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Virtual reality, real reactions?: Comparing consumers' perceptions and shopping orientation across physical and virtual-reality retail stores

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ABSTRACT

Virtual Reality (VR) is largely associated with a positive potential in terms of both higher efficiency and higher escapism for the consumer. Whereas previous research demonstrated the importance of consumers' hedonic and utilitarian shopping orientations in traditional channels, this study examines the potential of a VR store to elicit hedonism and utilitarianism. Combining literature on VR, shopping orientation, and retailing, we develop a multiple moderated mediation model. Then, in a quasi-experimental between-subjects design, we measure levels of hedonism, utilitarianism, store satisfaction, and perceived assortment size. Participants were exposed to the same shelf in a VR-based and a physical store. We found that VR has a negative impact on satisfaction that is moderated by perceived assortment size, and that VR elicits both utilitarianism and hedonism, which mediate the impact of the channel on store satisfaction differently but equally. Overall, consumers reported high levels of all measured outcome variables after being exposed to the VR experience. In addition, behaviors in the VR-based and physical stores compare quite well.

1. Introduction

Virtual Reality (VR) allows for the reconstruction of physical objects and spaces through their digital representation (Biocca, 1992). Individuals are usually immersed in the digital environment (Sheridan, 1992) through a headset, with the relevant implication that they need not physically share the same space with the objects or the environment reconstructed through VR. Thus, it is no surprise that the market for VR hardware is gargantuan and growing, with an estimated worth of 6 billion dollars in 2020, 30 billion dollars if one also considers the market for VR software, and an estimated 171 million users by the end of 2018.² Nonetheless, research suggests that the more immersive the virtual experience, as with VR, the higher the individual's belief in truly experiencing the objects and environments in the digital setting they are interacting with (Dede, 2009), thus potentially increasing the levels of escapism and enjoyment (Yee, 2006) but also potentially helping to make the shopping experience more efficient and less time consuming (Serrano, Baños, & Botella, 2016). A well-established stream of literature has addressed escapism, enjoyment, and efficiency in terms of, respectively, hedonic

and utilitarian shopping orientations, which have been conceptualized as the experiential and the goal-oriented sides of shopping (Wolfenbarger & Gilly, 2001). In this regard, previous literature has compared shopping orientations across different channels, such as offline and online shopping environments (Scarpi, Pizzi, & Visentin, 2014). Despite the potential of VR both for enhanced engagement of human senses (Van Kerrebroeck, Brengman, & Willems, 2017b) and improved shopping efficiency, to the best of our knowledge no previous study has examined individuals' shopping orientations in terms of utilitarianism and hedonism in VR and their influence on individuals' perceptions and behaviors. Accordingly, a first contribution of the present research is to specifically address hedonism and utilitarianism in a VR setting, comparing them to a physical store environment.

The potential implications of VR for marketing research have been known since the seminal work by Needel (1998), who addressed the role of VR as a future research tool for retailers to effectively test alternative shelf layouts. In particular, VR allows obtaining results faster, a higher level of control over the environment, and more flexibility in the manipulation of shelf layout. The underlying assumption is that VR can provide unbiased estimations of individuals' behaviors and reactions in the physical environment (Needel,

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1998). Again, to the best of our knowledge, no academic studies have attempted to provide empirical support for this claim. Accordingly, the present research aims to apply VR to the study of retailing, by specifically investigating whether consumer reactions in a VR environment can provide a reliable estimate of reactions to the same layout employed in a physical store setting. Research on the suitability of VR as a market research tool is still fragmented and lacks consensus on VR's effectiveness in replicating more established research tools. Noticeably, the relatively few studies comparing physical and virtual store settings found significant differences in how consumers behaved within the store environment (e.g. how much money they spent, as in Westland & Au, 1997), or in their store perceptions (e.g. ease of store navigation, as in Vrechopoulos, O'Keefe, Doukidis, & Siomkos, 2004). No prior study has attempted to relate these specific differences to a comprehensive theoretical framework by comparing how consumers approach the store environment in terms, for instance, of shopping orientation. However, findings from recent literature suggest that individuals search for information differently when exposed to virtual or physical stores in the choice for hedonic or utilitarian products (Siegrist et al., 2018).

More recent comparisons of physical and virtual store settings agree on VR effectiveness and realism, for instance in product design evaluation (Dijkstra, Van Leeuwen, & Timmermans, 2003), reactions to crowding (Van Kerrebroeck, Brengman, & Willems, 2017), or decisions in front of a shelf (Bigné, Llinares, & Torrecilla, 2016). Given the rapid generational changeover in technology, it is possible that the lack of consensus between older and newer studies stems from the realism and immersiveness of the virtual experience. For instance, Vrechopoulos et al. (2004) were using a (then) pioneering bi-dimensional web-based reproduction of store layouts and found systematic differences between virtual and non-virtual stores. Conversely, more recent studies relying on immersive VR environments found that VR can stimulate perceptual and physiological reactions in individuals comparable to those in physical, physical environments (Peperkorn, Diemer, & Mühlberger, 2015; Shin, 2018). As a result, thanks to at least one decade of studies, we now understand better how individuals develop perceptions and react in a virtual environment (VE).

Nonetheless, the question remains whether individuals develop different perceptions or adopt different shopping orientations physical compared with in a virtual store. This is not a trivial issue: the comparability of the physical and virtual contexts would give scholars and practitioners a better understanding of the extent to which consumer orientations and perceptions measured through VR can be used as reliable estimates for physical stores.

Accordingly, the present research aims to address the research gaps left by previous studies by applying latest-generation VR technologies to the study of consumers' behaviors in a retail setting. Specifically, it compares consumer reactions to the same shelf when it is implemented in a virtual and in a physical retail store.

In the following, after reviewing the relevant literature, we present and discuss a theoretical model aimed at explaining consumer in-store reactions as a function of the channel and the shopping orientation. We test the model in the context of a large European grocery retail chain by implementing the same shelf layout of a target category (industrial confectionery) both in a physical store and in a virtual store. In addition, we test whether consumer perceptions (satisfaction, perceived assortment size), shopping orientations (utilitarian and hedonic), and behaviors (choices, time spent in front of the shelf) converge between virtual and non-virtual stores.

2. Theoretical background

2.1. Virtual Reality: immersion and presence

Consistent with Lee and Chung (2008), in the present research we adopted the definition of VR proposed by Steuer (1992, p. 76): "VR is defined as a real or simulated environment in which a perceiver experiences telepresence." According to Burdea and Coiffet (2003), VR is a computer-generated 3D environment—called a *virtual environment*—that users can navigate through and possibly interact with, resulting in real-time stimulation of one or more of the user's five senses. The term *navigate* refers to the ability to physically move around in a virtually re-constructed space, and *interact* refers to the ability to select and move objects within the VE (Gutiérrez, Vexo, & Thalmann, 2008).

Regardless of the specific definition adopted, previous studies agree that the distinctive features of VR are *immersion* and *presence* (Lee & Chung, 2008). *Immersion* refers to the extent to which individuals are stimulated by the VE while isolated from the physical one (Witmer & Singer, 1998). A technology is immersive when it blurs the boundaries between the physical and virtual worlds (Suh & Prophet, 2018). Immersive VR systems allow individuals to interact with a VE, displaying changes in the latter that depend on individual movements in the physical environment (e.g., through head-mounted displays). Non-immersive VR systems provide virtual content through computer screens and use traditional interfaces (i.e., keyboards and mice), that do not allow interactivity (Mills & Noyes, 1999).

The level of immersion influences the feeling of *presence* (Baños et al., 2004; Tussyadiah, Wang, & Jia, 2016), or "the sense of being in a virtual environment rather than the place in which the participant's body is actually located" (Sanchez-Vives & Slater, 2005, p. 333). A sign of presence is "when people behave in a VE in a way that is close to the way they would behave in a similar real-life situation" (Gutiérrez et al., 2008, p. 3). Although feelings of presence are subjective, they undoubtedly are influenced by a VR system's ability to provide high-quality data to the user's senses (Dinh, Walker, Hodges, Song, & Kobayashi, 1999; Gutiérrez et al., 2008). Thus, presence depends on the sensory *depth* (information quality within a sensory channel) and *breadth* (number of sensory dimensions simultaneously experienced) of the interface (Steuer, 1992), that in turn influence its vividness and representational quality.

Through presence, VR environments activate individuals' reactions (Peperkorn et al., 2015). This is why VR is also valuable as a marketing research tool, allowing the collecting of data in a flexible and realistic (but highly controlled) store environment that increases the external validity of lab experiments (van Herpen, van den Broek, van Trijp, & Yu, 2016) by overcoming limits of traditional experimental stimuli such as a 2D shopping website through the implementation of 3D virtual shopping environments.

2.2. Evidence from previous studies on VR

Despite the relatively long history of VR (the term was coined around 1980; Barnes, 2016), and its current advanced stage of technological development (Gartner, 2016), most studies focus on technological aspects of the tool and seem to relatively neglect behavioral and organizational issues (Suh & Prophet, 2018). As a consequence, there is a scarcity of research on VR in the consumer behavior domain (van Herpen et al., 2016), so that "an abundance of research questions on the use and effectiveness of Virtual Reality for marketing purposes remains to be addressed" (Van Kerrebroeck, Brengman, & Willems 2017, p. 440). In other words, many studies on

VR do not pay adequate attention to VR as a marketing tool (Bigné et al., 2016), which is reflected for instance in “limited evidence of practical uses of VR in a retailing context” (Bonetti, Warnaby, & Quinn, 2018, p. 2).

In addition, the studies on VR applications in marketing often provide limited immersion and presence (Siegrist et al., 2018; Van Kerrebroeck, Brengman, & Willems, 2017). Yet, the use of immersive technologies is expected to become more widespread soon, and VR is becoming more accessible to the consumer markets with the availability of affordable VR headsets. Thus, empirical studies are needed to evaluate the effects of truly immersive technology (Suh & Prophet, 2018) and to focus on consumer experiences and behaviors, rather than—for instance—having participants sit in front of PC screens, unable to walk around and interact with the VR environment (see Siegrist et al., 2018, for a review).

Immersion and presence also depend on the technological development of VR systems, which has improved dramatically in the last decade. However, studies on VR's suitability as a market research tool exhibit a broad time range—from Needel's (1998) seminal work to Bigné and colleagues' (2016)—and therefore comprise highly heterogeneous stages of computer technology development. Just as an example, Appendix A provides images of previous VR environments from 2008 (Lee & Chung, 2008), 2016 (Huang, Backman, Backman, & Chang, 2016), and the present research (2018).

Thus, it might be partly a consequence of technological development if findings from earlier studies often show consumer reactions in VR-based and physical stores to compare badly (Vrechopoulos et al., 2004; Westland & Au, 1997), whereas recent studies usually converge well in showing that immersive and realistic VR stores allow for a meaningful investigation of consumer behaviors (Bigné et al., 2016), lead to both enjoyment and feelings of ease of use (Pantano & Servidio, 2012; Pantano & Viassone, 2015), and compare well with evidence from physical stores (Siegrist et al., 2018; Waterlander, Jiang, Steenhuis, & Mhurchu, 2015).

There is high heterogeneity in previous studies on individuals' reactions to VR-based stores. Table 1 is a non-exhaustive summary of those related to VR applications in marketing and retailing.

2.3. Virtual Reality and satisfaction

Satisfaction is an evaluative judgment that can be developed by individuals even in virtual experiences (Verhagen, Feldberg, van den Hooff, Meents, & Merikivi, 2011). As such, satisfaction with a VR environment has been extensively investigated in previous studies. Taken together, these studies suggest that VR-based stores can generate satisfaction. For instance, Van Kerrebroeck, Brengman, and Willems (2017) found a positive impact of VR on store satisfaction. Similarly, Srinivasan and Srivastava (2010) suggested that the use of VR technology as a marketing tool would help create memorable shopping experiences and generate satisfaction for consumers. However, what remains unanswered is *how much* satisfaction a VR-based store could provide compared with a physical store.

On that question, the literature provides mixed findings. For instance, Schnack et al. (2018) advance that a mismatch in consumer reactions between VR-based and physical stores might be due solely to technologies not allowing enough immersion in the VE. Similarly, Slater (2009) suggests that high levels of presence should bring individuals' reactions in a VE close to those in a physical context. These studies therefore seem to assume that levels of satisfaction in VR-based and physical environments should be the same—aside from technological failures—in line with Tanriverdi and Jacob (2000) and

Tortella-Feliu et al. (2011), who found no differences in satisfaction for VR.

Other studies instead suggested that VR-based stores represent advanced points of sale that generate higher satisfaction than traditional stores (Lee & Chung, 2008; Liu, 2010) and overall lead to more positive consumer reactions such as satisfaction (Lui, Piccoli, & Ives, 2007), alone or combined with more positive attitudes (Li, Daugherty, & Biocca, 2002; Suh & Lee, 2005).

However, Pantano and Servidio (2012) showed that consumer satisfaction with VR-based stores is affected by the ease of use and the enjoyment felt from the VE, in line with Ballantine (2005), who found that the level of interactivity and information provided through the virtual interface can lead to satisfaction. Given that interactivity, information, ease of use, and enjoyment are not exclusive to VR-based stores but have been widely documented in a number of shopping environments both offline and online (see Scarpi, 2012, for a review), we expect that VR-based and physical stores should both and equally lead to satisfaction. In other words, the features leading to perceptions of functionality and enjoyment might be different in the two environments, but there is no a priori reason why VR should provide less functionality and enjoyment than a physical store, at least in realistic VR-based stores that provide feelings of immersion and presence. Accordingly, the following hypothesis is advanced:

H1. Store satisfaction does not change between the physical and the virtual store.

2.4. Virtual Reality and shopping orientation

Previous studies showed that consumers expect new technologies to contribute both the functional and experiential side of shopping in physical and virtual stores (Burke, 2002). Studies specifically addressing VR explored users' experiences in virtual store simulations (e.g., in a virtual clothing store, as in Papagiannidis, Pantano, See-To, & Bourlakis, 2017) and found that the overall evaluation reflects both the hedonic and the utilitarian side of the shopping experience (Hassouneh & Brengman, 2015).

Utilitarianism has been previously defined as “ergic, task-related and rational” (Scarpi, 2012, p. 54), reflecting a purchase orientation driven more by efficiency and rationality (Chaudhuri, Aboulnasr, & Ligas, 2010; Griffi, Babin, & Modianos, 2000). If time and task efficiency are the main expected benefits from a channel by consumers adopting a utilitarian shopping orientation, it follows that the VR channel might positively influence levels of utilitarianism thanks to its efficiency. More specifically, literature has identified several areas through which VR favors higher efficiency in the shopping experience, such as route definition (Spiers, Sakamoto, Elliott, & Baumann, 2008), easiness in locating products by engaging vision (Serrano et al., 2016), high-quality product browsing that facilitates brand comparisons (Bigné et al., 2016), and product information acquisition (e.g., the ability to look at products from 360°, as in Walsh & Pawlowski, 2002), which allow consumers to accurately anticipate the consequences of product choice and use (Jeandrain, 2001).

Accordingly, we hypothesize as follows:

H2. The virtual channel enhances consumers' utilitarian shopping orientation.

Hedonism, on the other hand, has been defined as consumers' tendency to enjoy spending time shopping (Holbrook & Hirschman, 1982), so that consumers with a hedonic shopping orientation could enjoy VEs because of the unique features of this technology, such as the immersiveness (Pantano & Servidio, 2012), the presence, and the ability to engage all human senses including vision and hearing (Walsh & Pawlowski, 2002), providing vividness and representational richness (Steuer, 1992).

Table 1

Some relevant studies related to the application of Virtual Reality in marketing and retailing.

Reference	Research method	Independent variable(s)	Dependent variable(s)	Main empirical findings
Barnes (2016)	Review	Virtual reality (VR) use, psychological drivers, social factors	Marketing practices, consumer engagement in VR experiences	NA
Bonetti et al. (2018)	Review	Motives, applications, and implementation of AR and VR by retailers, consumer acceptance	Future research agenda on VR applications in retail	NA
Bigné et al. (2016)	Experimental	Attention, eye movement speed, time spent on the first purchase	Variety-seeking behavior, additional brand purchases within the product category, number of brand choices within the product category, number of purchases of other brands (different from the first purchase) within the product category	High level of attention to a brand and slow eye movements between brands lead to additional purchases
Bressoud (2013)	Experimental	Store type (VR vs. experimental real store)	Attitude toward innovative product, purchase intention, time spent purchasing a product innovation, purchase rate of an innovation	Shoppers in the experimental real store found it closer to a real store than did shoppers in the virtual store, reporting a more familiar experience and more realistic behavior
Campo, Gijbsbrechts, and Guerra (1999)	Experimental	Experimental purchase data (computer simulated shopping experience) vs. real-life scanner data	Number of products purchased, purchase share of generic products, purchase of national brands	Data obtained from a virtual store environment may correspond to real-life purchases, with some biases in respect to purchase quantity, share of generic brands, and time spent for the shopping trip
Huang et al. (2016)	Experimental	Perceived ease of use, perceived usefulness of a 3D tourism site, perceptions of autonomy, competence and relatedness while navigating a 3D tourism environment	Travel intentions while experiencing a 3D tourism environment, enjoyment while experiencing a 3D tourism site, intention to visit the destination	Perceived usefulness is positively related to the experience of enjoyment; perceptions of autonomy and relatedness had positive impacts on the experience of enjoyment
Lau, Kan, and Lau (2013)	Review	Use of virtual technology in shopping practices, interactivity between virtual technology and consumers	Relationships between the technology and consumer, connectivity to consumers, consumers' perception of shopping in VEs	NA
Lee and Chung (2008)	Experimental	User interface of VR shopping malls	Customer satisfaction, convenience*, enjoyment, quality assurance (compared to the ordinary shopping mall; * = no difference between the shopping malls)	VR shopping mall supports enjoyment, quality assurance, and customer satisfaction more positively than the ordinary shopping mall
Pantano and Servidio (2012)	Experimental	Introduction of virtual and immersive technologies in traditional points of sale, ease of use, enjoyment, store perception	Enjoyment, store perception, customer satisfaction	Consumer's satisfaction with immersive environments in the traditional points of sale is influenced by perceived ease of use, provided enjoyment, and new store perception
Schnack, Wright, and Holdershaw (2018)	Experimental	Use of immersive VR technology (vs. conventional desktop technology)	Perceived telepresence, perceived level of immersion, usability	VR technology has the potential to outperform conventional desktop applications in terms of presence
Siegrist et al. (2018)	Experimental	Use of VR (shelf type: virtual vs. real), motivation (health vs. taste)	Food choice, information-seeking behavior, attention to nutrition information	With regard to evaluating and selecting foods, behavior in VR is in many aspects comparable to behavior in real life
Suh and Prophet (2018)	Review	Factors associated with immersive technology use	Framework for immersive technology use	NA
Suh and Lee (2005)	Experimental	Use of VR in web-based storefronts (VR vs. static interface); product type (virtually high experiential vs. virtually low experiential)	Consumer learning about product (actual and perceived product knowledge), attitudes toward products presented, intention to purchase products presented	Participants exhibited significantly higher levels of product knowledge, product attitude, and purchase intentions with a VR interface (compared with a static one)
van Herpen et al. (2016)	Experimental	Use of VR to simulate a grocery store	Number, variety, and type of products selected, amount of money spent, responses to price promotions, selection of products from different areas of the shelf	VR improves research realism and was shown to better represent the behavior in the physical store than the picture condition
Van Kerrebroeck, Brengman, and Willems (2017a)	Quasi-experimental	VR experience staged in a shopping mall	Attitude toward the mall, mall satisfaction, loyalty intentions, perceived crowding, approach behavior (n.s.)	Overall positive impact of the usage of VR on attitude toward the mall, mall satisfaction, and loyalty intentions (more pronounced in case of high crowding)
Van Kerrebroeck et al. (2017b)	Experimental	Use of VR for marketing communications (vs. 2D representation), vividness, attitude toward the advertisement, attitude toward the brand	Vividness level, level of presence, attitude toward the advertisement, attitude toward the brand, purchase intention	VR leads to higher vividness, presence, attitude toward the ad, attitude toward the brand, and purchase intentions compared with a 2D representation

Table 1 (Continued)

Reference	Research method	Independent variable(s)	Dependent variable(s)	Main empirical findings
Vrechopoulos et al. (2004)	Experimental	Retailing layout types (virtual store layout)	Online consumer behavior: layout perceived usefulness*, virtual store ease of use*, entertainment during shopping*, shopping time* (* = not confirmed)	Hypotheses generated from conventional retailing store layout theories do not hold in a virtual setting
Westland and Au (1997)	Experimental	Digital retailing approach/interface (catalog search, bundling, VR storefront)	Approach suitability for electronic commerce, money spent (n.s.), number of items purchased (n.s.), time spent shopping	The investigated digital shopping experiences had no significant impact on items purchased or on money spent in shopping

A “pleasurable” virtual shopping experience should hence satisfy consumers who have a more hedonistic orientation toward shopping, stimulating exploration, immersion, and entertainment. VR has been suggested to provide an immersive experience through the high sense of presence (Biocca, 1992; Serrano, Botella, Baños, & Alcañiz, 2013) that can give consumers a sense of “escapism” from everyday reality (Yee, 2006). Despite the potential drawbacks that literature has associated to VEs in terms of cybersickness, nausea, eye fatigue (Nolin et al., 2016), previous studies have nonetheless highlighted the hedonic potential of VR technology (Verhagen et al., 2011), and suggested that those drawbacks can be managed, for instance, by including real world objects and providing tactile feedback (Rebenitsch & Owen, 2016).

Accordingly, we hypothesize as follows:

H3. The virtual channel enhances consumers' hedonic shopping orientation.

2.5. Shopping orientation and store satisfaction

Individuals' subjective evaluations of the extent to which a store meets or exceeds their expectations is typically referred to as store satisfaction in the literature (Bloemer & De Ruyter, 1998), where satisfaction can be thus seen as the response to a process accounting for the value that consumers obtain from the shopping experience (Jones, Reynolds, & Arnold, 2006). After a long debate, literature in retailing focusing on shopping experience has reached agreement that both the utilitarian and the hedonic shopping orientations may lead to store satisfaction (Kesari & Atulkar, 2016), although for different reasons (Carpenter, 2008). Specifically, previous studies found that satisfaction for consumers with a utilitarian shopping orientation stems from the ability to efficiently find the products one seeks (Cottet, Lichtlé, & Plichon, 2006), the fulfillment of task-oriented activities (Hoffman & Novak, 2009), and the minimization of shopping time (Babin, Darden, & Griffi, 1994). The hedonic shopping orientation, by contrast, leads to satisfaction when consumers feel they've experienced escapism, a pleasant shopping atmosphere (Cottet et al., 2006), fun, and surprise (Wolfenbarger & Gilly, 2001).

Accordingly, we advance the following hypotheses:

H4. Utilitarian shopping orientation positively affects store satisfaction.

H5. Hedonic shopping orientation positively affects store satisfaction.

Extant literature has already pointed to these relationships in physical store environments so that these hypotheses might not appear novel when referred to physical environments. However, it is the first time that hedonism and utilitarianism are investigated and related to satisfaction in a theoretical framework aimed at understanding consumer reactions to a VR-based shopping experience.

2.6. The moderating role of perceived assortment size

Consumers tend to process the same assortment differently depending on how the products are displayed (Pizzi & Scarpi, 2016). Specifically, consumers have been found to draw different inferences about product quality (Valenzuela, Raghurib, & Mitakakis, 2013), price (Inman, McAlister, & Hoyer, 1990), and popularity (Valenzuela & Raghurib, 2009) and to perceive different levels of actual assortment size (Mogilner, Rudnick, & Iyengar, 2008; Townsend & Kahn, 2014) as a function of how the assortment is organized and displayed (Hoch, Bradlow, & Wansink, 1999; Kahn & Wansink, 2004), ultimately affecting post-sales evaluations such as store satisfaction (Briesch, Chintagunta, & Fox, 2009). It follows that it is not just the actual assortment size (i.e., the total number of SKUs shelved) but rather the subjective perceptions of assortment size that drives consumer perceptions of the store (van Herpen & Pieters, 2002). Previous literature challenged the idea that larger perceived assortment sizes always leave consumers more satisfied (Broniarczyk, Hoyer, & McAlister, 1998), explaining this finding on the basis of either cognitive overload (Iyengar & Lepper, 2000), expectation disconfirmation (Diehl & Poyner, 2010), or actual assortment size (Scheibehenne, Greifeneder, & Todd, 2009). When addressing the role of perceived assortment size on the relationship between shopping orientation and satisfaction, one might consider that the relative preference for smaller product assortments may be stronger when consumers are motivated by instrumental rather than experiential goals (Aydinli, Gu, & Pham, 2012). Consumers who shop for instrumental goals, adopting a utilitarian shopping orientation, do not perceive variety positively (Babin et al., 1994), as more variety usually implies longer shopping times; those consumers tend instead to minimize shopping time. Therefore, smaller assortments should provide a greater fit with their desire for a quick shopping experience.

By contrast, variety seeking, curiosity, and the desire to explore the shopping environment at length are typical traits of the hedonic shopping orientation. In this vein, other studies advanced that choosing from larger assortments might lead consumers to perceive higher levels of satisfaction (Botti & Iyengar, 2006) because of the higher levels of enjoyment (Babin et al., 1994), freedom of choice (Kahn, Moore, & Glazer, 1987) and variety (Ratner, Kahn, & Kahneman, 1999) derived from a larger choice set. Thus, it appears reasonable to expect that store satisfaction connected with the level of hedonism characterizing the shopping experience will be enhanced by perceptions of larger assortment size. Conversely, such perceptions should have a negative impact on the relationship between utilitarian shopping orientation and store satisfaction.

More formally, we advance the following hypotheses:

H6. Higher levels of perceived assortment size weaken the relationship between utilitarianism and store satisfaction.

H7. Higher levels of perceived assortment size strengthen the relationship between hedonism and store satisfaction.

Finally, literature focusing on how assortment is displayed on shelves has typically built on the assumption that it is not just the value and amount of the merchandise that affect consumers' in-store perceptions, positing that it is the clarity—and not just the size—of the visual display that affects consumers' evaluations of the store (Reutskaja, Nagel, Camerer, & Rangel, 2011). Since the virtual channel helps enhance the visual clarity of the display (Lee & Chung, 2008) via the higher sense of control over the environment and the products shelved that improves customer decision quality (Ariely, 2000), we advance the following:

H8. Higher levels of perceived assortment size enhance the relationship between channel and store satisfaction.

2.7. The theoretical model

Overall, our hypotheses link the virtual and physical store, the hedonic and utilitarian shopping orientation, store satisfaction and perceived assortment size, referring to theories and previous findings on VR, shopping orientation, and consumer behavior in retail settings. Essentially, we hypothesize that both the virtual and the physical channel can lead to utilitarian and hedonic shopping orientations, which in turn affect satisfaction, whose level also depends on the perceived assortment size. In summary, we develop a multiple moderated mediation model, where shopping hedonism and utilitarianism mediate the relationship between channel and satisfaction, with perceived assortment size moderating the relationship between channel, hedonism, and utilitarianism—respectively—on satisfaction (Fig. 1).

3. Research methodology

3.1. Procedure

A quasi-experimental between-subjects design was implemented to test the research hypotheses. The quasi-experimental manipulation comprised two conditions of grocery store shoppers: physical and VR-based. Participants in the physical-store condition were regular shoppers randomly recruited in-store in a superstore of a large European grocery retail chain; those who participated in the VR-based condition were recruited from a panel held by a market research company. This sampling procedure ensured the representativeness of the target population of shoppers and high comparability between the two samples for the main socio-demographic profiling variables. This approach overcomes the limitation of studies comparing VR and physical store shoppers that usually recruit the VR-based participants

in way that risks self-selection biases (Van Kerrebroeck, Brengman, & Willems, 2017).

3.2. Stimulus

The same shelf layout of a target product category was used in both conditions. Industrial confectionery was selected because there is great heterogeneity between the products commonly classified within this target category, and they are typically purchased on impulse (Piacentini, MacFadyen, & Eadie, 2000). Thus, display criteria might significantly affect how consumers process the assortment and make their choices in front of the shelf.

A shelf planogram containing 95 confectionery products was developed using the card-sorting procedure by Blanchard, Aloise, and DeSarbo (2017). The preliminary adoption of the card-sorting technique ensured that the shelf layout implemented for this study was consistent with target consumers' categorization criteria for the 95-product assortment under investigation. Those 95 products constituted the actual assortment of the target category in the store considered for the analysis. The same shelf planogram was implemented in a physical store and in a virtual store that digitally recreated the physical point of sale.

In the physical-store condition, the planogram was implemented on the physical shelf for a 7-day period selected to ensure that no holidays, seasonal peaks, or other particular events occurred that could have affected sales (e.g., promotions).

In the VR-based store condition, the same shelf planogram was implemented by a company specialized in the implementation of VR environments for the retail industry (InVRsion) by modeling the same 95 products in 3D in order to reproduce them digitally in the virtual point of sale. The digital acquisition of the product images was performed by undertaking a semi-automatic modeling procedure - patented by the VR company - starting from high-resolution (6K) pictures of each product placed on a rotating platform that allows taking 360° pictures of the same object. Then, AI-based space carving techniques were applied in order to automatically detect the shape of each object and to assign textures to each model accordingly. To ensure maximum fidelity in the VR scenario, and to allow comparison between VR-based and physical points of sale, we also reproduced the sales environment of the physical store (shelves, flooring, lighting, spaces, etc.) through a real time rendering software (Shelfzone) - based on Unreal Engine VR Editor - that allows a rendering pipeline at a constant 90 fps framerate.

Price labels were also controlled to ensure complete correspondence between physical and virtual shelves. A virtual room was then set up in a location separate from the physical store, where the participants recruited from the panel were scheduled an appointment. The tools used in the VR setting were an HTC-Vive headset and two controllers acting as "virtual hands" that simulated touch by vibrating when participants contacted virtual objects (e.g., if they touched a shelf), and a computer with the retail-space simulator software (ShelfZone).

3.3. Sampling

In the physical-store condition, 50 consumers (quota sampling, 56% females, mean age 45 (S.D. = 14)) were recruited during a 7-day period while leaving the industrial confectionery products aisle—thus, after their shopping experience. Participants were selected whether they bought something or not: the only "screening" condition was that they had stopped their cart at least once in front of the shelf (the ratio of the screening was intended to exclude from the sample consumers who merely traveled down that aisle). In the VR-based store condition, 50 participants (50% females, mean age 43

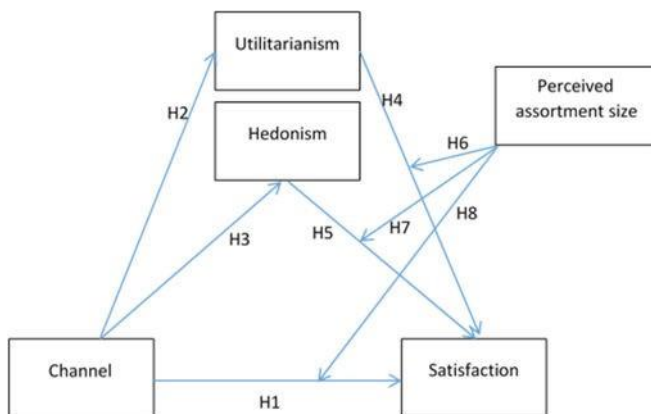


Fig. 1. The theoretical model.

(S.D. = 10)) were recruited through a market research company. The recruiting company scheduled 50 appointments over a 7-day period.

Participants were selected to obtain a sample sufficiently varied in age, gender, and household composition, and to reflect in both experimental conditions the target customers of the considered product category. They received a coupon in exchange for their participation.

3.4. Measures

In the VR-based store condition, after an initial unrelated training task to familiarize them with the VR tools and interface, participants were placed in the VR-based store in front of the industrial bakery shelf. Participants were told that they could choose which and how many products to buy and how long to stay in the aisle. Both in physical and in the virtual store conditions, respondents were left free not to choose any item if they felt so. This procedure overcomes limitations of previous studies where, in some cases, consumers were exposed to the VR condition for only a very limited time (e.g., 3 min, as in Van Kerrebroeck, Brengman, & Willems, 2017). The VR software automatically recorded which products participants purchased and the time they spent in front of the shelf. In the physical-store condition, these measures were recorded by two research assistants.

After completing their shopping experience, either in the physical or in the VR-based store, participants were asked to complete a questionnaire to allow us to investigate whether results from the two different channels converge. Specifically, two research assistants administered a questionnaire asking respondents to assess, using 7-point Likert scales, (a) their overall satisfaction with the store (adapted from Bloemer & De Ruyter, 1998), (b) the perceived assortment size (adapted from Diehl & Poynor, 2010), and (c) their levels of hedonic and utilitarian shopping orientation (adapted from Babin et al., 1994). Cronbach's alphas for the adopted scales ranged between 0.78 and 0.88. Finally, we also measure the levels of excitement as a one item measure on a 7-point scale adapted from Wakefield and Baker (1998). Items are reported in Appendix B.

Upon completing the questionnaire, participants were thanked and debriefed.

4. Analyses and results

Participants in the VR-based store condition reported high levels of perceived realism ($M=4.54$, $SD=0.83$) on a 5-point Likert scale, suggesting the comparability of the two experimental conditions and hence of the results from the two shopping environments. Furthermore, the shopping experience in the virtual context was also characterized by high perceived levels of presence in the VE ($M=4.82$; $SD=0.39$). Participants also reported perceiving the VE as neither difficult ($M=1.78$; $SD=0.98$) nor annoying ($M=1.68$; $SD=0.94$) on two 5-point bipolar scales. Finally, the virtual channel was perceived by participants as scarcely psychologically distant ($M=3.50$; $SD=2.48$) despite the novelty of the instrument and the total lack of physical interaction between consumer, point of sale, and products. This rules out the possibility that participants mentally represented the two shopping environments by adopting different levels of construal (Liberman & Trope, 1998) that, in turn, might lead them to focus on different features of the shopping environment (Trope & Liberman, 2010).

4.1. Comparison of individuals' behaviors and perceptions in the virtual and physical stores

An initial investigation shows that participants spent more time in front of the shelf in the VR-based ($M_{VR}=131.13$ s) than in the physical store ($M_{Store}=89.18$ s; $F(1, 99)=12.51$; $p=.001$, $\eta^2=0.11$).

However, participants were exposed to the same products and shelf layout in the two experimental conditions and perceived the same assortment size ($M_{Store}=3.58$; $M_{VR}=3.43$; $F(1, 99)=0.72$; $p=.40$, $\eta^2=0.007$) and assortment order ($M_{Store}=6.42$; $M_{VR}=6.32$; $F(1, 99)=0.32$; $p=.57$, $\eta^2=0.003$). That is to say, manipulating the channel does not lead to the switching of consumers' assortment perceptions. This rules out that the different lengths of the shopping experiences can be ascribed to different assortment perceptions. Another potential explanation for such different timings could be that consumers made different choices across the two channels. To rule out this possibility, we compared the distribution of purchase quotas for each product in the VR-based store with that registered in the physical store. A Mann-Whitney non-parametric test for the comparison of two independent samples revealed no significant differences in the purchased volumes between the two channels (Mann-Whitney $U=763.50$; $p=.09$). This evidence also enhances the ecological validity of the analysis, providing further support for the ability of VR to effectively reproduce consumers' behavior in the physical point of sale. Alternatively, it is possible that participants experienced different levels of difficulty in accomplishing the task that might translate into different levels of satisfaction with the experience. Results suggest that this is not the case, since no significant difference emerged in satisfaction due to the amount of time spent in front of the shelf (values above and below the median value: $M_{longT}=4.60$; $M_{shortT}=4.80$; $F(1, 49)=2.40$; $p=.13$; $\eta^2=0.04$).

Furthermore, no significant differences emerge in store satisfaction between the two experimental conditions ($M_{Store}=4.54$; $M_{VR}=4.70$; $F(1, 99)=1.282$; $p=.26$, $\eta^2=0.01$). This finding appears to provide initial support for H1.

4.2. The multiple moderation mediation model

In line with the theoretical background, we predicted that the effect of the channel on store satisfaction would be mediated by shopping orientation (hedonism vs. utilitarianism). Furthermore, we predicted perceived assortment size to moderate the relationships between shopping orientation and store satisfaction as well as the direct relationship between channel and store satisfaction. A multiple moderated mediation analysis was conducted with the PROCESS macro for SPSS (Model 15; see Hayes, 2013). A dichotomous measure of perceived assortment was computed by means of a median split to serve as a moderator. The statistical significance of the direct and indirect effects was evaluated by means of 5000 bootstrap samples to create bias-corrected confidence intervals (CIs; 95%).

The VR-based store leads to lower levels of store satisfaction both at lower ($B=-1.23$; $p<.001$) and higher ($B=-0.53$; $p=.04$) levels of the moderator. This evidence leads us to reject H1, in that store satisfaction changes as a direct function of channel, but provides support for H8, since larger perceived assortment enhances the relationship between being exposed to the VR-based store and store satisfaction (from -1.23 to -0.53).

As advanced in H2 and H3, the virtual channel positively affects consumers' shopping orientation in terms of both utilitarianism ($B=1.03$; $p<.001$) and hedonism ($B=1.43$; $p<.001$). As hypothesized in H4 and H5, both utilitarian ($B=0.46$; $p<.001$) and hedonic ($B=0.22$; $p=.03$) shopping orientations positively affect store satisfaction. In addition, as advanced in H6, perceived assortment size moderates the relationship between utilitarianism and store satisfaction ($B=-.30$; $p=.04$), with lower levels of perceived assortment strengthening this relationship ($B_{Low_AS}=0.47$; $B_{High_AS}=0.17$). However, H7 is rejected, in that perceived assortment size does not significantly moderate the relationship between hedonism and store satisfaction ($B=0.02$; $p=.89$), although the direction of the effect is consistent with the hypothesis ($B_{Low_AS}=0.32$; $B_{High_AS}=0.35$).

The results of the PROCESS model are illustrated in Fig. 2 and summarized in Tables 2 and 3.

4.3. Ruling out alternative explanations

In order to rule out the possibility that the relationship between shopping orientation and satisfaction is affected by participants' age or gender, additional moderated mediation models were estimated with age and gender as possible moderators. Results show that neither age (partial moderated mediation index = .20, LLCI = -0.20

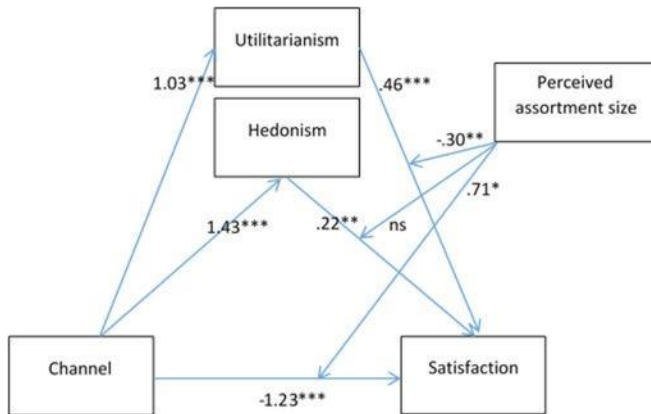


Fig. 2. The multiple moderated mediation analysis (model 15 by Hayes, 2013). **p* < .05; ***p* < .01; ****p* < .001.

Table 2 Multiple moderated mediation analysis from channel to store satisfaction.

Hypothesis	Coeff.	se	<i>t</i>	<i>p</i>	LLCI	ULCI
H1: Channel on store satisfaction	-1.23	0.28	-4.40	0.00	-1.79	-.68
H2: Channel on utilitarianism	1.03	0.20	5.13	0.00	0.63	1.43
H3: Channel on hedonism	1.43	0.20	7.11	0.00	1.03	1.83
H4: Utilitarianism on store satisfaction	0.46	0.11	4.30	0.00	0.25	0.67
H5: Hedonism on store satisfaction	0.22	0.10	2.17	0.03	0.02	0.42
H6: Moderation of perceived assortment on utilitarianism → store satisfaction	-.30	0.14	-2.06	0.04	-0.58	-0.01
H7: Moderation of perceived assortment on hedonism → store satisfaction	0.02	0.16	0.14	0.89	-0.29	0.34
H8: Moderation of perceived assortment on channel → store satisfaction	0.71	0.37	1.93	0.05	0.00	1.43

Note: LLCI = Lower limit confidence interval; ULCI = Upper limit confidence interval.

Table 3 Direct and indirect effects at the values of the moderator.

	Moderator: Perceived assortment	Eff	se	LLCI	ULCI
Utilitarianism	0	0.47	0.18	0.20	0.93
Utilitarianism	1	0.17	0.13	-0.07	0.47
Hedonism	0	0.32	0.17	0.03	0.70
Hedonism	1	0.35	0.20	0.00	0.78
Channel	0	-1.23	0.28	-1.79	-0.68
Channel	1	-0.53	0.25	-1.03	-0.03

Note: LLCI = lower limit confidence interval; ULCI = upper limit confidence interval.

ULCI = 0.48) nor gender (partial moderated mediation index = 0.39, LLCI = -0.16 ULCI = 1.03) significantly moderate the shopping orientation-satisfaction relationship, as the confidence intervals for each of the indexes contains zero (Hayes, 2018).

Furthermore, it is possible that participants spent more time in the virtual store because they were more excited by the novelty of the VR technology implemented. Indeed, data support a positive relationship between the level of excitement and the time spent in the store ($F(3, 99) = 2.815; p = .04, \eta^2 = 0.08$). To rule out that this heightened excitement affects the relationship between channel and shopping orientation, an additional moderated mediation model was estimated with excitement as possible moderator. Results show that excitement does not moderate the channel-shopping orientation relationship, as the confidence intervals for the partial moderated mediation index contains zero both at low (index = .02, LLCI = -0.03 ULCI = 0.11) and high (index = 0.04, LLCI = -0.04 ULCI = 0.16) values of the other moderator (i.e. perceived assortment) (Hayes, 2018). This finding rules out the possibility that the two channels are associated to different levels of hedonism and utilitarianism because of different levels of excitement.

5. Discussion

By means of a between-subjects experimental design, the present research aimed to address VR from the consumer's perspective, investigating the existence and the effects of shopping orientation in a VR-based store. Evidence from the present research compares well with findings from previous studies that implemented immersive VR contexts (e.g., Bigné et al., 2016) in the domains of marketing and retailing. Specifically, developing and testing a multiple moderated mediation model, this study shows that consumers' shopping orientations are affected by the virtual channel, which can lead to both utilitarianism and hedonism. Furthermore, results show that the consequences of the two different shopping orientations in the VR-based store fully adhere to predictions based on the evidence from previous investigations conducted in more traditional store settings. Namely, both hedonism and utilitarianism lead to store satisfaction, although the relationship is stronger for utilitarianism, in line with studies investigating shopping orientation in low-involvement product categories (Mano & Oliver, 1993). In addition, the present research addresses perceived—rather than actual—assortment size, in line with the suggestions by recent literature in consumer behavior (Pizzi & Scarpi, 2016). In particular, results from the present research show that assortment-size perceptions act as a moderator, with smaller perceived assortments helping utilitarian consumers to develop higher levels of satisfaction with the store. Results also show that the VR channel exerts a negative impact on store satisfaction that is, however, mitigated by perceptions of a large assortment size.

Accordingly, the contribution of this study to the literature is three-fold. First, it contributes to the literature on consumers' shopping orientation by demonstrating that utilitarianism and hedonism still hold in a VR environment, although with hedonism being more present than utilitarianism but exerting a smaller impact on store satisfaction. While it is well accepted in the literature that hedonic and utilitarian shopping orientations still hold for consumers making online purchases on e-commerce websites (Scarpi et al., 2014), although with some relevant differences from the physical shopping environment, few studies address individuals' shopping orientations in a VR-based environment. Because of the distinctive features of VR that might affect both the efficiency-related (Serrano et al., 2016) and the experiential (Yee, 2006) sides of shopping, determining whether and to what extent individual shopping orientations affect consumers' perceptions of a VR-based store is not a trivial issue. In this vein, our results provide initial evidence in favor of the existence

of both utilitarian and hedonic shopping orientations in VR-based stores, although the utilitarian side of shopping seems to dominate the hedonic side.

Second, the present research enriches the retailing literature by showing that perceived assortment size matters, and that it moderates the relationship between channel type, shopping orientation, and store satisfaction. Indeed, the present study purposely kept actual assortment size constant across the experimental conditions, finding no significant differences in assortment-size perceptions between the physical and the VR-based store conditions. In other words, although in a VR-based store consumers can look around 360° (Walsh & Pawlowski, 2002) and tackle brand comparisons more effectively (Bigné et al., 2016), this does not translate to differences in perceptions of assortment size. This finding might have some relevance to the retailing literature that addressed the role of assortment in multichannel retail strategies as a driver of consumers' channel choices (Melis, Campo, Breugelmans, & Lamey, 2015). In addition, our results provide additional evidence to those previous studies, supporting the notion that it is the perceived rather than the actual assortment size that ultimately influences consumers' perceptions and reactions in front of the shelf (Iyengar & Lepper, 2000; van Herpen & Pieters, 2002). Specifically, although the actual assortment size is the same, satisfaction with the store is less influenced by utilitarianism when consumers perceive a large assortment size.

Third, this study also contributes to the literature on human-computer interaction by empirically assessing the reliability of VR as a tool for estimating consumers' in-store perceptions and behaviors, in line with previous calls for a deeper empirical examination of the effectiveness of VR for marketing research (Van Kerrebroeck et al., 2017). Previous studies focused on many potential and fruitful applications of VR, spanning a wide range of human activities, showing that the high levels of presence and realism provided by VR enables a highly accurate simulation of individuals' behaviors (e.g., Pepperkorn, Diemer, & Mühlberger, 2015; Shin, 2018). The present work corroborates this notion and empirically tests the extent to which VR can accurately estimate individuals' perceptions and behaviors related to a shopping experience. The comparison of physical and VR-based stores shows clear evidence of similar effects in duration of the shopping experience, number, and type of product chosen. While most previous studies have relied on self-reported measures to assess the realism of VR-based environments, the present research allows us to assess the comparability of VR with the physical store channel also by looking at behavioral similarities across the channels. In addition, the present work proposes a theoretical lens to account for the observed effects of the virtual channel on individual perceptions of the store: the significant mediation found for shopping orientation suggests that individual reactions to a VR store can be ascribed both to the higher efficiency and the higher levels of immersiveness and escapism triggered by VR.

Finally, virtual store environments still represent an element of novelty for a great majority of consumers. Previous literature has documented that novelty is a significant driver of excitement that, in turn, can lead to a pleasure-oriented store patronage behavior (Kim, Fiore, & Lee, 2007). However, the novelty of the channel is only one among many other possible drivers of store excitement such as, for instance, novelty in the assortment (Ha & Lennon, 2010) or in the store layout (Poncin & Mimoun, 2014), and, in general, in the store aesthetics (Triantafyllidou, Siomkos, & Papafillipaki, 2017). Accordingly, the hedonic potential of the virtual store environment and its capability of inducing excitement can be expected not to exhaust once consumers will get more acquainted with the channel as long as the aesthetic dimensions are still able to provide pleasurable emotions.

5.1. Managerial implications

This study is not meant to be conclusive; nevertheless, we believe the results provide insights in the increasingly discussed area of VR that can be relevant for practitioners and can stimulate future research. First, managers might find it useful to know that consumer behaviors and perceptions measured through VR are reliable predictors of those in physical stores. This takes A/B testing to a whole new level of scope, cost saving, and time saving. VR can be used by practitioners to get a highly realistic estimate of the effectiveness of key variables such as assortment breadth and depth, store layout, and lighting, music, and other store atmospherics. Although the latter implications might seem to appeal especially to retailers, they also have relevant potential implications for practitioners in other industries, such as real estate agents and sellers of furniture, who would easily benefit from showing customers in VR how a house would look with different paint, different tile, or different furniture.

Second, findings from the present research suggest that hedonism and utilitarianism are both viable in a VR setting and lead to overall comparable outcomes in terms of store satisfaction. Therefore, it appears that through VR, retailers can target consumers adopting a utilitarian shopping orientation as well as those adopting a hedonic shopping orientation. Either way, the overall effect on satisfaction accounting for the direct, indirect, and moderated effects is about the same for the two shopping orientations: in the former case, the indirect impact is somewhat stronger but can be negatively affected by assortment-size perceptions; in the latter case, the indirect impact is somewhat weaker but is not further diminished by perceived assortment size.

6. Limitations and future research

Despite the use of a quasi-experimental design to investigate customer perceptions and reactions in virtual and physical shopping environments, this study is not without limitations. First, the analysis focuses on one product category (a shelf of industrial confectionery). This could also explain why the relationship between utilitarianism and store satisfaction was stronger than for hedonism, since industrial confectionery is a lower-involvement category than, for instance, apparel, where a hedonic shopping orientation might exert a stronger effect (Scarpi, 2006). Thus, future research should address categories beyond fast-moving consumer goods to increase the generalizability of the present findings. Furthermore, as VR technology will advance and become more widespread and familiar to consumers, future research could compare reactions of individuals differing on their familiarity with VR-based shopping environments. Given that hedonism is widely documented still today in very familiar shopping environments such as brick-and-mortar grocery stores and e-commerce websites (Scarpi et al., 2014), it can be expected that hedonic shopping orientation will remain a relevant antecedent of store satisfaction in virtual environments also once its novelty will decrease.

Second, objective measures were included in the present analysis, which assessed consumers' actual behavior by registering shopping times and choices. Future researches could extend this study's findings by incorporating subjective measures and qualitative interviews.

Furthermore, the present examination provides an understanding of the applicability of VR to the study of store perceptions. Notably, to increase the understanding of the potential impact of VR on marketing practice, we used a quasi-experimental study in a natural setting rather than simulations and fictional contexts. Nonetheless, this approach is based on a limited sample: hence, future research could collect larger customer bases over longer periods. Finally, the present

study purposely kept the two samples (physical vs. virtual store) independent in order to prevent self-selection biases. Future studies might consider recruiting participants for virtual store environments randomly in the physical store in order to account for potential differences in the respondents' task-orientation.

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Appendix A.



Fig. 3. Virtual-Reality-based store in Lee and Chung (2008).



Fig. 4. Virtual-Reality-based store in Huang et al. (2016).



Fig. 5. Virtual Reality in the present research.

Appendix B.

Table B.1 Measures used in the study

Construct	Items	Cronbach's Alpha
Store Satisfaction (adapted from Bloemer & De Ruyter, 1998)	Are you satisfied with the store?	.83
Perceived Assortment (adapted from Diehl & Poynor, 2010)	How much are you dissatisfied with the store you have just visited?	
Utilitarianism (adapted from Babin et al., 1994)	The industrial confectionery shelf had many options to choose from I accomplished just what I wanted to on this shopping trip	.87
Hedonism (adapted from Babin et al., 1994)	While shopping, I found just the item(s) I was looking for This shopping experience was truly a joy	.78
Excitement (adapted from Wakefield & Baker, 1998)	This shopping experience truly felt like an escape This store is: unexciting (1) – exciting (7)	

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