How do consumers evaluate products in virtual reality? A literature review for a research agenda

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Abstract

Purpose – This paper aims to review the existing literature about consumers' evaluation of products in virtual reality (VR), provide an accurate overview of this field, systematise the knowledge developed so far, identify the research gaps and propose a future research agenda.

Design/methodology/approach – A systematic literature review was performed on Scopus and Web of Science, resulting in a final pool of 31 articles.

Findings – Four main themes were identified, and a detailed research agenda is proposed based on the findings and following the theory, context, characteristics, methodology framework.

Research limitations/implications – The provision of formal inclusion and exclusion criteria may have resulted in additional potentially relevant articles not indexed in the data set under consideration.

Originality/value – The paper highlights how products are perceived in VR, the consumers' responses, the peculiarities of VR compared to other conditions and VR as a product test environment. To the best of the authors' knowledge, this paper seems to represent the first systemic review that focusses solely on how consumers assess products in VR. The results lead to a broad proposal of directions for future research that can expand knowledge on VR in marketing. Practical implications concern the use of VR to design product strategies and as a testing and prototyping environment.

Keywords Virtual reality, Product, Consumer, Evaluation, Systematic literature review, TCCM framework

Paper type Literature review

¿Cómo evalúan los consumidores los productos en realidad virtual? Una revisión de la literatura para una agenda de investigación

Resumen

Objetivo – Este artículo revisa la literatura existente sobre la evaluación de los consumidores de productos en Realidad Virtual, proporciona una visión precisa de este campo, sistematiza el conocimiento

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desarrollado hasta el momento, identifica las lagunas en la investigación y propone una agenda de investigación futura.

Metodología – Se realizó una revisión sistemática de la literatura en Scopus y Web of Science, que dio como resultado un conjunto final de 31 artículos.

Resultados – Se identificaron cuatro temas principales y se propone una agenda de investigación detallada basada en las conclusiones y siguiendo el marco Teoría, Contexto, Características, Metodología.

Limitaciones de la investigación – La provisión de criterios formales de inclusión y exclusión puede haber dado lugar a artículos adicionales potencialmente relevantes no indexados en el conjunto de datos considerado.

Originalidad – El artículo destaca cómo se perciben los productos en la Realidad Virtual, las respuestas de los consumidores, las peculiaridades de la Realidad Virtual en comparación con otras condiciones y la Realidad Virtual como entorno de prueba de productos. Esta parece representar la primera revisión sistémica que se centra exclusivamente en cómo los consumidores evalúan los productos en la Realidad Virtual. Los resultados conducen a una amplia propuesta de direcciones para futuras investigaciones que puedan ampliar los conocimientos sobre la Realidad Virtual en el marketing. Las implicaciones prácticas se refieren al uso de la Realidad Virtual para diseñar estrategias de producto y como entorno de prueba y creación de prototipos.

Palabras clave Realidad Virtual, Producto, Consumidor, Evaluación, Revisión sistemática de la literatura, Marco TCCM

Tipo de artículo Revisión de literatura

消费者如何评价虚拟现实中的产品？一个研究议程的文献回顾

摘要

目的 – 本文回顾了现有的关于消费者对虚拟现实产品评价的文献, 提供了这个领域的准确概述, 系统化了迄今为止的知识, 确定了研究差距, 并提出了一个未来的研究议程。

设计/方法/途径 – 在Scopus和Web of Science上进行了系统的文献综述, 最终形成了31篇文章的资料库。

研究结果 – 确定了四个主要的主题, 并根据研究结果, 按照理论、背景、特征、方法框架提出了详细的研究议程。

研究局限性 – 提供正式的纳入和排除标准可能会导致更多潜在的相关文章没有被收录到所考虑的数据集中。

原创性 – 文章强调了产品在虚拟现实中是如何被感知的, 消费者的反应, 与其他条件相比虚拟现实的特殊性, 以及虚拟现实作为产品测试环境。这似乎代表了第一个只关注消费者如何在虚拟现实中评估产品的系统性评论。研究结果为未来的研究方向提出了一个广泛的建议, 可以扩展营销中的虚拟现实知识。实际意义在于使用虚拟现实技术来设计产品策略, 并作为测试和原型设计环境。

关键词 虚拟现实; 产品; 消费者; 评价; 系统性文献综述; TCCM框架

文章类型 研究型论文

1. Introduction

The growing adoption of virtual reality (VR) applications among consumers corresponds to increasing attention from academia and practitioners. VR is now a mature and accessible technology with advanced features (Corallo *et al.*, 2020). Immersive VR devices such as head-mounted displays (HMDs) are widely available and affordable (Flavián *et al.*, 2019a), and VR is increasingly positioned as a relevant marketing platform (van Berlo *et al.*, 2021). VR applications are now common in several sectors (Rodrigues and Loureiro, 2022), such as tourism, health care, entertainment, education and real estate. Among the most promising from a marketing perspective are retail and shopping. Several major business players, such as Amazon, Alibaba and eBay, are investing in implementing VR solutions in their commerce system (Zarantonello and Schmitt, 2022; Xi and Hamari, 2021; Martínez-Navarro *et al.*, 2019). VR allows consumers to be immersed in a fully virtual environment characterised by immersion, presence and interactivity (Zarantonello and Schmitt, 2022).

VR shopping environments and marketplaces can realistically simulate physical ones and address the limitations of e-commerce (Luna-Nevarez and McGovern, 2021). VR can enrich the shopping experience with new, exciting and immersive solutions. It is accessible at any time and without the spatial and temporal limitations of the physical world. Firms can address shoppers' multisensory needs, simplifying the decision-making process and engaging them (Mishra *et al.*, 2021). Thus, VR represents one of the technological megatrends that will have a relevant impact on consumers' lives and activities (Xi and Hamari, 2021). The metaverse, of which VR is one of the enabling technologies, has ignited the interest of scholars and practitioners (Dwivedi *et al.*, 2022).

Marketing research is recently experiencing considerable interest in VR, despite its first steps dating back to the 1990s, realigning with other disciplines such as engineering, psychology and computer science, which present a more established contribution (Wedel *et al.*, 2020; Loureiro *et al.*, 2019). Yet, despite the growing attention around VR, it is still unclear how much is known about consumer behaviour in an immersive VR. Marketing literature seems to be still fragmented and scattered, although rapidly evolving, and knowledge should be deepened (Cowan *et al.*, 2021; Hollebeek *et al.*, 2020; Wedel *et al.*, 2020). Particular attention should be placed on consumer assessment of products in VR, and research is needed to better understand the potential of VR in a retail context (Kim *et al.*, 2021). Unlike other marketing applications, such as tourism and hospitality, in VR, consumers are asked not only to experience the environment but also to analyse and evaluate a virtual product. Multisensory experiences, such as those in VR, are context-specific (Mishra *et al.*, 2021). The evaluation of a tourism destination may be different from a virtual gaming experience. As an example, Flavián *et al.* (2021a) focussed on the effectiveness of VR in the hotel industry, which is characterised by the intangibility of the product offering. Orús *et al.* (2021) claim that the differences in their results compared to previous literature can be attributed to the differences between tangible and intangible industries, such as retailing and hospitality.

VR can also be relevant in prototyping and product evaluation (Hube *et al.*, 2020), as well as in the pre-purchase phase and in stimulating consumer attention towards new products (Hoyer *et al.*, 2020). In research, VR overcomes the limitations of traditional studies. New product ideas can be tested with the possibility of immediately varying each feature and reducing issues about cost, complexity, time, availability and perishability of products. VR decreases the effect of external factors, increases ecological validity and provides more and richer data about users' behaviour (Dwivedi *et al.*, 2022; Lombart *et al.*, 2019; Siegrist *et al.*, 2019).

Within this context, some questions arise:

Q1. How do consumers evaluate products in VR?

Q2. What responses, attitudes and behaviours are elicited?

Q3. What are the peculiarities of VR compared with other environments?

And finally:

Q4. What do we know and what do we not know about consumers' product evaluations in VR?

Our aim is to understand how products are perceived and evaluated in VR, what consumer attitudes, perceptions and responses emerge during the evaluation of products in VR and what advances the literature has produced so far. This seems to be an emerging theme in

which knowledge is not yet consolidated and needs systematisation. In line with Wedel *et al.* (2020), who claim that researchers could revisit consumer concepts and theories in VR, it is necessary to outline the state of the art of literature and identify the opportunities for future research. Despite the greater attention in other marketing areas, such as tourism and hospitality, to the best of our knowledge, there seems to be a lack of reviews addressing consumer evaluation of products in VR.

A preliminary search was conducted to frame the present work. Loureiro *et al.* (2019) provided a text mining-based review to understand the use of VR in marketing, identifying the use of VR in manufacturing and new product development, among the emerging topics. Xi and Hamari (2021) reviewed 72 articles, conference proceedings and book chapters to understand how VR influences the shopping experience and which technologies have been implemented in the shopping context. Cowan and Ketron (2019) proposed a framework based on user immersion and user experience, whereas Hollebeek *et al.* (2020) provided a categorisation of VR archetypes.

Based on the above, a literature review can provide a deep understanding of consumer assessment of products in VR and investigate the use of VR in product research in light of consumer perceptions. Accordingly, this paper aims to present the theory, context, characteristics and methodology identified in the reviewed articles, analyse the most relevant topics that emerged and provide a future research agenda. For the present study, a systematic literature review was conducted. Moreover, we adopted the theory, context, characteristics, methodology framework (TCCM; Paul and Rosado-Serrano, 2019) to present the future research agenda.

2. Virtual reality

In VR, users are immersed in 3D virtual environments where they can navigate and interact, which triggers sensory stimulation (Flavián *et al.*, 2021a, p. 1). The synthetic world of VR may or may not mimic the properties of a real-world environment (Loureiro *et al.*, 2019, p. 514). Hence, VR is a computer-generated simulation of a situation that incorporates the user, who perceives it via one or more of the senses (currently mostly audio-visual) and interacts with it in a manner that appears to be real (Wedel *et al.*, 2020, p. 443).

VR has specific characteristics that distinguish it from other Extended Reality technologies (Flavián *et al.*, 2019b). The "Reality-Virtuality Continuum" (Milgram and Kishino, 1994) has been the reference for classification of different realities for many years. Recently, Flavián *et al.* (2019b) extended this framework, identifying an independent dimension named pure mixed reality (PMR) and reaching a more comprehensive classification. According to the authors, the continuum ranges between reality and virtuality. At one end is the real environment, where users interact with elements in the real world, while at the other end is the Virtual Environment, which includes Virtual Worlds and VR. Virtual Worlds, such as Second Life, are continuous virtual environments in which, at any time, avatars representing users can interact with other avatars. The term VR has also been unrealistically used (Xi and Hamari, 2021) to refer to different classes of technology, such as Virtual Worlds, the internet or other digital assets and environments. Between these extremes, the physical and virtual worlds coexist and are integrated and mediated by technology. In augmented reality (AR), virtuality overlaps reality, i.e. digital contents are superimposed on the real environment; thus, AR enhances the physical environment (Heller *et al.*, 2021). In augmented virtuality, reality overlaps virtuality, i.e. real contents are superimposed on the virtual environment. In the middle of this continuum is PMR, where virtuality and reality are merged. Users can interact both with digital and real content,

which are integrated. All realities are independent of each other and are characterised by specific features.

Based on this classification, Flavián *et al.* (2019b) propose the "EPI Cube", a framework that considers the interplay between technological embodiment, perceptual presence and behavioural interactivity, and they suggest a comprehensive taxonomy of existing and new reality–virtuality technologies. The vertices of the EPI Cube represent radical examples of technologies. Applications of interest for this study are those that fall under Vertices 7 and 8 and that refer, respectively, to 360° HMDs videos and VR HMDs.

The framework proposed by Cowan and Ketron (2019) is based on user immersion and user experience. The applications that fall under automated virtual environment, relevant for this study, ensure the highest level of user experience and realism, using HMD and the Cave Automatic Virtual Environment (CAVE).

Based on the above, we refer to VR as a fully immersive environment that offers a sense of embodiment, as users see themselves as components of the virtual environment (Flavián *et al.*, 2019b, p. 550) in which they can interact with virtual content and objects in real-time.

3. Systematic literature review

A systematic literature review was conducted (Tranfield *et al.*, 2003; Fink, 2009) in line with the Preferred Reporting Items for Systematic Literature Reviews and Meta-Analyses (PRISMA) guidelines (Page *et al.*, 2021).

Data were obtained from Scopus and Web of Science online databases. Based on previous studies and in line with PRISMA, keywords were selected to build a search item appropriate to identify potentially relevant articles, screening titles, abstracts and keywords. They are presented below.

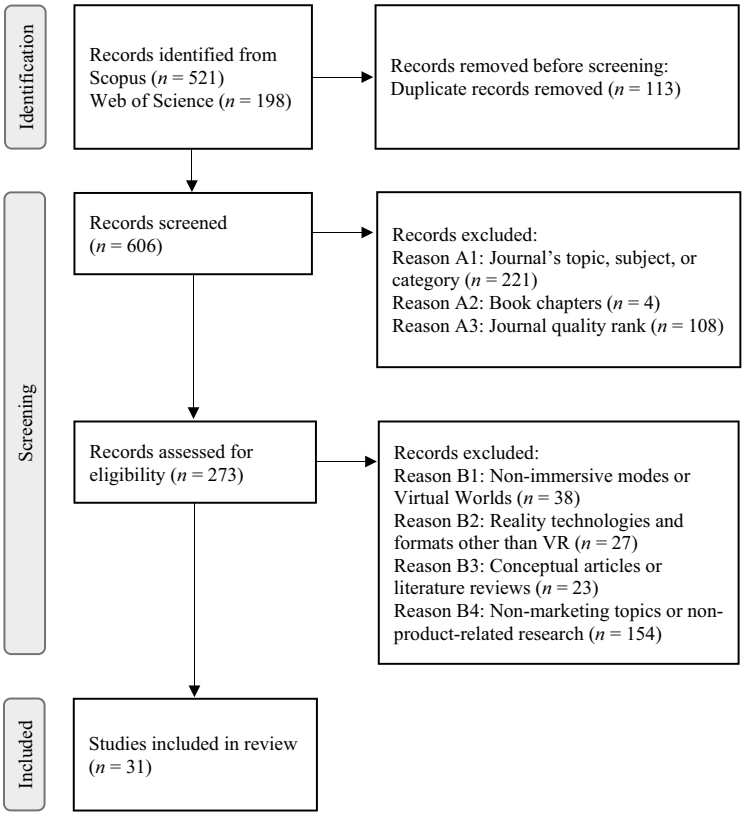
(produc OR goods OR commodit* OR merchandis* OR item* OR shop* OR store* OR retail* OR mall OR supermarket) AND ("virtual real*" OR "VR")*

The first group of keywords covers the word *product* (and synonyms), as well as shopping and retail, extending Xi and Hamari (2021); "virtual real*" and "VR" include all forms of the words *Virtual Reality* and their abbreviations. The asterisk allows searches for different suffixes.

The search was then refined to include only articles published in peer-reviewed academic journals. Only scientific articles written in English were included, and other types of publications, such as conference proceedings and book chapters, were excluded. The subject area filter "business, management and accounting" was applied in Scopus, and the category filters "business" and "management" were set in Web of Science to concentrate the analysis only on marketing-related articles. Articles published in any country up to 31 May 2022 and accessible online were considered. Based on these criteria, 521 records were then obtained from Scopus and 198 records from Web of Science. After merging the two raw data sets, all duplicates (113) were removed. Finally, a total of 606 records were obtained.

The article selection process is described below and summarised in Figure 1, adapted from the PRISMA flow diagram (Page *et al.*, 2021).

Starting with the complete data set, an initial screening was carried out. Firstly, those subjects and categories that are not related to marketing, such as logistics, organisation, decision sciences (221), were excluded. Some examples may be found in *Supply Chain Management*, *Information and Organization*, *Decision Support Systems*, *International Journal of Project Management*. Four records were removed, as they corresponded to other types of publications (book chapters). Successively, in line with Chevtchouk *et al.* (2021), only journals ranked at least Q1 or Q2 in the SCImago Journal Ranking (2021) were included.



Source: Authors' elaboration, adapted from the PRISMA 2020 flow diagram template for systematic reviews, Page *et al.* (2021)

Figure 1.
Procedure for selecting articles to be reviewed

A total of 108 records did not meet this criterion and were excluded. Finally, 273 records were identified to be assessed for eligibility.

The analysis continued by carefully reading the title, abstract, introduction and conclusions of the resulting records. A paper was considered not relevant if it does not deal with VR but with other types of product presentations, such as simple 3D or it refers to Virtual Worlds (38); or it deals with other reality technologies and formats other than VR, such as AR (27); or it is a conceptual article or a literature review (23); or it deals with non-marketing topics (such as economics, production management, or VR from a technical perspective), or it focusses on topics other than product-related marketing research, e.g. tourism, hospitality, real estate (154). Every article that fits in at least one of the exclusion criteria was not considered. Each doubtful case was resolved by reading the whole article. An article was considered potentially relevant if it deals with products evaluation or presentation in VR, or analyses consumer behaviour or attitudes related to products in VR, or considers VR as a testing environment involving products to some extent, or compares VR with other experimental conditions in product research. A common point for all selected articles is that one or more products are used in the study. A forward and backward

check was performed on all excluded items. Finally, to ensure the validity of the final selection of articles, all articles were read in full. In conclusion, a final pool of 31 articles was obtained.

4. Descriptive analysis

By looking at the distribution by year, a clear trend in the growth of papers emerges, reaching its peak in 2021 when about half of the contributions were published. *Journal of Business Research* features the highest number of articles.

Table 1 presents a summary of the theories, contexts, characteristics and methodologies used in the reviewed articles, following the TCCM framework. This framework allows the development of insight clearly and comprehensively, bringing out both theoretical and empirical aspects of a research domain (Castagnoli *et al.*, 2022). It is an effective tool to ensure a comprehensive understating of a given area of research (Roy Bhattacharjee *et al.*, 2022), and it takes into account the breadth of the state of the art (Akhmedova *et al.*, 2021). It is particularly suitable to highlight the knowledge gaps and suggest new directions for future research (Tsiotsou *et al.*, 2022).

First, theories have been reported whereas expressly stated in the articles. As context, we mapped the settings within which the studies were conducted. To this end, we included details about the countries where the research was carried out (if explicit), products used in the studies (in VR or not), the sample involved and the type of VR or other technologies, the format used and possible comparisons with other conditions. With characteristics, we referred to the main constructs, variables and relations that emerged from the article. Finally, the methodology reports the type of studies (not considering pre-tests).

5. Discussion of results

This section outlines key research streams, relevant topics and contributions of the reviewed articles. Four macro themes were identified. The content of the articles revolved around the fundamental elements of the following topics:

(1) products in VR;
(2) consumers in VR;
(3) VR compared to other conditions; and
(4) product tests in VR.

A summary is proposed in Table 2.

5.1 Products in virtual reality

VR does not necessarily have to mimic real-world shopping situations to allow for virtual product appraisal (van Berlo *et al.*, 2021). The high interactivity of VR leads to a product evaluation close to physical reality, according to Peukert *et al.* (2019). The authors consider the resolution and the quality of stimuli to be relevant in product diagnosticity. On the other hand, highly immersive shopping environments seem to positively influence a hedonic path through telepresence but negatively influence a utilitarian path through product diagnosticity. This effect is probably due to a technical limitation of the technology used, which did not allow the information on the packaging to be clearly read. Kang *et al.* (2020) found that consumers do not seem to place particular importance on the graphic quality when a product is presented in a 3D environment, compared to a 2D display or a 3D website. Probably, consumers in VR are exposed to multiple cues in addition to graphic quality, and they might consider it less relevant when evaluating informativeness. This result could also

Authors | Theory *Context*	Characteristics	Methodology
Hilken *et al.* (2021) | Mental imagery theory		
USA | Café's products | 296, 365 and 353 consumers | Online AR holograms on-screen, online 360° VR video, tablet PC AR holograms, 360° video with VR HMD	Effectiveness of AR in stimulating purchase intention compared to VR. Effectiveness of VR in improving brand attitudes compared to AR. Combination of AR and VR in improving purchase intention and brand attitudes	Online and laboratory experiments
Kim *et al.* (2022) | Flow theory		
USA | Apparel | 213 students | VR HMD, online store website	Role of VR store experience in eliciting shoppers' interest in the store and intention to visit the physical store. Mediation effect of flow	Laboratory experiment
Luangrath *et al.* (2022)		
Coffee, knitting, electronics, shirts, sweater, t-shirts, blankets | 502, 595, 967, 690, 622, 859, 144 consumers | Images, GIFs, Oculus Rift VR HMD, real products	Due to the active nature of product touch, the vicarious touch affects consumers' psychological ownership and product valuation, that in turn results in body ownership of the virtual hand	Field study, online and laboratory experiments
Alzayat and Lee (2021) | Hedonic and utilitarian values		
Tools, clothes | 48 students; 70 and 160 consumers | Oculus Rift HMD, online retail website	Hedonic and utilitarian shopping value in VR vs website. Mediating effect of telepresence on the relationship between VR and hedonic and utilitarian shopping values. Extension of the body and presentation of the body in VR vs website. Moderating effect of need for touch	Laboratory and online experiments
Bernritter *et al.* (2021) | Construal level theory		
EU, UK | Fashion retail, food and beverage | 3,384 consumers; 120 and 296 students; 303 consumers | HTC Vive	The role of type of promotion, product category involvement and location targeting on consumers' reactance and probability to buy in location-based mobile marketing. VR as an immersive environment to capture actual brand choices	Field quasi-experiment, laboratory and online experiments
Cowan *et al.* (2021)		
France, Ireland, USA | Ruinart champagne, BMW car | 128, 160, 228, 185 consumers | 360° VR, picture, video, website video, real products	Effect of high presence-inducing media (360° VR) vs low presence-inducing media (video or product presentations) on brand evaluation and purchase intention. Differences among online vs retail-store experiences, and high vs low product category knowledge. Mediating effect of mental imagery on the interaction of product category knowledge and high vs low presence-inducing media on brand evaluations and purchase intention. Effect of haptic instruction on the influence of product category knowledge and media-induced presence on brand evaluations and purchase intentions	Field and online experiments

Table 1.
TCCM framework map

(*continued*)

Authors | Theory *Context*	Characteristics	Methodology
Harz *et al.* (2021) | Theory of vividness		
Kitchen appliances, gardening tools. | 631 and 201 consumers | VR HDM and motion tracking sensors, online VR, real products	VR to improve prelaunch sales forecasting. VR vs traditional studio tests with real products. VR in fostering behavioural consistency between participants' information search, preferences and buying behaviour. The effect of VR on participants' perceptions related to presence and vividness and on decision uncertainty and convenience	Field studies, laboratory experiment
Huang *et al.* (2021)		
China | Potato chips | 80 consumers | NVIS nVisor SX60 HMD, resting-state fMRI	Colour–flavour incongruency effect. VR setting as a research tool combined with fMRI and voxel-based morphometry study	Laboratory experiment
Kim *et al.* (2021) | TAM, Telepresence theory		
US | Furniture | 146 students | Google Cardboard VR headset	Effect of interactivity and vividness on perceived usefulness and perceived enjoyment and impacts on consumer behavioural responses, mediating role of telepresence and previous experiences with VR	Laboratory experiment
Loureiro *et al.* (2021b) | Extended S(Stimuli) – O (Organism) – R (Response) framework		
Portugal | Shoes | 200 students | Oculus Rift HMD	Escapism affects consumers' cognitive and affective states that increase pleasure. Pleasure heightens vividness and presence, which affect intentions. The role of music in the background	Laboratory study
Mishra *et al.* (2021) | Theory of vividness, hedonic and utilitarian values		
India | Chair, paint, tourism experience, car |128+159+138 students | VR headset	Consumer responses to VR, AR and mobile apps: ease of use, responsiveness, word-of-mouth recommendation, overall positive experiences, visual appeal, emotional appeal and purchase intention. Moderating effect of product type (hedonic and utilitarian)	Laboratory experiments
Park and Kim (2021)		
USA | Apparel | 404 consumers, 196 students | 3D VR online store, try-on online store, standard online store, HTC Vive HMD, virtual try-on, static pictures	Effect of VR 3D virtual store and AR virtual try-on technology on purchase intention. Mediating role of cognitive elaboration. Interaction of consumers' shopping goals (searching vs browsing) with the website technology and the influence on their responses	Online and experiments
Ringler *et al.* (2021) | Theory in sensory marketing, mental simulation and cue diagnosticity		
US | Blender; sports utility vehicle; lawnmower | 427, 476, 270 students, 201 consumers | Vive Pro MV	The effect of consequential product sounds on customers' perceptions and willingness to pay. Use of consequential product sounds in VR shopping	Laboratory and online experiments

(*continued*)

Table 1.

Authors | Theory *Context*	Characteristics	Methodology
Schnack *et al.* (2021a) | Big Five personality traits		
New Zealand | Food and beverage, magazines | 113 consumers | HTC Vive HMD	Impact of Big Five personality traits on product inspection time, the proportion of private label purchases and impulsive buying in immersive VR store environments. Impact on basket size, shopping time and amount spent	Laboratory study
Schnack *et al.* (2021b)		
New Zealand | Convenience products | 71 consumers | HTC Vive HMD, Electroencephalography	Different types of locomotion techniques in VR shopping environments (instant teleportation vs motion-tracked walking) and the influence on consumer behaviour	Laboratory experiment
van Berlo *et al.* (2021) | Consumer learning theory		
The Netherlands | Chocolate | 81 consumers | HTC Vive HMD	The moderating effect of virtual product appeal of brands in VR on brand attitude and purchase intention. The mediating role of emotional response on the effect of brands in VR games on brand attitude and purchase intention	Laboratory experiment
Han *et al.* (2020) | Flow theory, TAM		
Supermarket | 120 consumers | VR HMD	Effect of telepresence, challenge, body ownership and control (consumer flow) on playfulness and usefulness (technology acceptance). Intention to adopt VR in consumer setting. Role of technology readiness and time distortion on the relationship between telepresence and playfulness	Laboratory study
Kang *et al.* (2020) | Affective–cognition model		
USA | Office desk, chair | 218 consumers | Picture, video desktop, website 3D, Oculus Rift CV1 HMD	Interactivity, visual-spatial cues and graphics quality in enhancing the playfulness and informativeness of the shopping interface and in influencing subsequent product evaluation and purchase intention	Online and laboratory experiment
Meißner *et al.* (2020) | Expectation–confirmation theory		
Germany | Mueslis |257 students | VR HMD, 3D on desktop screen, real products	How high immersive VR affect variety-seeking (brand loyalty – taste loyalty), price-sensitivity and satisfaction with the choice made	Laboratory experiment
Naderi *et al.* (2020) | Model of object recognition		
USA | Digital camera | 91, 90 students. | Ultra-HD TV, Oculus Rift CV1 HMD	The effect of product design and environment congruence on the perceived aesthetic, affective responses and purchase intentions. Immersive VR in reducing confounding effects and providing a better understanding of the product	Laboratory experiments

Table 1. (*continued*)

Authors | Theory *Context*	Characteristics	Methodology
Pfeiffer *et al.* (2020) Food and beverage | 29 students, 20 consumers | CAVE, eye-tracking, real products	Eye movements to classify goal-directed and exploratory search. Comparison between a virtual and real supermarket	Laboratory experiment, field study
Schnack *et al.* (2020) New Zealand | Food and beverage | 153 consumers | HTC Vive HMD	Shopper behaviour in an immersive VR store: private label share, private label share per category, shelf positioning, gender differences in purchase behaviour, unplanned purchases, product handling time	Laboratory study
Huang and Wan (2019) China | Potato chips | 80, 120 consumers | nVisor SX60 HMD	Colour–flavour incongruency effect in product evaluation and brand perception. Effect of the interaction with the product in VR on colour–flavour incongruency	Laboratory experiments
Lombart *et al.* (2019) | Cue utilization theory France | Fruits and vegetables | 142 students | Oculus Rift DK2 HMD	The effects of fruit and vegetable abnormalities on consumer perceptions and purchasing behaviour in an immersive VR store. VR as an environment to study fresh food products with many participants	Laboratory experiment
Martínez-Navarro *et al.* (2019) | Affective–cognition model, Presence theory Spain | Beer, water, wine | 178 consumers | Desktop screen, power-wall, HTC Vive HMD, physical market	The effectiveness of different VR formats and devices in eliciting positive consumer responses compared to a physical store: affective responses (emotions, discomfort, affective appraisal), cognitive responses (presence and band recall) and conative responses (purchase intention)	Laboratory and field experiment
Meißner *et al.* (2019) Granola, banking mixture | 33 consumers | CAVE, eye-tracking	VR as an effective setting to benefit from mobile eye-tracking and laboratory experiment advantages	Laboratory study
Peukert *et al.* (2019) | Hedonic and utilitarian values Germany | Mueslis | 257 consumers | HTC Vive HMD, desktop computer screen	The effect of immersion on the intention to reuse the shopping environment via two paths: perceived product diagnosticity - perceived usefulness and perceived telepresence - perceived enjoyment	Laboratory experiment
Esmark Jones *et al.* (2018) | Social identity theory, reactance theory USA | Embarrassing products | 120, 99, 127 consumers, 44 students | 360° VR video with HMD, real products	Packaging components that influence product anonymity and the relationship between anonymity, embarrassment and purchase intentions. Moderating effect of location and discount. VR as an immersive environment to capture product choices	Field study, online and laboratory experiments

(*continued*)

Table 1.

Authors | Theory *Context*	Characteristics	Methodology
Ketelaar *et al.* (2018) Denmark | Grocery | 120 consumers | CAVE	The effect of openness in advertising design, in interaction with location congruency of mobile advertising, in a VR supermarket (as a realistic, interactive and controllable environment	Laboratory experiment
Ketelaar *et al.* (2017) Denmark | Cola, toilet paper, chocolate sprinkles, crisps | 120 consumers | CAVE	The effects of location congruency and medium type on consumers' advertising attention and brand choice. VR as an immersive environment to capture actual brand choices	Laboratory experiment
Bigné *et al.* (2016) Spain | Beer | 41 consumers | CAVE, human behaviour tracking, eye-tracking	Consumer paths, seeking behaviour, purchase behaviour, attention and time spent in a VR supermarket	Laboratory experiment

Table 1. **Source:** Authors' own work

be due to the novelty of VR. Interactivity and visual–spatial cues affect the informativeness and playfulness of VR (Kang *et al.*, 2020). Interactivity allows shoppers to freely move and manipulate the product, while a visual-spatial cue refers to the possibility of visualising a full-size product in 3D.

Product type has a significant impact on purchase intentions in a VR environment, and utilitarian products seem to lead to more positive results. Probably the immersive experience of VR makes the purchase less monotonous, leading to greater customer satisfaction and purchase intention (Mishra *et al.*, 2021). Products perceived as an extension of the body (tools such as hammers and pencils) seem to be more suitable for a VR–retail experience (Alzayat and Lee, 2021). These product categories could benefit more from VR than products perceived as a presentation of the body (clothes and accessories). This contrasts with the fact that clothing and accessories have been considered leaders in virtual-based experiences (Alzayat and Lee, 2021). VR can deliver realistic cues for food and drink and elicit natural product-searching processes (Huang *et al.*, 2021; Bigné *et al.*, 2016).

The vivid presentation of a product in VR and the interaction with virtual content can make consumers feel as if they are in a store (Kim *et al.*, 2021). Seeing and interacting with the product in VR did not seem to influence choice satisfaction, according to Meißner *et al.* (2020), probably because it was not possible to judge the product more accurately. A different result may be obtained when evaluating a product, whereby the reference environment is important or when the use of a product is more complex and requires detailed evaluations. Interacting with the product in VR reduced the colour–flavour incongruency effect on product evaluation, but the same effect was not found for brand perception (Huang and Wan, 2019). Finally, in contexts other than traditional shopping, virtual product appeal strengthens brand attitude but not purchase intention (van Berlo *et al.*, 2021).

The possibility to touch a product is one of the key components of shopping and retail experiences. VR can simulate real products and be a medium to effectively

Themes	Summary of the contributions	References
Products in VR	Relevant factors involved in the product assessment in VR The impact of product type in the evaluation in VR The role of sensory input in the product evaluation in VR	Luangrath *et al.* (2022), Alzayat and Lee (2021), Cowan *et al.* (2021), Kim *et al.* (2021), Huang *et al.* (2021), Mishra *et al.* (2021), Ringler *et al.* (2021), Schnack *et al.* (2021a), van Berlo *et al.* (2021), Kang *et al.* (2020), Meißner *et al.* (2020), Huang and Wan (2019), Peukert *et al.* (2019), Bigné *et al.* (2016)
Consumers in VR	The responses consumers generate when evaluating products in VR The role of emotions in product assessment in VR Shopping behaviour in VR	Cowan *et al.* (2021), Huang *et al.* (2021), Kim *et al.* (2021), Loureiro *et al.* (2021b), Mishra *et al.* (2021), Park and Kim (2021), Schnack *et al.* (2021a), van Berlo *et al.* (2021), Han *et al.* (2020), Kang *et al.* (2020), Meißner *et al.* (2020), Schnack *et al.* (2020), Martínez-Navarro *et al.* (2019), Peukert *et al.* (2019)
VR compared to other conditions	Differences between VR and physical reality Comparison between VR and other less immersive conditions and environments. Virtual and Augmented Reality	Hilken *et al.* (2021), Kim *et al.* (2022), Alzayat and Lee (2021), Cowan *et al.* (2021), Harz *et al.* (2021), Mishra *et al.* (2021), Park and Kim (2021), Kang *et al.* (2020), Meißner *et al.* (2020), Pfeiffer *et al.* (2020), Martínez-Navarro *et al.* (2019)
Product test in VR	VR as an experimental environment Advantages of studies conducted in VR VR as a product test tool Combination of VR with other technologies to conduct studies	Bernritter *et al.* (2021), Harz *et al.* (2021), Huang *et al.* (2021), Schnack *et al.* (2021a), Schnack *et al.* (2021b), Meißner *et al.* (2020), Naderi *et al.* (2020), Pfeiffer *et al.* (2020), Schnack *et al.* (2020), Lombart *et al.* (2019), Meißner *et al.* (2019), Esmark Jones *et al.* (2018), Ketelaar *et al.* (2018), Ketelaar *et al.* (2017), Bigné *et al.* (2016)

Source: Authors' own work

Table 2. The four macro themes identified across the reviewed articles

haptically explore products (Alzayat and Lee, 2021). The importance of sensory input also depends on product type, and haptic cues have a relevant impact on consumer brand evaluations, even if they are not physical products (Cowan *et al.*, 2021). The need for touch negatively moderates the relationship between VR and hedonic shopping value (Alzayat and Lee, 2021), so individuals with a high need for touch derive less hedonic value in VR-based retail. The vicarious haptic effect is strongest for individuals highly stimulated by an immersive VR experience. Luangrath *et al.* (2022) found that this effect increases body ownership and, in turn, the psychological ownership of the product and the product evaluation. Ringler *et al.* (2021) showed how consequential product sound affects consumers' perception of a product and willingness to pay. According to Schnack *et al.* (2021a), VR could generate sensory cues not comparable to those in a physical store (such as the absence of smell or physical touch), which potentially impacts the way human personality plays in shaping behaviour. The authors did not identify a link between shopper personality and shopping behaviour in an immersive VR store.

Companies in different industries already provide solutions in which consumers can evaluate products in VR. Prada offers the possibility of directly experiencing its product offerings in VR [1], IKEA has long been providing a VR environment where consumers can try out and evaluate [2] different furniture configurations.

5.2 Consumers in virtual reality

Consumer attention and purchase conversion rates may be increased in VR shops, triggering impulse buying and packaging inspection (Schnack *et al.*, 2021a). VR also leads to more favourable word-of-mouth recommendations, which may help reduce barriers to VR adoption in businesses (Mishra *et al.*, 2021). Meißner *et al.* (2020) and Peukert *et al.* (2019) found that shoppers are less price-sensitive in VR. Brand evaluations and purchase intention are also influenced by product category knowledge, presence induced and haptic input (Cowan *et al.*, 2021). Notably, van Berlo *et al.* (2021) found that the sense of presence does not influence brand recall. Shoppers also place significant importance on the visual appeal of a product when they experience a highly playful VR environment (Kang *et al.*, 2020). Body ownership and control show a significant relationship with perceived usefulness and, with telepresence, with perceived playfulness of the VR shopping experience (Han *et al.*, 2020). Moreover, perceived usefulness and playfulness lead to the behavioural intention to visit the VR store and purchase products. According to Loureiro *et al.* (2021b), the vividness and presence of the VR store are increased by consumers' pleasure, triggered by the escapism (as experience); consumer intentions are strengthened as a result. Vividness and presence drive the desire to continue using the VR store and recommend it. Because of pleasure, consumers have a more vivid sensation of presence and a richer representation of the VR store.

Emotions experienced in VR have an impact on the sense of presence and lead to an increase in purchase intention. The affective evaluation of VR acts on brand recall, which also influences purchase intention (Martínez-Navarro *et al.*, 2019). Consumer–brand interactions in VR can evoke emotional responses in terms of both arousal and valence (van Berlo *et al.*, 2021). This drives the perceived hedonic value of the brand, which in turn drives consumers' commercial behaviour.

Consumers in a VR store show similar shopping patterns to real-world behaviour during a multi-category shopping trip (Schnack *et al.*, 2020). Huang *et al.* (2021) also argue that consumers may exhibit similar shopping behaviours in virtual and brick-and-mortar shops. As Peukert *et al.* (2019) point out, the effect of immersion on user behaviour and VR shopping acceptance might be more pronounced when users can experience an entire shop. 3D VR stores increase consumers' cognitive elaboration and purchase intentions, especially for shoppers that are browsing more than searching (Park and Kim, 2021). However, Kim *et al.* (2021) claim that VR interactivity is limited when compared to the experience with products in physical stores, while greater than an online platform. Moreover, VR provides more realistic images of products in a 3D naturalistic environment than an online platform. The high degree of vividness can enhance the shopping experience, impacting perceived usefulness and enjoyment.

For example, in the business context, there are solutions for analysing consumer behaviour when evaluating products in VR, as in the case of Kellogg's, for the study of product placement and assortment on the shelves (Accenture, 2019).

5.3 Virtual reality compared to other conditions

Pfeiffer *et al.* (2020) found similarities between physical and virtual supermarkets, calling for research that contrasts VR with physical reality. VR stores can lead to advantages over physical stores regarding positive consumer responses. Martínez-Navarro *et al.* (2019) compared different VR formats and devices. HMDs are the most effective among VR devices, as they lead to higher levels of presence (compared to powerwalls), but they also generate more discomfort (compared to PCs). However, discomfort perceived in a VR store does not influence the sense of presence or brand recall. This is relevant, as the discomfort was the only advantage attributable to the physical store over the virtual one. 3D and 360°

VR do not elicit significant differences in consumers' cognitive and affective responses. Only purchase intentions are affected by the VR format. However, VR stores are more effective in generating cognitive and affective responses. In all VR conditions, brand recall was found to be significantly higher than in physical stores. Finally, VR increases purchase intention compared to physical stores.

Consumers seem more open to trying different products in an immersive VR (Meißner *et al.*, 2020), showing stronger variety-seeking, even though they do not seem to be more satisfied with their choices compared to non-immersive VR. Harz *et al.* (2021) compared two types of VR with a test using real products. Laboratory VR produced more consistent consumer behaviour than online VR and created superior behavioural consistency compared with the real product test because of the sense of presence and vividness. Cowan *et al.* (2021) showed that 360° VR retail environments are best used online, if retailers aim to influence brand responses, compared to in-store. However, when consumers show high product category knowledge, an online environment in 360° VR gets a worse brand attitude and purchase intention. When haptic information is presented in 360° VR, these negative effect results were attenuated.

According to Kim *et al.* (2022), consumers experience higher immersion during a VR experience than during a website experience. The flow state results are enhanced, leading to a higher intention to visit the physical store. VR retail positively affects hedonic purchase value compared to an online retail website, but this does not seem to be the case for the utilitarian purchase value. This process is mediated by telepresence, which lets consumers feel as if they are in a simulated retail space (Alzayat and Lee, 2021). However, according to Kang *et al.* (2020), purchase intention is lower in a 3D VR than in a 3D Web condition. One explanation is that as informativeness is relevant in shaping purchase behaviour if shoppers find the 3D VR shop less informative, they tend to have a lower willingness to purchase.

Comparing VR, AR and mobile apps, Mishra *et al.* (2021) argue that consumers show higher purchase intentions for a utilitarian product in VR than in apps and a positive experience for a hedonic product in AR compared to apps. Park and Kim (2021) examined the effect of an AR virtual try-on app and a 3D VR shop on clothing purchase intentions. If consumers are in a browsing mode, VR is more effective in increasing purchase intention than AR and static images, whereas VR and AR are both more effective than static images when consumers are in a searching mode. According to Hilken *et al.* (2021), AR is better suited for improving purchase intentions than VR, whereas VR is more effective in enhancing brand attitude than AR. Moreover, the combination of AR and VR can improve both purchase intentions and brand attitudes, but only if VR is used after AR. This effect seems to be due to an alignment with the online-to-offline journey in experiential retail. Customers simulate procedural action sequences with VR once they have decided on which products to consume with AR.

5.4 Product tests in virtual reality

Companies such as BMW [3] and Volvo [4] use VR for product testing and prototyping. Indeed, academic research is also considering VR in this sense. A VR supermarket allows researchers to obtain a highly controlled experimental environment (Pfeiffer *et al.*, 2020) whose immersive and interactive experience allows them to measure both actual brand choice and process variables and to offset the limitations of a field study (Bernritter *et al.*, 2021). VR offers a naturalistic experimental environment suitable for the study of shopper behaviour. Intending to generalise findings to real store settings, VR can provide high external validity (Meißner *et al.*, 2019).

VR laboratory studies produce consistent and realistic consumer behaviour (Harz *et al.*, 2021). A VR experience allows participants to achieve a better and more complete understanding of the product (Naderi *et al.*, 2020). Immersive VR also reduces external variables, such as distractions or lack of realism, allows for controlling confounding effects and generates an immersive, interactive and more realistic experience. VR increases realism and choice immersion, permitting to capture the consumer's product evaluation and the actual brand choice (Esmark Jones *et al.*, 2018; Ketelaar *et al.*, 2017) and allowing the measurement of process variables that are usually hard to assess in field experiments (Ketelaar *et al.*, 2018). VR leads to high experiential control and ecological validity. Also, it opens opportunities that cannot be pursued by traditional techniques (Meißner *et al.*, 2020). When it comes to locomotion techniques in VR shopping environments, instant teleportation and motion-tracked walking are the most used (Schnack *et al.*, 2021b). Although the latter more closely simulates what happens in a real store (but at increased complexity and costs), the absence of physical walking in the instant teleportation does not seem to impact shoppers' emotional states or purchase behaviours.

VR allows easier manipulation of variables and offers an efficient and effective experimental condition. It can be applied earlier in product and packaging design (Huang *et al.*, 2021). It also offers a variety of purchase metrics and benefits that overcome the limitations of traditional methods (Schnack *et al.*, 2020). As reported by Harz *et al.* (2021), VR laboratory studies provide forecasting advantages when compared to online VR or traditional tests and can also be applied in the early stage of new product development, as companies can use a virtual blueprint for their tests.

VR represents a valuable research tool for conducting consumer behaviour experiments in the food and beverage domain. Lombart *et al.* (2019) analysed easily perishable products: it is possible to reduce waste and other issues, replicate studies more easily, ensure high control over the product stimuli and guarantee higher validity in the results. In addition, in VR, consumers can interact and manipulate products, as they could not do in other conditions.

As highlighted by Schnack *et al.* (2021a), any differences identified between physical and VR could be due to differences between subjective and objective research instruments, i.e. the nature of the instruments used to collect data. Many research studies present limitations due, for instance, to the use of self-reported measurement. Combining VR with other technologies overcomes these criticalities and increases the experiments' efficiency. Bernritter *et al.* (2021) combined eye-tracking and VR to track the gaze of participants and understand what they were looking at during the experiment. Bigné *et al.* (2016) integrated CAVE with tools to track eye movements and human behaviour. Huang *et al.* (2021) combined VR and resting-state functional magnetic resonance imaging to uncover the spontaneous neural basis of individual differences in product searching. Similarly, Schnack *et al.* (2021b) combined HMD with electroencephalography. Finally, Harz *et al.* (2021) used motion-tracking sensors for interactions. Meißner *et al.* (2019) also provided an examination of the advantages and disadvantages of combining eye-tracking technologies with VR, desktop and natural environments.

6. Emerging future research topics and research agenda

This section presents the key areas for future research based on the TCCM framework. A summary is proposed in Table 3. Uncovered areas of investigation and mixed findings emerge from the analysis, which needs to be addressed to build a solid corpus in this domain.

Proposed topics based on identified research gaps	Avenues for future research
Theory	
Revisit existing consumer behaviour theories and concepts in the light of VR Application of marketing theories and concepts not yet considered in VR Merge theories that can help understand consumers' interactions with products in VR Perceptions of space, depth, presence of others and crowdedness	Which theories are best suited to understanding how consumers interact with products in VR? Which theories, not yet considered, can be successfully applied? Do we arrive at different results in VR by applying theories valid in physical reality? Can dedicated theories be developed to analyse the interaction with products in VR? Which theories of consumer behaviour and product research can be merged for studies in VR? Do factors such as depth, presence of others and crowdedness influence product evaluation in VR? Do social relationships influence the way consumers interact with products in VR?
Context	
Research in different cultural contexts and generational cohorts Research on non-tangible aspects of the product (novelty, prototypicality, value, sustainability) Differences among low- and high-involvement products in VR, and among different types of stores in VR Differences between VR and physical reality Free navigation and interaction in VR, without the use of controllers Consequences of using VR devices for an extended period of time Research comparing several reality technologies and formats (VR, AR, PMR) Complement behavioural data with biometric measures	Does culture or generational differences affect product evaluation in VR? What role do non-tangible aspects of products in VR play? Are there differences between the evaluation of non-tangible aspects in VR compared to other conditions and physical reality? How do consumers evaluate low- and high-involvement products in VR? How does the type of store influence the evaluation of products in VR? How do consumers evaluate analytical product attributes, such as packaging, in VR? Are virtual products perceived differently than physical products? Is the possibility of free navigation and interaction in VR relevant in the evaluation of products in VR? What consequences does the use of VR devices for an extended period of time have when interacting with products? What peculiarities do technologies, such as VR, AR and PMR, have when interacting with products? What are the differences between them? How is it possible to complement behavioural data with biometric measures to gain a deeper understanding of consumers' product evaluations in VR?
Characteristics	
The role of cognitive engagement of VR in paying attention to specific stimuli Research analysing the role and the impact of sensory cues (touch, smell, taste) Consumer attitudes/behaviour in VR Product evaluation in VR B2B markets	Does cognitive engagement influence consumers in focussing on specific product stimuli in VR? How can sensory cues (touch, smell, taste) be analysed in the interaction with products in VR? What implications do they have on consumer response? What differences emerge with physical reality? What characteristics could product evaluation in VR have in a B2B market? What criticalities?

(*continued*)

Table 3.
Proposed topics for future research

Proposed topics based on identified research gaps	Avenues for future research
Methodology	
Field studies and non-student samples to increase external validity and generalisability	How to capture actual behaviour in VR? How to increase external validity and generalisability when it comes to product assessment in VR?
Longitudinal research to verify changes in consumer response over time	Does collecting longitudinal data in VR show a change in consumer response over time?
Qualitative studies to complement quantitative research	How can qualitative insights be gained in the study of product evaluation in VR?

Table 3. **Source:** Authors' own work

6.1 Theory: new research directions

A base theory or theoretical framework was not always identified in the reviewed articles, and often the theory was only used as a background or frame. Hedonic and utilitarian values (Alzayat and Lee, 2021; Mishra *et al.*, 2021; Peukert *et al.*, 2019), the theory of vividness (Harz *et al.*, 2021; Mishra *et al.*, 2021), the flow theory (Kim *et al.*, 2022; Han *et al.*, 2020), the affective-cognition (Kang *et al.*, 2020; Martínez-Navarro *et al.*, 2019) and the technology acceptance model (TAM; Kim *et al.*, 2021; Han *et al.*, 2020) are among the most recurrent theories .

Two main implications for future research emerge. First, scholars may revisit existing consumer behaviour theories and concepts considering VR development (Wedel *et al.*, 2020). Moreover, researchers should go further in merging theories that can help understand how consumers interact with products in VR or propose new models.

Second, future research could include theories frequently used in marketing research but rarely used or not considered in consumer behaviour studies in VR. Much work seems to be done to consolidate theoretical knowledge on this topic. Research is needed to better understand perceptions of factors such as space, depth and crowdedness in VR and how consumers' product choice are affected (Biswas, 2019). The presence of others, such as shoppers or sales assistants, or forms of social relationships, could influence individuals' behaviour in VR (Loureiro *et al.*, 2021b; Xi and Hamari, 2021; Ketelaar *et al.*, 2018). The sales assistant could also be smart and interactive, even customisable.

6.2 Context: new research directions

The reviewed studies deal with a wide variety of contexts, and three main themes emerge. First, most of the studies were conducted in the EU or USA, leaving open the possibility of discovering whether and how differences exist between consumers in different countries. Cultural backgrounds or diverse technology adoption levels (Japutra *et al.*, 2021) could play a role in product evaluation in VR, and cross-cultural studies might enhance the generalisability of the results (Utami *et al.*, 2022). Possible differences between different generational cohorts could also be interesting to discover.

Second, regarding the products used in VR studies, non-tangible aspects, such as novelty, prototypicality, value (Naderi *et al.*, 2020), sustainability or analytical attributes, such as packaging (Branca *et al.*, 2023), should be investigated. Further research could also compare the evaluation of low-involvement products with high-involvement products and consider several types of stores (Japutra *et al.*, 2021; Loureiro *et al.*, 2021b).

Third, implications arise about the technologies used. Differences between VR and physical reality should be clarified (Branca *et al.*, 2023; Pfeiffer *et al.*, 2020), as previous

literature shows that certain dissimilarities between the two conditions subsist (Naderi *et al.*, 2020; Siegrist *et al.*, 2019). Future research could also investigate the effect of navigating and interacting with products in VR without the use of controllers but through motion detection technologies. The consequences of using VR devices for an extended time could also influence consumers' reactions (Mishra *et al.*, 2021). More results on the comparison of VR with other reality technologies and formats, such as AR and PMR, are needed. VR and other reality technologies and formats offer new forms of data (Rauschnabel *et al.*, 2022) useful in understanding consumers from several perspectives (behavioural, physiological, emotional and attitudinal). Finally, VR could also be combined with other technologies to gain a deeper understanding of consumers' product evaluations and complement behavioural data with biometric measures, such as electroencephalogram, eye-tracking, heart rate, skin conductance and haptic feedback (Schnack *et al.*, 2021a; Schnack *et al.*, 2021b; van Berlo *et al.*, 2021; Schnack *et al.*, 2020).

6.3 Characteristics: new research directions

Four research directions emerge on this theme. First, future studies should address whether the high level of cognitive engagement during a VR experience can discourage consumers from paying attention to specific stimuli (Martínez-Navarro *et al.*, 2019).

Second, a promising area is the impact of sensory characteristics, such as touch, sound, fragrance and taste, on product evaluation and subsequent purchase decisions (Alzayat and Lee, 2021; Cowan *et al.*, 2021; Harz *et al.*, 2021; Loureiro *et al.*, 2021b; Ringler *et al.*, 2021). Flavián *et al.* (2021b) analyse the effect of ambient scent on the VR tourism experience, highlighting the paucity of multisensory studies in the food and beverage domain and the lack of consistency about the effect of the senses in VR experiences.

Third, mixed findings seem to be emerging. Among others, for instance, there seems to be less consensus on consumers' purchase intention (Mishra *et al.*, 2021; Park and Kim, 2021; Kang *et al.*, 2020; Martínez-Navarro *et al.*, 2019) and choice satisfaction (Mishra *et al.*, 2021; Meißner *et al.*, 2020) in VR with respect to other conditions. The importance of the visual and graphical quality of stimuli in VR (Kang *et al.*, 2020; Peukert *et al.*, 2019), as well as differences between the behaviour in a virtual store versus a real one (Kim *et al.*, 2021; Pfeiffer *et al.*, 2020; Schnack *et al.*, 2020), should be also clarified.

Finally, none of the reviewed research considers behavioural analysis in B2B markets. Future research could address this gap, revealing how product evaluation in VR occurs in the business market.

6.4 Methodology: new research directions

First, most of the reviewed articles apply the methodology of experiments. The frequency of samples consisting of students and the recourse to laboratory studies could mean that consumer behaviour in VR and the possible differences with the real world are not fully representative. Many studies call for field experiments to increase the external validity and generalisability of results. Given the diffusion of VR among consumers, a viable alternative for analysing actual behaviour could be the use of conjoint analysis (Branca *et al.*, 2023).

Second, as the rate of adherence to the technology improves over time (Mishra *et al.*, 2021), it would be appropriate to conduct longitudinal research to verify any changes in consumer response over time (Loureiro *et al.*, 2021a).

Finally, the use of qualitative studies, such as focus groups and in-depth interviews regarding product assessment in VR, could complement the knowledge obtained from quantitative studies.

7. Conclusion and limitations

VR is gaining increasing interest in the academic and business worlds and is going to revolutionise the consumer shopping experience (Meißner *et al.*, 2019). To understand consumers' attitudes and behaviours in product evaluation in VR, a systematic literature review was conducted, answering previous calls for insight into marketing-based VR applications and peculiarities in consumers' attitudes and behaviour in VR (Cowan *et al.*, 2021; Hollebeek *et al.*, 2020; Wedel *et al.*, 2020). The article reconstructs the state of the art and identifies several opportunities for future research on an evolving topic, which has produced only the first results of a strongly growing trend.

In terms of theoretical implications, the analysis revealed the main key research streams and relevant topics, resulting in four themes:

(1) the study of products in VR;

(2) the response of consumers in VR;

(3) the comparison of research on products in VR and other experimental conditions; and

(4) the peculiarities of using VR as a testing environment for products.

Based on these results and through the application of the TCCM framework, directions for future research agendas have been developed. This study contributes to systematising knowledge on product research in VR, moving from recent conceptual articles (Hollebeek *et al.*, 2020; Cowan and Ketron, 2019; Flavián *et al.*, 2019b) and addressing recent reviews that analyse VR in marketing from other perspectives. The article extends Loureiro *et al.* (2019), in which VR in manufacturing and new product development were identified among the applications of VR in marketing, and Xi and Hamari (2021), who focus on the shopping context and experience. Furthermore, it highlights promising areas of investigation that are still not covered, calling for future research and it brings out mixed findings that need to be addressed.

This article also has practical implications, informing managers and practitioners about consumers' product evaluation in VR. The reviewed studies present numerous insights for the construction of effective product offerings and shopping experiences in VR that can overcome the limitations of e-commerce (Luna-Nevarez and McGovern, 2021) and physical reality and engage consumers (Mishra *et al.*, 2021). The use of VR can have several positive impacts. It allows for offering digital and personalised experiences in stores (Cowan *et al.*, 2021), presenting products more playfully than in traditional modes (Kang *et al.*, 2020) and providing multisensory experiences (Mishra *et al.*, 2021). In VR, it is possible to generate better consumer responses than in physical environments (Martínez-Navarro *et al.*, 2019) and stimulate the willingness to try more products – and thus to support the launch of new offers or brands – by reaching consumers who seem less price sensitive in VR (Meißner *et al.*, 2020) and more inclined to impulse purchase (Schnack *et al.*, 2021a). Furthermore, the design, prototyping, development and consumer evaluation of products can be disruptively influenced by this technology (Bu *et al.*, 2021; Huang *et al.*, 2021; Hube *et al.*, 2020). Thus, VR can have an impact even before products reach the actual purchasing process. Conducting studies in VR allows for leaner and cheaper but equally effective processes (Branca *et al.*, 2023). As VR does not have the limitations of physical reality, further advantages include the possibility of expanding the boundaries of traditional experiments, obtaining greater ecological validity, controlling experimental conditions, devising rigorous processes and obtaining a wider and more complex stream of data (Harz *et al.*, 2021; Meißner *et al.*, 2020; Pfeiffer *et al.*, 2020; Schnack *et al.*, 2020; Lombart *et al.*, 2019; Meißner *et al.*, 2019).

This article is not without limitations. Given the inclusion and exclusion criteria, there can be relevant contributions not included in this paper. In addition, only high-quality journals were considered. Also, the number of articles considered in the review is not particularly high, given the emergent nature of the topic analysed. Future studies may also include conference proceedings and other types of publications to broaden the knowledge base. Finally, bibliometric analysis or other quantitative methodologies could be used to further explore this research domain.

Notes

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