependent variable.
+ dwell time (gaze. ms); dwell time (fixation. ms); revisit count (fixation dwells); fixation count; and time to first fixation (TTFF).
++ number of peaks, peaks per minute and the amplitude of the peak.

looks at a specific element.

4. Results

4.1. Number and types of informational cues used by consumers in their decision-making in a VR-store setting

To address H1a we analysed: (a) the number of informational cues used by the participants to make their purchase decisions; (b) the effect of platform type for both product categories. The results from the clickstream data showed that, on average, 4.7 informational cues were used to make the decision about which sofa to buy, significantly lower than the 5.08 used in the smart TV purchase decision ($t = 3.83$; $p < .01$). However, the number of clicks made was not associated with purchase behaviours with particular sofa models (cues employed when purchasing sofa = 4.72; cues employed when not purchasing sofa = 4.72; $t = 0.00$ $p > .10$) or smart TV models (cues employed when purchasing smart TV = 5.10; cues employed when not purchasing smart TV = 5.02; $t = 0.25$ $p > .10$). Second, for both product categories, there were condition-based differences in the number of informational cues used by the participants to make purchase decisions. In the VR condition, the participants needed fewer informational cues (sofa: 4.47; smart TV: 4.88) than in the website condition (sofa: 4.99; smart TV: 5.28) (t sofa = 1.76; $p < .05$) (t smart TV = 1.49; $p < .10$); therefore, H1a is rejected.

As to the type of informational cues needed for decision-making (H1b), 95.8% of the participants buying sofas requested price information (31.3% with their first click; 29.3% with their second; 9.3% with their third), 77% sought information from consumer reviews (16.1% with their first click; 15.8% with their second; 18.9% with their third) and 75.7% clicked the technical information button (25.7% in the first option; 16.8% in the second; 14.2% in the third). The other cues used for decision-making about the sofa were star ratings (65.5%), delivery time (62.9%), the sustainability of the product (58.9%) and, finally, the brand (58.6%). In the smart TV case, price was the most requested informational cue, clicked by 96.4% of the sample (20.7% with their first click; 27% with their second; 15.5% with their third), followed by technical information about the product (81.6% of participants; 33.6% in the first option; 15.5% in the second; 11.5% in the third), the brand (81.3%; 25.7% in the first option; 13.2% in the second; 15.5% in the third) and consumer reviews (77%; 9.3% in the first option; 17.8% in the second; 16.1% in the third). These cues were followed by star ratings (58.3%), delivery time (57.9%) and, finally, the sustainability of the product (55.3%). These results lead us to conclude that, overall, the participants needed a higher number of intrinsic informational cues (i.e., price, and technical information) than extrinsic informational cues (i.e., consumer reviews) to make purchase decisions.

Differences were observed based on the platform used. For the sofas, price was the only cue more clicked by the participants who used VR devices than those who viewed the shopping website. The other cues, particularly regarding technical information sustainability, were more clicked by those exposed to the 2D website. For smart TVs, the comparative profile was slightly different. The subjects who used a VR device again clicked more to obtain information about price than did users of the website; they also clicked on delivery time and consumer reviews. The remainder of the informational cues were more requested by those exposed to the 2D store. Therefore, H1b is partially supported.

H2a proposes that the use of VA avatars influences the number of informational cues consumers use in their decision-making in immersive stores. The presence or absence of an avatar did not influence the amount of informational cues requested to make a product choice for either of the two product categories. In the with-avatar condition, the participants used 4.54 (sofa) and 4.97 (smart TV) cues. In the no-avatar condition, the cues used were 4.89 (sofa) and 5.16 (smart TV), the mean differences being non-significant (t sofa = 1.20; p > .10) (t smart TV = 0.70; p >. 10). To test H2b, we checked whether there was a positive interaction effect between the two independent variables (interface/retailing type -Web vs. VR- and presence/absence of voice avatar) on the number of informational cues the participants used in their product choices. The results, however, did not support the existence of a positive interaction effect between the variables on the number of clicks made by users, both for the sofa category (F = 0.108, p > .05) and for the smart TV (F = 0.103, p > .05). Therefore, H2b is rejected.

4.2. Influence of VR-setting and presence/absence of avatar on flow state

To address H3a and H3b we performed independent t-tests to check if there are differences in flow state based on store type and the presence/absence of an avatar (see Table 3). As can be seen, the purchasing process in the VR store generated a greater flow state in the user in three of the dimensions (temporal dissociation, focused immersion and curiosity) than in the website condition (H3a supported). On the contrary, the presence/absence of an avatar was not associated with any significant difference in the flow state reported by users.

Combining results from self-reported H3ab and clickstream data H1ab and H2ab, it is interesting to conclude that although the VR condition generated a feeling of a greater flow state (i.e., temporal dissociation, focused immersion and curiosity) in the participants than the Web condition, the number of information cues needed to choose a product was higher in the Web condition than in the VR condition.

4.3. Visual attention paid to the informational cues

H4 sought to identify which type of informational cues attracted more visual attention. Table 4 shows the eye-tracking metrics used in this study as proxies for visual attention.

In the sofa case, the informational cue that received the most visual attention was technical information, with more fixations (5,0), dwell time of fixations (1541 ms) and dwell time of gaze (1347 ms); and it received the second most attention in the two other metrics, revisit count (2.2 fixations dwells) and TTFF (7703 ms). Overall, delivery time was second in terms of receiving most visual attention, as it received 4.0 fixations, 2.3 revisits and had a dwell time (fixations) of 1314 ms.

The larger amount of information contained in the technical information cues (they contained the most words) could partially explain why they were viewed most; and, given technical data was the second most cue clicked on by the sofa purchasers, it can be concluded it provided them with diagnostic information. Two other cues were frequently clicked by the sofa buying participants, price and consumer reviews, receiving moderate visual attention: price (3.6 fixations, 1.9 revisits; dwell time of fixations of 1222 ms; TTFF of 7772 ms) and consumer reviews (3.8 fixations, 2.1 revisits; dwell time of fixations of 1244 ms; TTFF of 7477 ms). The three most clicked cues, price, technical information and consumer reviews, were, in turn, those with the lowest TTFFs. Finally, again for the sofa buyers, consistent with the low number of participants who requested information about the brand and the sustainability of the product, these two cues received the least visual attention.

In the case of the smart TV purchase, again, price, technical information and consumer reviews attracted the most visual attention. Technical information received the most fixations (4.3), consumer reviews the shortest TTFFs (5,902) and price the most dwell time (1149 ms). The brand, an informational cue very frequently clicked on by participants when they purchased the smart TV, nevertheless had moderate visual attention metrics and, curiously, product rating, a cue not highly consulted by the participants, received greater visual attention than brand. Finally, once again, sustainability was the informational cue that received the least visual attention. Therefore, H4 is supported for both products.

4.4. Influence of voice assistant avatars on the visual attention paid to informational cues

H5 sought to measure the influence of the presence or absence of a VA avatar on the visual attention paid to the product informational cues. Overall, the purchase process was slightly slower (t = 1.90; p < .10) in the presence of an avatar (mean duration: 5:16 min) than in the absence of an avatar (mean duration: 4:35 min), which suggests that greater visual attention is paid in the first condition. Table 5 (sofa) and Table 6

Table 3
Influence of VR-setting and avatar on flow state.

	Setting	Mean	*t* value	Avatar	Mean	*t* value
Flow: Temporal dissociation	Web	3.43	3.45**	No	3.85	.45
	VR	4.40		Yes	3.98	
Flow: Focused immersion	Web	5.61	1.68*	No	5.93	1.62
	VR	5.94		Yes	5.61	
Flow: Curiosity	Web	4.66	3.50**	No	5.12	.56
	VR	5.46		Yes	4.99	
Flow: Enjoyment	Web	5.22	2.69**	No	5.50	.08
	VR	5.79		Yes	5.51	
Flow: Control	Web	5.55	.83	No	5.53	.76
	VR	5.36		Yes	5.36	

* = $p < .05$; ** = $p < .01$.

Table 4
Eye-tracking metrics (visual attention).

Area of interest (sofa)	Dwell time (gaze, ms)	TTFF (ms)	Fixation time (fixation, ms)	Revisit count (fixation dwells)	Average number of fixations
Brand	981	8700	1113	1.9	3.6
Delivery	1114	8228	1314	2.3	4.0
Consumer reviews	1061	7477	1244	2.1	3.8
Price	1009	7772	1222	1.9	3.6
Rating	1132	8415	1280	2.1	3.8
Sustainability	1141	10,289	1298	1.9	3.7
Technical information	1347	7703	1541	2.2	5.0
Area of interest (smart TV)					
Brand	962	7593	1156	1.9	3.7
Delivery	1145	8428	1310	2.2	3.9
Consumer reviews	1116	5902	1394	2.2	3.8
Price	1149	7622	1287	2.1	4.0
Rating	1112	7948	1328	2.4	4.0
Sustainability	952	8507	1248	1.9	3.4
Technical information	1072	6299	1264	1.9	4.3

Table 5
Influence of presence/absence of an avatar on eye-tracking metrics (visual attention) in sofa purchase.

Area of interest	Dwell time (gaze. ms)			TTFF (ms)			Fixation time (fixation. ms)		
	AV	NA	*t* value	AV	NA	*t* value	AV	NA	*t* value
Brand	1159	766	2.44**	8949	8397	.31	1318	863	2.48**
Delivery	1497	711	4.95***	9010	7388	1.08	1747	850	4.57***
Consumer reviews	1275	837	3.26***	8482	6383	1.51	1463	1006	3.27***
Price	1011	1007	.23	8493	6945	1.22	1161	1292	.56
Rating	1363	861	3.00***	9618	6976	1.71*	1484	1037	2.29**
Sustainability	1239	1017	.84	10,577	9919	.44	1409	1156	.86
Technical information	1610	1046	2.56**	8514	6770	1.01	1764	1284	2.00**

Area of interest	Revisit count (fixation dwells)			Average number of fixations		
	AV	NA	*t* value	AV	NA	*t* value
Brand	2.5	1.1	3.22***	4.5	2.5	3.31***
Delivery	3.2	1.3	4.41***	5.2	2.7	4.47***
Consumer reviews	2.7	1.5	3.58***	4.5	3.0	3.57***
Price	2.4	1.4	2.75**	4.1	3.0	1.90*
Rating	2.7	1.5	3.16***	4.6	2.9	3.23***
Sustainability	2.2	1.4	2.10**	4.1	3.1	1.59
Technical information	2.9	1.5	3.08***	6.3	3.6	3.52***

AV = Avatar; NA = No avatar; * = p < .10; ** = p < .05; *** = <0.01.

Table 6
Influence of presence/absence of an avatar on eye-tracking metrics (visual attention) in smart TV purchase.

Area of interest	Dwell time (gaze. ms)			TTFF (ms)			Fixation time (fixation. ms)		
	AV	NA	*t* value	AV	NA	*t* value	AV	NA	*t* value
Brand	1242	644	3.52***	7007	8259	0.80	1369	914	2.37**
Delivery	1345	930	1.95*	9536	7239	1.35	1479	1129	1.40
Consumer reviews	1298	901	1.86*	6548	5136	1.28	1629	1114	2.02**
Price	1203	1091	.59	8787	6414	1.61	1316	1256	.28
Rating	1321	877	1.89*	8491	7324	.88	1503	1127	1.47
Sustainability	1094	810	1.97*	9075	7960	1.36	1441	1063	1.40
Technical information	1140	998	.81	6511	6060	.31	1345	1172	.85

Area of interest	Revisit count (fixation dwells)			Average number of fixations		
	AV	NA	*t* value	AV	NA	*t* value
Brand	2.6	1.1	3.58***	4.7	2.5	3.79***
Delivery	2.7	1.7	1.88*	4.6	3.2	2.16**
Consumer reviews	2.7	1.6	2.23**	4.4	3.0	2.10**
Price	2.5	1.7	1.82*	4.4	3.6	1.25
Rating	2.9	1.7	2.34**	4.7	3.2	2.31**
Sustainability	2.5	1.4	1.88*	4.0	2.9	2.16**
Technical information	2.1	1.7	.95	4.7	3.8	1.31

AV = Avatar; NA = No avatar; * = p < .10; ** = p < .05; *** = <0.01.

(smart TV) confirm this result, distinguishing between the visual attention paid to all informational cues.

In the sofa purchase, the with-avatar condition generated much higher visual attention in all metrics (except TTFF), for all informational cues. Thus, the fixation count and revisit count were significantly higher in the with-avatar condition for the seven cues analysed. On the other hand, dwell time (gaze and fixation) was higher in the with-avatar condition only for brand, delivery, consumer reviews, star ratings and technical information.

The viewing patterns were very similar with smart TVs and sofas, which suggests that viewing patterns are similar for durable products. Again, the TTFF was the same for both conditions, but significant differences were seen in the other visual attention metrics, in favour of the with-avatar condition, for almost all informational cues. When the avatar was present, participants made more fixations on, and revisits to, brand, delivery, consumer reviews, ratings and technical information (not on/to price and sustainability). Dwell time (gaze and fixations) was more balanced for informational cues, except for brand and consumer reviews, which were more viewed in the with-avatar condition.

Overall, these results allow us to conclude that the presence of a voice assistant avatar prompts consumers to pay more visual attention to the informational cues presented in a VR store setting, supporting H5. Two complementary theories support these findings. Distraction hypothesis (Harp & Mayer, 1998) argues that the selective attention paid by the user draws his/her attention away from important information. In our context, the VA can be seen as a distraction. Further, schema theory (Axelrod, 1973) posits that the recipients of information adopt new informational cues (in our context, the VA) to incorporate it into their previously held schemas. Both approaches suggest that recipients allocate cognitive load to the distraction element (i.e., the VA) by seeing it as a new informational cue. Therefore, visual attention measured through dwell time and fixation time is higher when a new element (VA) appears than in the absence of additional information. In a nutshell, additional cues demand greater visual attention be paid.

4.5. Influence of voice assistant avatars on the arousal experienced by consumers during a purchase

Finally, we tested if the use of voice assistant avatars influenced the consumer's arousal (H6). Independent samples t-tests showed there were no significant differences in both scenarios in terms of number of peaks (Avatar = 19.23; No avatar = 13.63; t = 1.64; p > .10), or in the

number of peaks per minute of navigation (Avatar = 3.92; No avatar = 3.55; t = 0.53; p > .10), but that there were statistical differences in the amplitude of the peaks (Avatar = 0.304; No avatar = 0.202; t = 4.34; p < .01); thus, arousal was more intense in the presence of the VA avatar (H6 supported). Thus, the presence of avatars in VR stores seems to generate higher arousal among participants than is aroused in VR stores without voice assistant avatars.

5. Discussion and conclusions

The present study gives insights into the informational cues consumers use in purchasing experiences in VR and online stores. While the individual effects of both cue types on perceived product quality have been extensively researched, few studies have investigated their simultaneous effects (see Narwal & Nayak, 2020, for a review). The findings of this study extend our understanding about the effects intrinsic and extrinsic information cues have on consumers for different product types. We extend research into media richness by using cue utilization theory to examine how purchase intentions are influenced by intrinsic and extrinsic cues. When consumers make product choices in VR stores and online websites, the multiple information cues available interact and impact on their decision making, thus understanding the effects of their interaction avoids overestimating a single cue's independent effect (Kakaria, Simonetti, & Bigne, 2023).

The present study used VR stores and online websites to explore how consumers are affected by media richness in a store environment offering augmented layers of information and the help of VA avatars. The results revealed that their cognitive appraisal of media-rich virtual reality experiences influenced their arousal, the visual attention they paid to products and their purchase decisions. Although media richness has been shown to be an antecedent of consumer behaviours in other settings (Holzwarth, Janiszewski, & Neumann, 2006; De Amorim et al., 2021), the present study is, to the best of the authors' knowledge, the first to measure its impact in a VR scenario, and through the mediating lenses of emotional (arousal), cognitive (visual attention) and behavioural responses (click-through).

Scholars agree that VA avatars can improve the customer experience and radically change their shopping journeys (Aw, Tan, Cham, Raman, & Ooi, 2022). Despite the enormous benefits VA avatars can provide to consumers and businesses, and the technological progress they represent, only in recent years has research strongly focused on their intersection with retailing (Balakrishnan, Dwivedi, Hughes, & Boy, 2021; Vlačić, Corbo, e Silva, & Dabić, 2021). Against this backdrop, our study sheds new light on the formation of VA-enabled customer experiences and VA use in shopping in VR environments.

This work makes four contributions to the retailing and attention-focused marketing literature. First, using behavioural data gathered from clickstreams, we explored the consumer's decision-making processes in online stores and VR retail environments. As Huddleston et al. (2023) pointed out, intention is not always predictive of behaviours, thus, carrying out self-reported studies isolates behavioural outcomes rather than intentions. Consequently, a contribution of our study is that we analysed the effects of intrinsic and extrinsic cues on an actual purchase based on clickstream data, rather than on purchase intentions.

Second, this is one of the few studies to take a holistic view of the proportion of visual attention allocated to a combination of intrinsic versus extrinsic cues during a customer journey. The present study adds to the scarce research that has used eye-tracking in VR experiments (Bigne et al., 2016; Meißner, Pfeiffer, Peukert, Dietrich, & Pfeiffer, 2020) by examining consumers' information processing in two immersive settings, one 2D and one 3D; the results are enriched by using galvanic skin responses to measure users' arousal levels. When asked to reflect on their behaviours, consumers often provide socially desirable responses which accord with their perceptions of the questioner's expectations. Therefore, as Wedel and Pieters (2008) noted, capturing consumers' visual attention is critical.

Third, we complement recent research by explaining how VAs can affect the consumer's decision-making processes in both types of e-commerce platforms. To the best of the authors' knowledge, this study is among the first to investigate the role of VA avatars in providing product informational cues in the search stage of the customer shopping journey in 2D and 3D retail settings. Combining VR with voice assistants has been identified as an opportunity for retailers to better understand consumer behaviours in the metaverse.

Fourth, this work compares the customer journey in two immersive settings. The findings suggest that customers' experiences with VR-stores trigger emotional (arousal) and cognitive (visual attention) evaluations of products that differ depending on the platform used.

The present study also contributes to the clickstream data analysis literature by analysing the sequencing of consumers' viewing behaviours and clickstream data to explain how they process intrinsic and extrinsic informational cues in 2D websites and VR stores. In doing so, we aim to overcome the disadvantages faced by previous purchase-predicting approaches that used only clickstream data.

Understanding which, and how, informational product cues attract visual attention will help retailers create optimal shopping environments. These factors may also indirectly benefit consumers by making the shopping process more efficient and pleasurable. This research extends media richness theory (Daft & Lengel, 1986) and the accessibility-diagnosticity theoretical framework (Feldman & Lynch, 1988) to VR contexts. VR can be assimilated into rich media to deliver media content due to its immersive and interactive nature. As a result, VR has greater consumer value than have websites. Regarding the accessibility-diagnosticity theoretical framework, this study demonstrates than the more accessible and diagnostic is the information provided by stores to consumers during the shopping experience, the fewer will be informational cues they need to process to make their product choices, and the greater will be the flow state they experience (i.e., temporal dissociation, focused immersion and curiosity).

The results of this research have implications for retailers operating online and in the metaverse. Retailers control, combine and use product informational cues to capture consumers' attention and, thereby, encourage them to pay more visual attention to products and to make purchases. Given that VR stores provide a richer experience to the consumer, which enhances his/her perceptions of the argument quality of the information the store provides during the purchase process, we recommend that online stores use more informational cues than are used by VR stores. Focusing on the type of informational cues employed, we recommend retailers include as much detailed information about price as possible in VR and in online stores; we also recommend they include information on delivery time, and consumer reviews. In 2D websites, retailers selling experience products should pay special attention to information about technical cues and sustainability, as they attract the greatest number of interactions (click-through).

As AI-powered VA avatars enhance the customer experience, retailers need to consider them as hubs that can facilitate the pre-purchase phases of the consumer shopping journey. We recommend that retailers use VA avatars in VR-stores as they increase consumers' arousal and visual exploration of the featured products.

6. Limitations and future research lines

This study has limitations that open avenues for future research into consumer behaviours in VR settings. While the study obtained data from three sources, that is, questionnaire, neurophysiological and behavioural data, we did not undertake a causal analysis to identify which type of data better explains consumer choice. The immersive setting was a VR representation provided by the retailer; that is, it did not integrate the consumer's own space/home. Future studies might use augmented reality representations of consumers' own spaces to analyse their purchase behaviours.

We examined a search product (smart TV) and an experiential

product (sofa). Another interesting line of research would be to replicate the study to compare the results with other sectors which operate VR, such as tourism services and, thereby, obtain valuable insights. We also suggest that future studies combine the measurement of implicit behaviours with self-reported measures of consumer behaviour (e.g., satisfaction, intention to visit the physical store) linking the visual attention paid to informational cues to the customer journey. The present study gathered neurophysiological data through eye-tracking. However, other measures (see, for details, Casado-Aranda et al., 2023), such as heart rate variability and face reading, might provide additional insights. Last, to understand what the advent of the metaverse means for the future of retailing (Dwivedi et al., 2023), new research needs to examine the effects of the interactions of virtual personas in immersive retailing spaces (Yoo, Welden, Hewett, & Haenlein, 2023). This will entail examining the value of virtual consumers and the role of retailers.

Credit author statement

The three authors have equally contributed to the paper.

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.

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References

Aw, E. C. X., Tan, G. W. H., Cham, T. H., Raman, R., & Ooi, K. B. (2022). Alexa, what's on my shopping list? Transforming customer experience with digital voice assistants. *Technological Forecasting and Social Change, 180*, Article 121711.

Axelrod, R. (1973). Schema theory: An information processing model of perception and cognition. *American Political Science Review, 67*(4), 1248–1266.

Balakrishnan, J., Dwivedi, Y. K., Hughes, L., & Boy, F. (2021). Enablers and inhibitors of AI-powered voice assistants: A dual-factor approach by integrating the status quo bias and technology acceptance model. *Information Systems Frontiers*, 1–22.

Ben Saad, S., & Choura, F. (2023). Towards better interaction between salespeople and consumers: The role of virtual recommendation agent. *European Journal of Marketing, 57*(3), 858–903.

Bigne, E., Llinares, C., & Torrecilla, C. (2016). Elapsed time on first buying triggers brand choices within a category: A virtual reality-based study. *Journal of Business Research, 69*(4), 1423–1427.

Bigne, E., Ruiz-Mafé, C., & Badenes-Rocha, A. (2023). The influence of negative emotions on brand trust and intention to share cause-related posts: A neuroscientific study. *Journal of Business Research, 157*, Article 113628.

Bigne, E., Simonetti, A., Ruiz, C., & Kakaria, S. (2021). How online advertising competes with user-generated content in TripAdvisor. A neuroscientific approach. *Journal of Business Research, 123*(February), 279–288.

Bucklin, R. E., Lattin, J. M., Ansari, A., Gupta, S., Bell, D., Coupey, E., … Steckel, J. (2002). Choice and the Internet: From clickstream to research stream. *Marketing Letters, 13*, 245–258.

Capgemini. (2018). How are virtual assistants affecting the customer experience?. https://www.capgemini.com/2018/12/how-are-virtual-assistants-affecting-the-customer-experience/.

Casado-Aranda, L. A., Sánchez-Fernández, J., Bigne, E., & Smidts, A. (2023). The application of neuromarketing tools in communication research: A comprehensive review of trends. *Psychology and Marketing*. https://doi.org/10.1002/mar.21832

Chen, K. J., Kim, J., & Lin, J. S. (2015). The effects of affective and cognitive elaborations from Facebook posts on consumer attitude formation: Affect and cognition in attitude formation. *Journal of Consumer Behaviour, 14*, 208-128.

Choi, H. S., Ko, M. S., Medlin, D., & Chen, C. (2018). The effect of intrinsic and extrinsic quality cues of digital video games on sales: An empirical investigation. *Decision Support Systems, 106*, 86–96.

Choudhary, V., Currim, I., Dewan, S., Jeliazkov, I., Mintz, O., & Turner, J. (2017). Evaluation set size and purchase: Evidence from a product search engine. *Journal of Interactive Marketing, 37*(1), 16–31.

Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management Science, 32*(5), 554–571.

De Amorim, I. P., Guerreiro, J., Eloy, S., & Loureiro, S. M. (2022). How augmented reality media richness influences consumer behaviour. *International Journal of Consumer Studies, 46*(6), 2351–2366.

Dwivedi, Y. K., Hughes, L., Wang, Y., Alalwan, A. A., Ahn, S. J., Balakrishnan, J., et al. (2023). Metaverse marketing: How the metaverse will shape the future of consumer research and practice. *Psychology and Marketing, 40*(4), 750–776.

Etienne, E., Leclercq, A. L., Remacle, A., Dessart, L., & Schyns, M. (2023). Perception of avatars nonverbal behaviors in virtual reality. *Psychology and Marketing*. https://doi.org/10.1002/mar.21871

Farah, M. F., Ramadan, Z. B., & Harb, D. H. (2019). The examination of virtual reality at the intersection of consumer experience, shopping journey and physical retailing. *Journal of Retailing and Consumer Services, 48*, 136–143.

Feldman, J. M., & Lynch, J. G. (1988). Self-generated validity and other effects of measurement on belief, attitude, intention, and behavior. *Journal of Applied Psychology, 73*(3), 421–435.

Flavián, C., Ibáñez-Sánchez, S., & Orús, C. (2019). The impact of virtual, augmented and mixed reality technologies on the customer experience. *Journal of Business Research, 100*, 547–560.

Gall, D., Roth, D., Stauffert, J. P., Zarges, J., & Latoschik, M. E. (2021). Embodiment in virtual reality intensifies emotional responses to virtual stimuli. *Frontiers in Psychology, 12*, Article 674179.

Gao, X. S., Currim, I. S., & Dewan, S. (2022). Validation of the information processing theory of consumer choice: Evidence from travel search engine clickstream data. *European Journal of Marketing, 56*(8), 2250–2280.

Gorini, A., Capideville, C. S., De Leo, G., Mantovani, F., & Riva, G. (2011). The role of immersion and narrative in mediated presence: The virtual hospital experience. *Cyberpsychology, Behavior, and Social Networking, 14*(3), 99–105.

Grant, R., Clarke, R. J., & Kyriazis, E. (2007). A review of factors affecting online consumer search behaviour from an information value perspective. *Journal of Marketing Management, 23*(5–6), 519–533.

Guo, B., & Sismeiro, C. (2020). “Between click and purchase: Predicting purchase decisions using clickstream data. *Advances in Consumer Research 50th Annual Conference of the Association for Consumer Research (ACR2019)*, 17–20. Atlanta, Georgia, USA. Association for Consumer Research, pp. 608–609.

Harp, S. F., & Mayer, R. E. (1998). How seductive details do their damage: A theory of cognitive interest in science learning. *Journal of Educational Psychology, 90*(3), 414.

Hernandez-Ortega, B., & Ferreira, I. (2021). How smart experiences build service loyalty: The importance of consumer love for smart voice assistants. *Psychology and Marketing, 38*(7), 1122–1139.

Hilken, T., Chylinski, M., Keeling, D. I., Heller, J., de Ruyter, K., & Mahr, D. (2022). How to strategically choose or combine augmented and virtual reality for improved online experiential retailing. *Psychology and Marketing, 39*(3), 495–507.

Holzwarth, M., Janiszewski, C., & Neumann, M. M. (2006). The influence of avatars on online consumer shopping behavior. *Journal of Marketing, 70*(4), 19–36.

Huddleston, P. T., Behe, B. K., Driesener, C., & Minahan, S. (2018). Inside-outside: Using eye-tracking to investigate search-choice processes in the retail environment. *Journal of Retailing and Consumer Services, 43*, 85–93.

Huddleston, P., Coveyou, M. T., & Behe, B. K. (2023). Visual cues during shoppers' journeys: An exploratory paper. *Journal of Retailing and Consumer Services, 73*, Article 103330.

Jourdan, P. (2000). Search or experience products: An empirical investigation of services, durable and non-durable goods. *Asia Pacific Advances in Consumer Research, 4*, 167.

Kakaria, S., Bigné, E., Catrambone, V., & Valenza, G. (2023). Heart rate variability in marketing research: A systematic review and methodological perspectives. *Psychology and Marketing, 40*(1), 190–208.

Kakaria, S., Simonetti, A., & Bigne, E. (2023). Interaction between extrinsic and intrinsic online review cues: Perspectives from cue utilization theory. *Electronic Commerce Research*, 1–29.

Kim, G., Jin, B., & Shin, D. C. (2022). Virtual reality as a promotion tool for small independent stores. *Journal of Retailing and Consumer Services, 64*, Article 102822.

Kirmani, A., & Rao, A. R. (2000). No pain, no gain: A critical review of the literature on signaling unobservable product quality. *Journal of Marketing, 64*(2), 66–79.

Kukar-Kinney, M., Scheinbaum, A. C., Orimoloye, L. O., Carlson, J. R., & He, H. (2022). A model of online shopping cart abandonment: Evidence from e-tail clickstream data. *Journal of the Academy of Marketing Science, 50*(5), 961–980.

Lee, S. A., Lee, M., & Jeong, M. (2021). The role of virtual reality on information sharing and seeking behaviors. *Journal of Hospitality and Tourism Management, 46*, 215–223.

Maier, E., & Dost, F. (2018). Fluent contextual image backgrounds enhance mental imagery and evaluations of experience products. *Journal of Retailing and Consumer Services, 45*, 207–220.

Maity, M., Dass, M., & Kumar, P. (2018). The impact of media richness on consumer information search and choice. *Journal of Business Research, 87*, 36–45.

Martínez-Navarro, J., Bigné, E., Guixeres, J., Alcañiz, M., & Torrecilla, C. (2019). The influence of virtual reality in e-commerce. *Journal of Business Research, 100*, 475–482.

Meißner, M., Pfeiffer, J., Peukert, C., Dietrich, H., & Pfeiffer, T. (2020). How virtual reality affects consumer choice. *Journal of Business Research, 117*, 219–231.

Miyazaki, A. D., Grewal, D., & Goodstein, R. C. (2005). The effect of multiple extrinsic cues on quality perceptions: A matter of consistency. *Journal of Consumer Research, 32*(1), 146–153.
Moe, W. (2006). An empirical two-stage choice model with varying decision rules applied to internet clickstream data. *Journal of Marketing Research, 43*(4), 680–692.
Montgomery, A. L., Li, S., Srinivasan, K., & Liechty, J. C. (2004). Modelling online browsing and path analysis using clickstream data. *Marketing Science, 23*(4), 579–595.
Narwal, P., & Nayak, J. K. (2020). How consumers form product quality perceptions in absence of fixed posted prices: Interaction of product cues with seller reputation and third-party reviews. *Journal of Retailing and Consumer Services, 52*, Article 101924.
Novak, T. P., Hoffman, D. L., & Duhachek, A. (2003). The influence of goal-directed and experiential activities on online flow experiences. *Journal of Consumer Psychology, 13*(1–2), 3–16.
Oh, S. Y., Bailenson, J., Krämer, N., & Li, B. (2016). Let the avatar brighten your smile: Effects of enhancing facial expressions in virtual environments. *PLoS One, 11*, Article e0161794.
Olson, J. C., & Jacoby, J. (1972). Cue utilization in the quality perception process. In M. Venkatesan (Ed.), *ACR proceedings of the third annual conference of the association for consumer research* (pp. 167–179). Chicago, IL: Association for Consumer Research.
Orquin, J. L., & Wedel, M. (2020). Contributions to attention-based marketing: Foundations, insights, and challenges. *Journal of Business Research, 111*, 85–90.
Pfeiffer, J., Pfeiffer, T., Meißner, M., & Weiß, E. (2020). Eye-tracking-based classification of information search behavior using machine learning: Evidence from experiments in physical shops and virtual reality shopping environments. *Information Systems Research, 31*(3), 675–691.
Poushneh, A. (2021). Humanizing voice assistant: The impact of voice assistant personality on consumers' attitudes and behaviors. *Journal of Retailing and Consumer Services, 58*, Article 102283.
Radiah, R., Roth, D., Alt, F., & Abdelrahman, Y. (2023). The influence of avatar personalization on emotions in VR. *Multimodal Technologies and Interaction, 7*(4), 38.
Rus-Calafell, M., Ward, T., Zhang, X. C., Edwards, C. J., Garety, P., & Craig, T. (2020). The role of sense of voice presence and anxiety reduction in AVATAR therapy. *Journal of Clinical Medicine, 9*(9), 2748.
Schutte, N. S., & Malouff, J. M. (2020). Connections between curiosity, flow and creativity. *Personality and Individual Differences, 152*, Article 109555.
Shin, D. (2019). How does immersion work in augmented reality games? A user-centric view of immersion and engagement. *Information, Communication & Society, 22*(9), 1212–1229.
Szybillo, G. J., & Jacoby, J. (1974). Intrinsic versus extrinsic cues as determinants of perceived product quality. *Journal of Applied Psychology, 59*(1), 74–78.
Torre, I., Holk, S., Yadollahi, E., Leite, I., McDonnell, R., & Harte, N. (2022). "Smiling in the face and voice of avatars and robots: Evidence for a 'smiling McGurk effect'". *IEEE Transactions on Affective Computing*, 1–12.
Vanderburg, J. L., Welch, L., Beard, C., Gilbert, R., & Loveland, K. A. (2023). Associations between psychological distress, early adverse experiences, and choice of avatars in an immersive virtual world. *Computers in Human Behavior, 148*, Article 107902.
Vlačić, B., Corbo, L., e Silva, S. C., & Dabić, M. (2021). The evolving role of artificial intelligence in marketing: A review and research agenda. *Journal of Business Research, 128*, 187–203.
Wedel, M., Bigné, E., & Zhang, J. (2020). Virtual and augmented reality: Advancing research in consumer marketing. *International Journal of Research in Marketing, 37*(3), 443–465.
Wedel, M., & Pieters, R. (2008). A review of eye-tracking research in marketing. *Review of Marketing Research*, 123–147.
Xu, C., Siegrist, M., & Hartmann, C. (2021). The application of virtual reality in food consumer behavior research: A systematic review. *Trends in Food Science & Technology, 116*, 533–544.
Yoo, K., Welden, R., Hewett, K., & Haenlein, M. (2023). The merchants of meta: A research agenda to understand the future of retailing in the metaverse. *Journal of Retailing, 99*(2), 173–192.