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Elsholz, Sophia Patrizia; Korbel, Jakob Johannes; and Zarnekow, Rüdiger, "Shopping in a Virtual Reality: A Stimulus-Organism-Response (S-O-R) based Systematic Literature Review" (2023). *Wirtschaftsinformatik 2023 Proceedings*. 45.
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Shopping in a Virtual Reality: A Stimulus-Organism-Response (S-O-R) based Systematic Literature Review

Research Paper

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Abstract. The virtual reality (VR) technology has become increasingly relevant in recent years due to the advantages that occur through the representation of the real within a virtual world. One promising application area of VR is virtual shopping, i.e., providing customers with the ability to visit virtual stores instead of purchasing products on 2D websites or brick-and-mortar stores. To gain insights into the opportunities of the technology in the realm of shopping, we emphasize and discuss the literature on the use of VR for shopping based on a systematic literature review, thereby deepening our understanding of virtual retail concepts and synthesizing the empirical evidence on the advantages of VR. For this purpose, we developed a Stimulus-Organism-Response (S-O-R) based framework to summarize the key findings. The results comprise suggestions for VR shopping applications as well as possible future research avenues.

Keywords: virtual reality, VR, retail, shopping, SOR.

1 Introduction

In recent years, the online sale of products, i.e., E-commerce, has become increasingly important, not least because of the COVID-19 pandemic. The lockdowns during the pandemic fostered the relevance of E-commerce, as brick-and-mortar stores had to close and find new ways to distribute their products (Nistor, 2021). However, traditional online shops are associated with several disadvantages compared to shopping in brick-and-mortar stores, such as a higher perceived product risk (Lau and Lee, 2019), since the products cannot be experienced physically. One promising technological approach that is supposed to address these disadvantages in online shopping is virtual reality (VR).

While the VR technology has been the subject of research for decades, the recent developments pertaining VR hardware allow to enroll the technology to end customers at a reasonable price and low entry barriers, making it usable for consumers - especially due to the efforts of the company Meta. Currently, VR devices are primarily used for gaming, watching movies, or exercising (National Research Group, 2022), but there are many other areas where VR has a high potential, such as education (Jaziar et al., 2020), tourism (Beck et. al, 2019), and shopping (Xi and Hamari, 2021). Shopping in a VR

18th International Conference on Wirtschaftsinformatik,
September 2023, Paderborn, Germany

has several potential benefits: it does not only allow customers to feel presence in a store but is also safe and time-efficient since customers can shop from home (Hassanein and Head, 2014). In addition, users can have a better experience than in traditional online shopping, can interact with objects and can try on clothing from home. Furthermore, they can also get a feeling on how certain furniture pieces could look in real life. Due to the availability of customer-friendly hardware today, these advantages are also recognized by the customers. According to PwC, 32% of the customers using VR purchase products after testing or browsing them via VR. Another 19% of users purchase luxury goods via their devices (PwC, 2022).

The objective of this paper is to synthesize these advantages of VR for online retail by reviewing literature on shopping in VR environments. Therefore, we rely on the stimulus-organism-response (S-O-R) framework (Mehrabian and Russell, 1974). The S-O-R framework offers a valuable theoretical lens through which to understand and analyze the effects of VR on online retail. This framework posits that stimuli from the environment (such as VR characteristics) influence the internal psychological processes of individuals (cognitive and affective outcomes), which, in turn, shape their behavioral responses (purchase intentions and decisions). By adopting this framework, we aim to unravel the intricate relationships between VR characteristics, psychological outcomes, and consumer behavior in the context of online shopping. Using this framework, we can systematically analyze how specific VR features and design elements influence consumers' perceptions, emotions, and subsequent purchase intentions. Understanding these relationships not only fills a current research gap but also provides valuable insights on how VR shopping applications can be designed to create the optimal environment for purchasers and maximize companies' revenues.

To achieve the research objectives, we analyzed 43 quantitative studies pertaining VR shopping based on systematic literature review. The methodological approach, i.e., literature selection and coding process, is described in section 2, followed by a descriptive analysis. Afterwards, the studies are analyzed in section 3, and discussed by introducing a unified graph which summarizes the relevant findings in section 4.1. From this graph, we derive practical suggestions for VR shopping applications in 4.2 and a future research agenda for VR shopping in section 4.3. Finally, the results of the study are summarized in section 5.

2 Methodology

The methodology of this paper is based on the guidelines of Webster and Watson (Webster and Watson, 2002) for executing systematic literature reviews. The proposed guidelines specify the study selection process and the means of data extraction. In this section, the search strategy and selection process are described, followed by a two-step process to develop categories for the literature reviewed.

2.1 Search Strategy

To ensure a comprehensive sample of research studies, the literature search processes were conducted in the two databases Web of Science and AISeL. For both databases, the identical search string was used: ("virtual reality" OR VR) AND (shop* OR retail* OR commerce OR business). The terms were searched in the title, abstract and keywords (Web of Science) and subject in the AISeL database, respectively.

2.2 Study selection

The study selection process consisted of two phases as shown in Figure 1. In the first phase, we conducted a preliminary search in the databases Web of Science and AISeL (n = 716). A pre-screening of the initial sample set for duplicates, publications in languages other than English, and unavailable studies, resulted in the exclusion of 26 articles. In the second phase, the detailed screening, we excluded a further 647 studies due to the (1) document type, (2) year of publication, and (2) the scope of the studies. To ensure a high quality of the results, only (1) journal articles and conference proceedings were included in the study, leading to the exclusion of 55 publications (document type). In addition, although VR has been studied for decades, the first modern HMDs sold for commercial purposes were introduced in 2014 (Kushner, 2014). Therefore, studies conducted before this year were excluded, resulting in the exclusion of 235 publications. However, the highest number of publications were excluded due to scope of this study (357) based on three exclusion criteria. The first criterion pertains studies whose content is beyond the thematic scope of this literature review (286), such as medical studies, educational studies or studies that used VR for shopping, but rather to verify concepts related to brick-and-mortar stores. Criterion two relates to the methodological approaches within the articles. Since this study aims on emphasizing measurable quantitative effects, publications that do not focus on quantitative research designs (44) were excluded from the sample set. The last criterion concerns studies that investigate other technologies than VR, for example augmented reality (AR) or desktop computer screens (27). After the screening process, the final set comprises 43 publications.

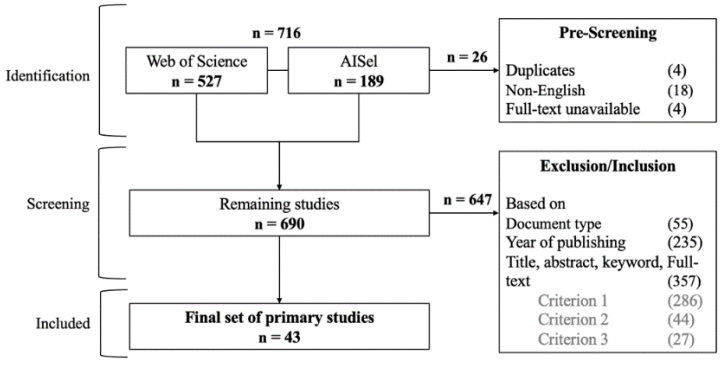

Figure 1. Study search and selection process.

2.3 Data extraction

The aim of the data extraction process is to extract the most relevant information from the final set of studies. For this purpose, we created a table containing meta information about all articles. This table included authors, year of publishing, title and abstract among other things. After collecting meta information from the relevant articles, we started an iterative process to develop a classification system. In the first step, we created further columns to have a first overview over the investigated constructs in each article. The purpose of the second iteration was to refine and improve the category system by inspecting them more closely. The resulting categories follow the S-O-R framework (Mehrabian and Russel, 1975), meaning that the categories represent specific instances of either stimulus (the input), organism (the process within humans) or response (the output). A modified version of S-O-R including VR specific aspects can be found in section 4.3. In the next phase, we used the developed category system to describe the relationships between the concepts studied in the articles. This process consisted of four steps. In the first step, all variables, their influential connection, and the direction of their connection were visualized in a unified graph. We only considered concepts that were identified as significant in the research studies. Since the number of connections between the different factors and outcomes can be considered complex, we synthesized the findings into the previously developed categories and further abstracted the connections in step three. Finally, in a fourth step, we were able to derive the S-O-R based framework that assigns the categories to one of S-O-R's main categories.

2.4 Descriptive statistic

In the following, we describe the included publications statistically in order to provide an overview on the year-wise distribution and publication outlets.

Year of publishing. As described in the methodology section, the literature review only includes studies more recent than 2014. However, the first publication in the sample is from 2017 (1). The number of publications increases after 2017, from 3 publications in 2018, to 10 in 2019, with a peak in 2020 (12 publications). The contributions slowly decline in 2021 (11). Since the selection of articles was performed in August 2022 the number of articles for 2022 is smaller than for previous years (6).

Publishing outlets. Table 1 shows the outlets in which the studies were published. The most encountered outlet is the "Journal of Business Research" (14%), followed by the "Journal of Retailing and Consumer Services" (7%). Five outlets published two papers each: "Applied Sciences", "Fashion and Textiles", "Food Research International", "Psychology & Marketing" and "Virtual Reality" (4.7% each). The remaining outlets only published one of the papers in the sample set.

Table 1. Publishers and corresponding studies

Venue/outlet	Studies	#	%
Journal of Business Reasearch	(Alzayat and Lee, 2021), (Cowan et al., 2021), (Han et al., 2020), (Meißner et al., 2020), (Pizzi et al., 2020), (van Berlo et al., 2021)	6	14,0
Journal of Retailing and Consumer Services	(Lombart et al., 2019), (Schnack et al., 2021b), (Schnack et al., 2021a)	3	7,0
Applied Sciences-Basel	(Kim and Ha, 2021), (Moghaddasi et al., 2021)	2	4,7
Fashion and Textiles	(Jang et al., 2019), (Jin et al., 2021)	2	4,7
Food Research International	(Schnack et al., 2019), (Siegrist et al., 2019)	2	4,7
Psychology & Marketing	(Hilken et al., 2022), (Mishra et al., 2021)	2	4,7
Virtual Reality	(Lau and Lee, 2019), (Su et al., 2020)	2	4,7
Behavior & Information Technology	(Wu et al., 2019b)	1	2,3
Communication Research Reports	(McCain et al., 2018)	1	2,3
Computers in Human Behavior	(Lombart et al., 2020)	1	2,3
Electronics	(Liu et al., 2020)	1	2,3
Foods	(Jacobsen et al., 2022)	1	2,3
Frontiers in Psychology	(Plechatá et al., 2019)	1	2,3
Frontiers in Robotics and AI	(Verhulst et al., 2018)	1	2,3
Heliyon	(Moes and van Vliet, 2017)	1	2,3
Human-centric Computing and Information Sciences	(Wu et al., 2019a)	1	2,3
IEEE Access	(Meirinhos et al., 2022)	1	2,3
Information Resources Management Journal	(Hsu et al., 2020)	1	2,3
Information Systems Journal	(Kinzinger et al., 2022)	1	2,3
Interacting with Computers	(Pengnate et al., 2020)	1	2,3
International Journal of Advanced Computer Science and Applications	(Dad et al., 2018)	1	2,3
Journal of Retail & Distribution Management	(Xue et al., 2020)	1	2,3
Internet Research	(Wang et al., 2019)	1	2,3
Journal of Consumer Behaviour	(Schnack et al., 2020)	1	2,3
Journal of Interactive Marketing	(Kang et al., 2020)	1	2,3
Journal of Management Information Systems	(Peukert et al., 2019)	1	2,3
Journal of Marketing Research	(Luangrath et al., 2022)	1	2,3
Journal of Product & Brand Management	(Naderi et al., 2020)	1	2,3
Journal of Research in Interactive Marketing	(Kim et al., 2021)	1	2,3
Mobile Information Systems	(Alkarney and Almakki, 2022)	1	2,3
Multimedia Tools and Applications	(Jang and Hsieh, 2021)	1	2,3
		43	

3 Results

The result section synthetizes the findings of the literature in the identified and previously defined categories (1) products, (2) device and control, (3) theories, (4) general and application dependent VR characteristics, (5) psychological outcomes, and (6) behavioral outcomes.

Products. This category lists the most common types of products offered in the VR shopping environments. Most studies focus on selling clothing or shoes (31%) and groceries (31%). In case of the latter, the customers navigate through a virtual supermarket. The third most common product category are specific kinds of food or beverage, such as cereals (16%). Less considered products are furniture (9%), kitchen appliances (4%) or tools (2%).

Device and control. The experimental settings in the studies differ in terms of the used VR devices. The type of the device determines not only the quality of the graphics but also its usability, e.g., wired head-mounted displays (HMDs) provide a higher resolution while smartphone-based VR solutions are easier to use. Most of the studies (58%) use wired HMDs. They provide the best graphics quality due to being directly

connected to a computer. From the remaining studies, the majority (33%) does not specify the device used. Smartphone-based HMDs were rarely used (7%) and only one study uses a wireless HMD that processes the application directly inside the device. The user input is mostly controlled by hand-held controllers (53%). In this category the subject holds two small wireless controllers, one in each hand. 39% of the studies do not specify the input device. Finally, only a minority of the applications were controlled by the hands of the users (5%).

Theories. The effects of VR technology can be explained by various theories. These theories can be categorized into consumer experience and acceptance theories, and cognitive theories. Prominent consumer experience and acceptance theories in the reviewed studies are the "Media Richness Theory" (20%), the "Technology Acceptance Model" (TAM) (20%) and the "Telepresence Theory" (13%). The Media Richness Theory states that the effectiveness of a communication method depends on the richness of information (Daft & Lengel, 1986). Especially VR has the potential to provide information through different channels, such as auditive signals, but also information boxes or virtual salespersons. The Technology Acceptance Model describes how the customers' perceived ease of use and usefulness of the VR technology influence their acceptance of this new shopping possibility (Davis, 1989). Lastly, the Telepresence Theory concerns technology which is intended to create a level of immersion and engagement that can evoke emotions and behaviors similar to those experienced in face-to-face interactions (Steuer, 1992). For that purpose, HMDs are very suitable due to the high perceived immersion of the screens. Cognitive theories try to find explanations for human behavior by utilizing insights into processes occurring in the human brain. The most applied of those in the literature sample is the "Flow Theory" (16%). The Flow Theory suggests that an optimal experience occurs when the challenges and skills, in the case of this study a VR experience, are in balance, leading to a state of immersive concentration and enjoyment (Csikszentmihalyi, 1990). The second most encountered theory is the "Theory of Reasoned Actions" (10%). The Theory of Reasoned Action can be applied to understand consumer behavior in VR shopping by examining the influence of attitudes, subjective norms, and perceived behavioral control on consumers' intentions (Ajzen & Fishbein, 1980), e.g., in adopting and engaging with VR shopping experiences.

General and application dependent VR characteristics. General VR characteristics deal with aspects that are related to all applications that utilize VR. In comparison to shopping in a brick-and-mortar store or a traditional online store, VR has many advantages and new features. Although the technology is the subject of research for decades, there are multiple hardware components that need to be improved to generate the best experience. In contrast to traditional online stores, VR shopping allows for a higher degree of interactivity, which is the most examined phenomenon (21%). In the reviewed studies, interactivity also includes playfulness and responsiveness. The second highest focus in the studies are usability aspects of VR devices. This includes accessibility, difficulty, and efficiency (17%). The topic of usefulness has also been a major research aspect in terms of general VR characteristics (13%). Another commonly encountered topic dealt with the informational aspect of VR devices (12%) in terms of

media richness, novelty and informativeness. Since a well working hardware is crucial for customer acceptance, several studies focusing on the hardware have been carried out (10%). For example, it was examined how the subjects rate the display, smoothness, or readability. Another focus is the environment (10%), which includes the atmosphere, vividness, and realism. Experiments show which parts of the VR experience the participants appreciate the most. The interaction between customer and system can occur in different ways. Some studies explore the influence of the input device, as well as how realistic the vicarious touch is perceived by the subjects (8%). Others include the body and how body ownership is perceived by customers (5%), the influence of movement on the experience (3%) and how subjects assess information security risks (2%). Different applications offer different ways to present products and stores. In addition, they differ in terms of design quality and additional features. The category of application dependent VR characteristics deals with all attributes that are determined by the application designers. Most of the studies explored different product features (42%). These include technical aspects like the graphical quality of the goods, but also other attributes like perceived product healthiness, attractiveness, or presentation type. The second most examined area is the store itself (21%). This includes general aesthetics and environment, as well as the ease of finding products. Some studies investigate the comfort (13%), as well as application functions, such as gestures (13%) or sounds (8%). Only a minority of studies examined the effect of avatars (4%) and personalization (4%).

Psychological outcomes. The psychological outcomes were divided into two categories: cognitive outcomes and affective outcomes. Cognitive outcomes aim to determine the effects of the stores on the human brain and the perception of the applications, which is strongly related to processes and states of the brain and the autonomic nervous system (Riedl et al., 2016). The most explored outcome variables are aspects related to the perceived value (23%). Furthermore, several studies made experiments concerning recall and learning (23%). In addition, price-related aspects were an important research topic (16%). The fourth most encountered area in terms of cognitive outcomes is activation and attention (10%). Stimulated processes such as challenge and creative thinking are further examined topics (6%). Regarding affective outcomes, i.e., theories that explain feelings and emotions of humans, the presence is the most encountered topic (29%). Presence includes social presence, physical presence, and spatial presence. The second most examined affective outcomes concern positive emotions such as arousal, satisfaction, and pleasure (23%). The hedonic motivation is examined by a minor number of studies (10%) with the aim to examine how certain VR attributes influence the perceived joy. Since the customers' attitude determines whether they will use VR technology again in the future, a large part of the reviewed literature deals with attitude towards and using VR (9%). Other experiments address the experience (7%), brand attitude (7%) and activative feelings, such as entertainment or fun (6%). Only a small number of studies examined negative feelings, like worries or stress (3%).

Behavioral outcomes. Behavioral outcomes consist of purchase attributes and behavioral intentions and actions. Purchase attributes characterize the most important

properties of the purchased products and time spent by customers on the purchase. Most of the studies focus on the total time spent in the virtual environment (26%) and the total price paid (22%). An important research aspect has been specific attributes of the bought products (22%), e.g., if the products were healthy or how high the private label share is. Some studies also investigated the total number of items bought (17%). Other research areas include the number of impulsive purchases (9%) and the shelf location of the chosen items (4%). Behavioral intentions and actions are influenced by the mental state of customers. The analyzed literature is mostly focused on the purchase intention and purchase decision (48%). This not only emphasizes the economic importance of VR shopping, but also the intention to adopt or reuse VR technology, for example for private purposes. The intention to adopt or reuse play an important role in many studies (16%). Some experiments investigated the interaction with the product, e.g., searching for more information (10%) or the general behavioral intention (10%). Lastly, articles examined the word-to-mouth intention, i.e., tell others about their experience (7%), and the intention to visit a virtual store in the future (3%).

4 Discussion

In this section, we discuss the results by synthesizing relevant constructs from the literature to derive a general framework for VR shopping based on the S-O-R-framework. Afterwards we draw on the relationships between the categories to develop practical suggestions for VR shopping applications and propose areas for potential future research.

4.1 General framework for shopping in VR

The S-O-R theory distinguishes between Stimulus, Organism, and Response (Mehrabian and Russel, 1975): The Stimulus refers to the environmental factors or events that affect an individual's behavior or experience. It can be anything that can be perceived by the senses, such as visual or auditory stimuli. In the VR shopping context, VR characteristics belong to the category Stimulus. The Organism meditates between Stimulus and Response and refers to the individual's affective and psychological outcomes in the context of VR shopping. The Response is therefore influenced by the Stimulus and Organism and refers to the observable and measurable behaviors or outcomes resulting from the interaction between the stimulus and the organism. Our VR shopping framework includes the Response subcategories behavioral intentions and purchase attributes.

Our general framework for shipping in VR assigns all examined constructs in the reviewed literature to the main S-O-R main categories, boundary conditions, or device / control. Figure 3 illustrates the significant relationships between the concepts / constructs and the number of studies that have validated a positive significance, represented by the line thickness. Concepts that contain a group of variables are bold and described below. In the graph, the concepts' input node is described by circles which are connected to other concepts to show a significant relationship. Examined

variables that belong to the category of the Stimulus are general VR characteristics and application dependent characteristics such as usability, informativeness, interactivity and the environment. Those influence cognitive and affective psychological outcomes, such as attitudes, positive and negative feelings, or presence, which in turn influence the response, consisting of behavioral intentions and purchase attributes. Examples for that category include purchase intention, behavior, and the intention to reuse the technology. Within the main S-O-R categories, there are also variable groups influencing other variables of the same category. The boundary condition age affects the usability on the one hand and positive feelings on the other hand. Device and gestures are related to variables of each of the main categories. Figure 3 shows that the S-O-R framework is appropriate to understand how VR shopping applications have an impact on consumer's cognitive and effective outcome as well as their behavior. VR shopping applications can profit from these findings and use them for implementing more appealing stores and applications. Concrete suggestions derived from our findings are explained in the next section.

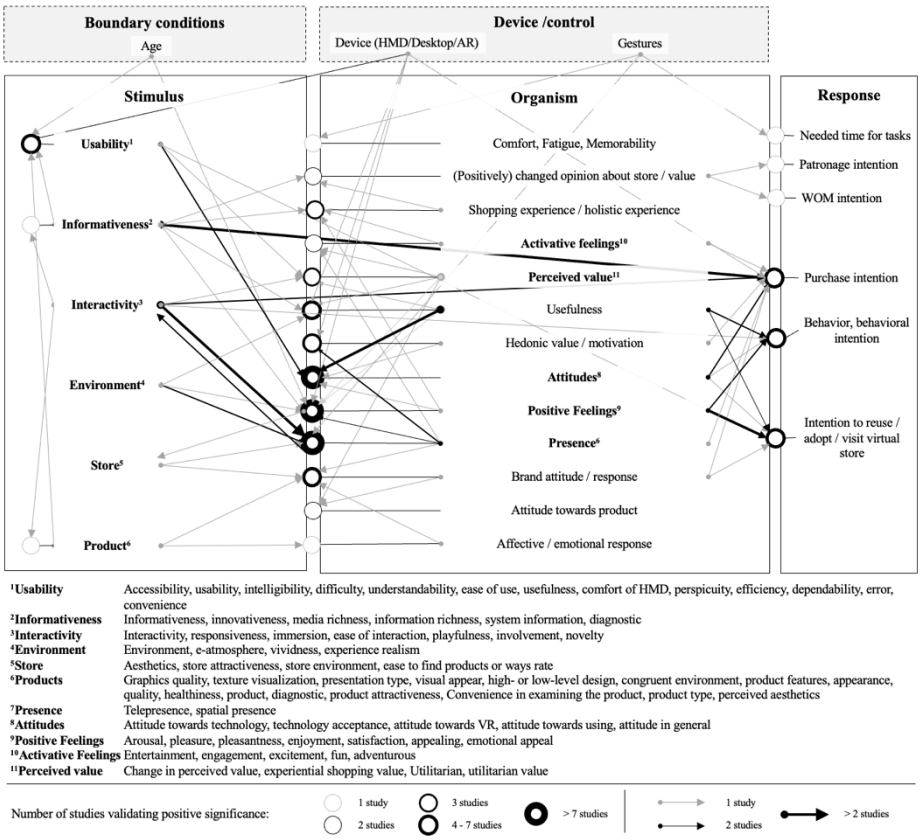

Figure 3. The aggregation of the most relevant concepts shows how different categories for VR shopping are influenced by others based on significant relationships in the reviewed literature.

4.2 Practical Implications for VR shopping applications

The results from the literature review and the developed framework allow to derive five practical implications for VR shopping applications. We deduced the implications from the relationships between concepts / constructs that have been verified as significant at least more than two times in the reviewed studies. The recommendations are based on the S-O-R framework in Figure 3, as highlighted in the texts. For example, three studies detect a positive relation between informativeness and purchase intention. Due to this positive relation, we derived the first suggestion to make use of the ability of VR to incorporate information in various ways in the stores. The five implications comprise:

1. *Include various product information in the store*. Shops should focus on how they can integrate various kinds of information **(S)** for the customers instead of merely showing the products in VR. For example, shop owners can integrate information boards close to the products in the virtual shop. The positive effect on the purchase intention **(R)** has been verified for various product types: clothing (Moes and van Vliet, 2017), groceries (Hsu et al., 2020) and furniture (Kang et al., 2020). Thus, additional information sources should be evaluated and integrated when designing VR shopping environments.
2. *Develop additional VR shops alongside traditional online stores*. Compared to other shopping possibilities like desktop or AR, VR **(S)** has the highest impact on positive feelings **(O)**. For instance, enjoyment and pleasure when shopping for clothing (Jin et al., 2021; Liu et al., 2020) or an increased intention to adapt the technology when shopping for groceries (Alkarney and Almakki, 2022) and tourism (Jang and Hsieh, 2021). Also, the behavioral intention is influenced by more positive feelings for clothing (Dad et al. 2018) and furniture (Kim et al., 2021). Thus, online shop owners are advised to offer the possibility to shop in VR next to the traditional website or AR services to utilize these advantages.
3. *Create immersive environments to build presence*. In comparison to traditional online shopping, VR applications **(S)** have the potential to create the feeling of being present in a store **(O)**. However, to create a feeling of presence, VR shopping applications need to invest in realistic and high-quality store environments to recreate the feeling of shopping in person to acquire customers that would prefer visiting brick-and-mortar stores **(R)**. The effect of immersion on presence has been observed for clothing (Jang et al., 2019) and furniture (Kim et al., 2021).
4. *Consider the usability of VR (grocery) stores*. Increasing the ease of use, for example by more intuitive gestures or introductions to applications **(S)**, helps customers to develop a positive attitude **(O)** towards virtual grocery stores (Hsu et al., 2020; Alkarney and Almakki, 2022). Through the advanced usability, the customers can focus on the immersive environment instead of getting frustrated by interaction problems, which increases the purchase intention **(R)** (Hsu et al., 2020; Lombart et al., 2020).

5. *Create interactive environments*. The more interactive an environment is designed **(S)**, the more consumers interact with the system **(R)**. VR shops need to utilize this opportunity of VR systems which can help build a more interactive store environment. For example, by integrating virtual assistants in the environment that customers can interact with or by implementing different ways of discovering additional information **(S)** which leads to a higher purchase intention **(R)** for clothing (Lau and Lee, 2019) and cameras (Naderi et al., 2020).

4.3 Future research avenues

Apart from the practical implications, the results allow the identification of research gabs that have barely been addressed in current VR shopping research. To align the future research avenues with the findings in this study, the relation to the S-O-R framework in Figure 3 is highlighted in every paragraph.

Target group analysis. Although part of the quantitative studies concerned the influence of age on the perception of VR, none of the publications investigated and determined different target groups for VR shopping. In contrast to traditional stores, VR allows to provide different shopping environments **(S)** to different kinds of customers and could thus directly be adjusted to the target audience. Since the environment has an indirect influence on purchase intention and intention to use/adopt **(R)**, potentially through the mediation of the users' internal reactions **(O)**, the relationship of environment and demographical aspects should be studied to exploit this benefit, e.g., explore specific VR shopping applications for demographic groups.

Comparison of wired and wireless HMDs. Only one study relied on wireless HMDs, i.e., the Oculus Quest (Kim and Ha, 2021). The remaining studies used wired headsets or did not provide any information about the device in use **(S)**. However, it must be assumed that the type of HMD, wired or wireless, plays a major role for customers **(O, R)**. Advantages of wireless headsets are that customers can move freely in a room and without been hindered by a physical cable. On the other hand, wireless headsets include the necessary computational units, whereas wired headsets are connected to desktop computers that are more powerful and thus can provide a higher graphical quality.

Optimal shelf locations and structures. VR allows sellers to easily expand their shops. Compared to physical stores, they can expand their store by making simple adjustments without relocating the store or pay more rent **(S)**. In the past, only little research addressed the optimal shelf locations. It was observed that purchase rates increase with higher shelf levels for regular store shelves (Schnack et al., 2020). However, the optimal shelf size and space between shelves has not been studied as well as how to structure shelfs.

Explore the social experience in VR shopping. Another possible future research avenue could be social aspects of shopping in VR. These include social experiences

(O) on the one hand and social effects **(R)** on the other hand. Social experiences can be interactive shops where customers have the possibility to talk to others, for example friends or salespeople, even though they can physically be in other parts of the world **(S)**. Such social effects only sparsely been addressed in the reviewed literature. Future studies could explore how shopping in VR is related to appreciation by others or even peer pressure **(O-R).**

Negative feelings and outcomes related to VR shopping. Many of the reviewed studies focused on positive feelings such as enjoyment, pleasure, or arousal and on activative feelings, such as entertainment or engagement. Nevertheless, only a minority of the studies focus on negative feelings related to VR technology **(O)**. The only mentioning of negative feelings relate to stress and worries about fitting problems when buying clothing (Liu et al., 2020; Schnack et al., 2021b). Future research may focus on other negative feelings, such as fear or confusion, regret, shopping addiction, or frustration after shopping in a virtual world **(O-R).**

5 Conclusion and Limitations

The aim of this study was to investigate and synthesize the evidence on the effects of VR shopping based on a systematic literature review and the S-O-R framework. For this purpose, we selected and analyzed 43 quantitative studies. In order to synthesize the publications, we classified the constructs and concepts, which showed positive significant relationships in the identified studies, into categories that have been developed in a two-step process. Subsequently, we constructed a unified graph based on S-O-R that highlights the positive relationships. Based on the unified graph, practical implications could be derived for relationships that were significant in at least two research studies. The practical implications comprise the importance of interactivity, presence, and usability in the development of VR shopping applications as well as the use of various information and the creation of VR shops alongside traditional online stores. In addition, the analysis of the publications led to the identification of five research gabs, i.e., future research avenues: the investigation of target groups, the influence of the hardware devices in use (wired, wireless), optimal shopping room design (e.g., shelf positioning), social aspects, and negative feelings and outcomes.

Apart from the practical and theoretical implications, the study has several limitations. First, the literature search was only carried out in two databases, which limits the number of accessible publications. In addition, the analyzed sample set contains no conference proceedings (excluded in the screening process). Second, no forward-backward search was performed in this study, thus additional relevant publications may not have been included in the sample set. The inclusion of additional databases and a forward-backward search may strengthen the results in this study. Third, limitations stem from the selected constructs / relationships for the practical implications. While we focus on the relationships with the highest number of validated positive significance, the remaining positive relationships have been neglected in this study. Thus, future research could focus on investigating the relationships that were validated twice or less in the reviewed studies in order to derive further theoretical and practical implications.

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