

Non-immersive virtual reality technologies in real estate: How customer experience drives attitudes toward properties and the service provider

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ABSTRACT

Although previous research has highlighted that virtual reality (VR) technologies can enhance customer experience, the efficacy of VR technologies in real estate remains unclear. Therefore, this study examines the effects of offering consumers a non-immersive VR experience via a widely available technology, that allows them to view real estate products. Participants accessed the website of a real estate agency that presented apartments through either static photos or interactive 360° visits. The latter condition was associated with better “visiting” experiences and more positive attitudes toward both the products and the agency. This study highlights the advantages of such technologies in enhancing customer experience and attitudes, particularly in the highly competitive real estate industry.

1. Introduction

An increasing number of studies have focused on customer experience (CX), which is defined as the “customer’s cognitive, emotional, behavioral, sensorial, and social responses to a firm’s offerings during the customer’s entire purchase journey” (Lemon and Verhoef, 2016, p.71). Offering customers rich and enjoyable experiences appears to be a good approach for marketers to develop a competitive advantage (Antéblan et al., 2013; Puccinelli et al., 2009; Rawson et al., 2013; Verhoef et al., 2009). Technological developments have increasingly provided marketers new opportunities to adopt the experiential challenge. In the service sector, both academics and practitioners have called for additional research to better understand and meet the requirements of customers who are increasingly demanding compelling experiences (Ostrom et al., 2015).

The real estate sector is particularly promising in terms of the potential benefits of adopting an experiential approach. It is a sector in which large consumer demands could be met. A distinguishing feature of the real estate industry is that the “product dimension” is accompanied by an important “service dimension.” Indeed, a real estate agency has to advertise and promote its products (i.e., properties) to potential buyers. Real estate agents must provide buyers with ample information that allows them to imagine themselves interacting with the product and fosters positive reactions toward the products and the associated service. Effectively performing this global service is inextricably linked to the

development of digital tools that have dramatically affected the industry in recent years. Among these tools, virtual reality (VR) technologies are of importance. These technologies generate an interactive virtual environment that simulates a real-life experience, and allow users to control and navigate their actions in the virtual world (Zeng and Richardson, 2016; Lee et al., 2013). In real estate, these technologies can allow consumers to teleport themselves from anywhere (in VR) directly to properties that are for sale or rent, and thus save valuable time and money by easily (re)visiting a broad range of properties before potentially seeing one or other selected properties in person. Therefore, these technologies have the potential to revolutionize this service-based industry by generating compelling CX (Rose et al., 2012).

There is, however, a dearth in the research on whether VR, in an easily usable form, can improve consumers’ perceptions of real estate products. This research examined the impact of non-immersive VR visits (consisting of interactive 360° panoramic view) on consumers’ visiting experience as well as their attitude toward both the products (i.e., apartments) and the service provider (i.e., the real estate agency). The term “non-immersive VR” used in this study refers to technologies that display virtual content via a computer screen without requiring additional equipment. Users interact with non-immersive VR using traditional interfaces, such as a mouse and keyboard. This kind of VR differs from immersive VR, which is largely based on head-mounted displays that track users’ motions and display changes accordingly, so that users are totally surrounded by enclosed virtual environments (Suh and

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Prophet, 2018; for extensive information regarding the categorization of VR technologies, see Flavián et al., 2019). This study focused on non-immersive VR and the real estate sector to provide a multifaceted contribution. It aimed at contributing to the literature on CX by investigating how experiencing a non-immersive VR technology may positively impact consumers' (1) feeling of being present in the virtual environment (i.e., presence), state of psychological immersion (i.e., escapism), and enjoyment; (2) attitude and behavioral intention toward the product; and (3) attitude toward the service provider. Additionally, the study was designed to address managerial implications for real estate service providers. This research might emphasize how using such technology could improve consumers' attitudes toward both the products and the service providers.

2. Background

2.1. VR potential for products and environments

Over the last few years, VR technologies have been increasingly applied to various fields, from educational to medical to military contexts. A growing literature is connecting VR and marketing issues (see Loureiro et al., 2018). Considering that real estate properties are both products (that agencies intend to sell) and environments (i.e., places consumers can visit), it is arguably relevant to draw on the VR literature on both products and environments to suggest a major interest VR may have for the real estate industry. With regard to product promotion, previous studies have emphasized promising VR applications. Consumers can enjoy visual and functional control of the products by using 3D image rotation, which allows for better inspection of products by viewing them from different angles (e.g., Li et al., 2002; Jiang and Benbasat, 2004). Studies suggest that such virtual product experience may improve consumer product knowledge and attitudes toward brands and enhance consumer purchase intentions (e.g., Klein, 2003; Li et al., 2002). Regarding *environments*, a major field of application relates to the retail setting. Previous studies have noted that VR will allow researchers to realistically simulate retail environments in order to examine VR's impacts on CX (e.g., pleasure, enjoyment, satisfaction) and responses to the products and the brands (e.g., attitude, purchase behaviors). Hollebeek et al. (2020) stated that VR can nurture the CX throughout customers' journey and thus has a major effect on the brand relationship quality. It has also been shown that the increased realism of a virtual store elicits consumer behavior that is more consistent with behavior in a physical store (e.g., Li and Meshkova, 2013). Another major environment-related VR application relates to the field of tourism marketing. Recent studies on using VR technologies in this field have emphasized the positive impact that VR technologies may have on CX, enjoyment, and intention to visit various destinations (e.g., Jeng et al., 2017; Tussyadiah et al., 2018; Yeh et al., 2017). For instance, Willems et al. (2019) recently found that compared to static images or to a 360° video of a city destination, offering a virtual visit via a VR headset is associated with major positive impacts, including on users' sensation of being present in the environment and purchase intentions. Such studies emphasize VR's potential to positively influence consumers in the context of products and environments. They strongly suggest the interest of VR regarding real estate products.

2.2. Theoretical model

Previous research on the use of VR in marketing has largely focused on its impact in terms of CX (e.g., Loureiro et al., 2018). This "experiential perspective" is mostly reflected in the main theoretical models used by researchers examining consumers' responses to VR stimuli. The widely used S-O-R theory (Mehrabian and Russell, 1974) focuses on the links among inputs (stimulus), processes (organism), and outputs (response).

More specifically, this account represents the stimuli (in terms of

environmental cues, such as products presented through VR technologies) influencing the organism's (i.e., consumers) emotional and cognitive states. The stimuli, in turn, create responses, such as approach or avoidance behavior (e.g., satisfaction, purchase intention). As such, unlike other theoretical accounts (e.g., flow theory), the S-O-R framework allows not only a focus on users' sense of immersion (psychological state level), but also on the consequences of immersive technology (Loureiro et al., 2018; Suh and Prophet, 2018). Thus, researchers may find the S-O-R theory to be a useful means with which to explore the factors associated with VR (e.g., Eroglu et al., 2003; Jani and Han, 2015; Kim et al., 2019; Roschk et al., 2017). In addition, recent research has emphasized that the S-O-R model is effective for predicting user behavior when using information and communication technologies (e.g., Chen and Yao, 2018; Kamboj et al., 2018; Kim et al., 2019; Wu and Li, 2018).

Concerning the organism level, affective reactions to immersive technology use may include concepts such as enjoyment, fun, pleasure, or arousal (Suh and Prophet, 2018). With regard to the cognitive state, presence is a widely used construct to account for the positive impact of VR on CX (Tussyadiah et al., 2018). Presence refers to the psychological state in which a user feels lost or immersed in the mediated environment to the degree to which the user feels physically "present" in a virtual environment (Schubert et al., 2001; Slater and Steed, 2000; Slater and Usoh, 1993; Slater and Wilbur, 1997; Steuer, 1992). Research has shown that a higher sense of presence in virtual environments has been associated with enjoyment and pleasure in interacting with this environment (Larsson et al., 2001; Li et al., 2001; Sylaiou et al., 2010). Additionally, playfulness is an interesting concept related to presence and users' experiential factors during the use of VR (e.g., Kang et al., 2020). Playfulness relates to the experience lived by participants (Holbrook, 2006) and has been considered as including two dimensions: intrinsic enjoyment, which is provided by use of technology; and escapism, which results from its use (Mathwick et al., 2001). While intrinsic enjoyment may be considered as "an end unto itself," escapism refers to "the aspect of playfulness that allows the customer to temporarily get away from it all" (Mathwick et al., 2001; Mathwick and Rigdon, 2004). Playfulness may be regarded as an appropriate construct in the study of human-computer/technology interactions because computers/technologies incorporate playful features such as multimedia, graphics, and animation (Poncin et al., 2017; Serenko and Turel, 2007). Previous research shows that playfulness has an important role in enhancing users' attitude and intention to use a website (Ahn et al., 2007). It has also been considered to be a factor that can increase user acceptance (e.g., Ha and Stoel, 2009; Kim et al., 2019; Lin et al., 2005). Additionally, in this study, playfulness was considered relevant because selling real estate properties involves consumers' ability to imagine themselves in particular properties.

With regard to users' responses associated with VR experience in the field of marketing, studies have mainly examined brand attitude (e.g., Bressoud, 2013; De Gauquier et al., 2018; Dobrowolski et al., 2014; Li et al., 2002; Suh and Lee, 2005), product knowledge (e.g., Li et al., 2002; Suh and Lee, 2005), purchase intention (e.g., Cauberghe et al., 2011; De Gauquier et al., 2018; Li et al., 2002; Papagiannidis et al., 2013; Suh and Lee, 2005; Van Kerrebroeck et al., 2017; Verhagen et al., 2014), or (virtual) purchase behavior (e.g., Bressoud, 2013; van Herpen et al., 2016; Verhulst et al., 2017; Waterlander et al., 2011, 2013, 2015; Wu et al., 2013).

This study focused on real estate products to examine how using a non-immersive VR as "stimulus" may be associated with users' positive organismic experience (i.e., presence, pleasantness, and playfulness) as well as responses that may result from such experience (i.e., attitude toward the products and the agency, and behavioral intentions). The research hypotheses were guided by findings from the VR marketing literature regarding links between users' organismic experience and consumers' responses.

3. Research hypotheses

The hypotheses developed in light of the related literature are presented in Fig. 1.

Previous research has emphasized the impact VR technologies may have on CX with regard to products or environments (e.g., Jeng et al., 2017; Suh and Prophet, 2018; Tussyadiah et al., 2018; Yeh et al., 2017). A major psychological effect relates to users' feeling of being "present" in the virtual environment (e.g., Larsson et al., 2001; Li et al., 2001; Sylaiou et al., 2010; Tussyadiah et al., 2018). Some studies have also emphasized the positive impact of VR technologies on playfulness (e.g., Kang et al., 2020; Kim and Forsythe, 2008). This resulted in the following hypotheses:

H1a. Visiting real estate properties through VR technology (vs. photos) is associated with a greater perception of presence.

H1b. Visiting real estate properties through VR technology (vs. photos) is associated with a greater experience of playfulness.

Considering previous studies that have emphasized positive impacts of VR on consumers' attitude toward environments (e.g., Jeng et al., 2017; Tussyadiah et al., 2018; Yeh et al., 2017), the authors formed the following hypothesis:

H1c. Visiting real estate properties through VR (vs. photos) is associated with a more positive attitude toward real estate properties.

VR may improve users' feelings of presence and stimulate imagination (Diemer et al., 2015; Loureiro et al., 2018; Willems et al., 2019). In addition, recent findings show the positive impacts VR technologies may have when it comes to behavioral intentions (e.g., Willems et al., 2019). Consequently, it was assumed that VR would have a positive impact on customers' intention to arrange a real visit to the properties (which is a major objective for any real estate agency):

H2a. Visiting real estate properties through VR (vs. photos) is associated with a greater intent to visit the properties for real (i.e., behavioral intention).

H2b. Higher feeling of presence experienced during the virtual visit results in a higher intention to visit the properties for real (i.e., behavioral intention).

Recent research in the field of tourism (Tussyadiah et al., 2018) suggests that the sense of being in the virtual environment directly results in improving consumers' attitudes toward the environment and that this attitude change leads to a higher intention to visit. In a synthesis of the literature Hollebeek et al. (2020) highlighted the key role of presence in gaining an in-depth understanding of CR and its influence on behavioral intentions when using RV. These previous findings of a significant positive indirect effect of VR presence on visit intention, by way of attitude change, lead to the following hypothesis:

H2c. Attitude toward the real estate product mediates the relationship

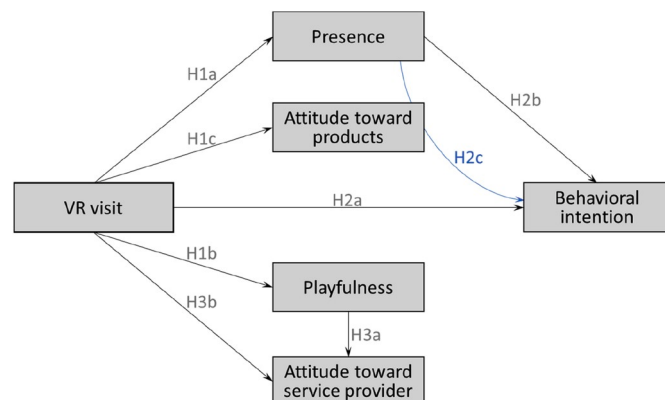


Fig. 1. Hypothesized relationships among factors.

between the feeling of presence and the intention to visit the properties for real (i.e., behavioral intention).

Service providers have to manage customers who are increasingly sensitive to compelling, enjoyable, and playful experiences (Garrett, 2006). Research has provided evidence of a link between experiencing playfulness when using a website and users' attitude toward the website. In particular, researchers have shown that playfulness has an important role in enhancing user evaluations such that it serves as a notable antecedent of attitude toward the product (Ahn et al., 2007). The authors could reasonably assume that the positive impact of experience is not restricted to users' attitude toward the product, but also holds toward the service provider:

H3a. Greater playfulness experienced during the virtual visit results in a more positive attitude toward the service provider.

H3b. Visiting real estate properties through VR (vs. photos) is associated with a more positive attitude toward the service provider.

4. Methodology

4.1. Procedure

Researchers recruited participants by phone and face-to-face contact, and participants were asked to take part in the study by clicking on a link. All participants were native speakers with normal or corrected-to-normal vision.

A total of 366 participants (232 of whom completed the experiment) took part in the study. They consisted of unpaid Belgian consumers who had been asked to participate via emails and social media who were randomly assigned to one of two conditions (i.e., visit photos vs. VR). This resulted in two equivalent groups on several key variables: gender (52% women, 48% men), time elapsed since the last real estate (product) purchase, number of previous real estate purchases ($M = 1.77$), real estate expertise ($M = 2.11$ on a five-point scale), familiarity with technology ($M = 3.67$ on a five-point scale), and involvement in the product category ($M = 4.08$ on a five-point scale). Unfortunately, they were not equal in terms of age ($M = 41$ in the photos condition, vs. $M = 37$ in the VR condition, $F(1,232) = 6.25$, $p < 0.05$).

The procedure included four stages (Fig. 2). Participants were first presented with two apartments (within-subject factor) on a computer screen through either photos or VR technology (between-subject factor). Using two properties was mainly justified by the objective of potentially adding consistency to the findings and ecological validity (as consumers rarely see only one property). An introduction screen instructed participants to imagine that they were looking for an apartment and would be presented with two apartments on sale. Instructions stated that they would subsequently be asked to answer a few simple questions regarding their general feelings about the apartments. The program would then ask participants to click on a link to the real estate agency website, which would present them with the first apartment. Then, they simply had to close this webpage once they had freely "visited" this apartment. The website featured a fictitious agency that researchers developed for the study. In the "photos condition," participants discovered the apartment through a series of 12 good-quality photos covering the different areas. In the "VR condition," participants had the opportunity to move through the apartment and use panoramic views from all visiting points (i.e., similar to exploring streets through "Google street view," except that the graphic quality was superior in the virtual visit of the apartment). Screenshots of both conditions (captured from a relatively similar vantage point) are presented in Appendix 1.

Researchers used apartments as products instead of houses because apartments are more suited for focusing on interiors (houses would have involved including more external elements relating to their façade and the layout of the gardens). Both apartments were upper-mid standing apartments of approximately 70 and 120 square meters, respectively.

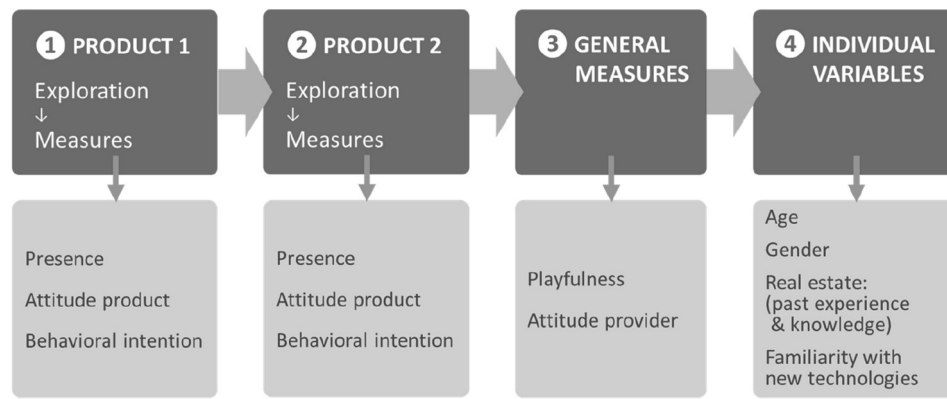


Fig. 2. Stages of the procedure.

With regard to the kind of technology used (i.e., non-immersive VR consisting of interactive 360° panoramic view), different justifications should be considered. First, this technology does not require any specific equipment from consumers (other than a computer). Therefore, beyond problems that may be associated with intrusive materials with which

users may not be familiar, the easy-to-use aspect of this technology makes it suitable for particularly broad potential marketing applications. Second, the technology allows consumers to avoid one problem still experienced in immersive VR systems; namely, the uncomfortable side effects that are sometimes associated with health conditions, such

Table 1
Measures taken at each stage of the study.

Measurement phase	Measurement scales	Items			Cronbach α	
		Number	Wording	Scale		
After each apartment Presentation	Presence (adapted from Schubert et al., 2001)	3	• Did you feel that discovering this apartment was pleasing? • While discovering this apartment, did you have the feeling of ‘being there’, inside the apartment? • Can you easily imagine yourself living in this apartment?	From <i>Not at all</i> (1) to <i>Definitely</i> (5)	0.7/0.7	
	Attitude toward the products (adapted from Batra and Stephen, 1994)	3	• Do you like this apartment? • Do you find this apartment beautiful? • Does this apartment make you dream?	From <i>Not at all</i> (1) to <i>Definitely</i> (5)	0.8/0.8	
	Behavioral intention (wish to visit for real)	1	• Do you wish to visit this apartment for real?	From <i>Not at all</i> (1) to <i>Definitely</i> (5)		
	After the two presentations and their respective measures	Playfulness (Mathwick et al., 2001)	5	<i>When you were using the website to ‘visit’ the two apartments ...</i> • You did not realize the time elapsed • You were not aware of any noise • It stimulated your curiosity • It led to your exploration of the apartments • It aroused your imagination	From <i>Strongly disagree</i> (1) to <i>Strongly agree</i> (7)	0.8
Attitude toward the service provider (adapted from Raghubir and Corfman, 1999)		4	• Do you like this real estate agency? • Does this agency appear to be trustworthy? • Does this agency appear to be innovative? • Would you recommend this agency to other people?	From <i>Not at all</i> (1) to <i>Definitely</i> (5)	0.8	
Final measures (individual variables)		Gender & Age	2			
		Past experience with and knowledge of real estate	3	1) How many properties have you purchased in your life? 2) When was the last time you purchased a property? 3) What is your level of knowledge and expertise in real estate?	1) Number of years 2) 4 response options: In the last year, 1–3 years ago, 3–5 years ago, 5–10 years ago, More than 10 years ago 3) 4 response options: You do not know anything, You have some interest in the field, You have much interest in the field (but you are not a professional working in the field), and You are a professional working in the field	
	Familiarity with new technologies	11	• 3 items from Kinard and colleagues (2009) e.g., You generally avoid using new technologies because you are not familiar with • 3 items from Rosen and colleagues (2013) e.g., You believe it is important to keep informed of the latest developments in the field of new technologies • 4 items from Poncin et al. (2017) e.g., You like testing new technologies	From <i>Strongly disagree</i> (1) to <i>Strongly agree</i> (5)	0.9	

as cybersickness. This refers to visually-induced motion sickness resulting from immersion in a computer-generated virtual world (e.g., LaViola, 2000). Typical symptoms of cybersickness include nausea, eyestrain, and dizziness (e.g., Stanney et al., 1997). Third, recent research (Higuera-Trujillo et al., 2017) has emphasized that in the context of participants' exploration of an environment, using 360° panoramas may be an effective means of closely approaching the physical environment (i.e., physical life conditions). In particular, compared to photographs or even immersive VR, this kind of technology may offer the closest to reality results, according to participants' psychological responses (e.g., presence).

After each apartment presentation, researchers asked participants to answer a series of questions pertaining to their experience during the presentation and their perception of the apartment (see Table 1). Researchers performed this procedure twice to strengthen the consistency of the findings because it accounts for the idiosyncratic nature of each apartment. Moreover, this procedure considers the general impact of the technology used during the visit on the consumer experience, attitudes, and behavioral intentions. After participants had been presented with both apartments and completed the respective measures, they answered a series of general questions relating to their visiting experience and their attitude toward the real estate agency. These general measures were performed only after the presentation of both apartments (and their respective specific measures) with the aim of addressing global experience (concerning playfulness) and because the attitude toward the service provider related to a global feeling.

The last part of the experiment included items regarding participants' individual variables.

4.2. Measures

The various measurements relating to participants' experience and responses are presented in Table 1. They consist of specific measurements taken immediately after the presentation of each property, and in general, measurements performed after the two presentations and at specific measurements phases. Every measurement, involving several items, showed a satisfactory Cronbach's Alpha. The full list of measurement scales and the associated numbers of items are presented in Table 1. Finally, the experiment included a section that addressed various individual variables (i.e., age, gender, knowledge and expertise in real estate, involvement in the product category, and familiarity with the technology).

5. Results

The authors excluded 106 participants who did not fully complete the experiment, fifteen who systematically provided identical answers (e.g., always indicating the first response option on the left, which cast doubt on their real involvement in the experiment), and thirteen who

took an abnormally long time to complete the experiment (i.e., over one hour, which was at odds with the other participants).

After data processing, 232 participants remained in the sample for analysis. In addition, during preliminary analysis, the authors checked to see if there were significant differences in time to complete the study between the two presentation modes. The authors analyzed the impacts of the presentation mode on the various measures for specific property presentation using GLM with repeated measures. In repeated measures analysis of variance, the effects of interest accounted both for within-subject effects (such as property 1 or property 2), and between-subject effects (here-presentation modes [photos vs. VR]), as well as interaction between the two types of effects (Table 2). The authors used classic ANOVA and GLM for general measurements of playfulness and attitude toward the service provider.

The results show that compared with the photos condition, the VR condition was associated with higher levels of presence during each visit (respectively $M = 3.33$ vs. $M = 3.94$ for property 1; $M = 3.25$ vs. $M = 3.80$ for property 2; see Table 2). It may be noted that the presence ratings were significantly higher for property 1 than for property 2 ($F(1,230) = 4.467$, $p < 0.05$), but that the interaction effect between within- and between-subject effects was non-significant. Consistently, compared to the photos condition, the VR condition was also associated with higher levels of playfulness (respectively $M = 3.98$ vs. $M = 4.72$; see Table 2). H1a and H1b are therefore supported by the results.

The findings relating to participants' attitudes toward the properties were also consistent with expectations (i.e., H1c). Specifically, compared to the photos condition, the VR condition induced a more positive attitude toward the properties (respectively $M = 3.32$ vs. $M = 3.49$ for property 1; $M = 3.12$ vs. $M = 3.29$ for property 2; see Table 2). This attitude was significantly higher toward property 1 than property 2 ($F(1,230) = 7.95$, $p < 0.005$), but no significant interaction effect emerged).

In addition, compared to the photo condition, higher intention to visit the properties for real was observed in the VR condition (respectively $M = 3.23$ vs. $M = 3.49$ for property 1; $M = 3.16$ vs. $M = 3.23$ for property 2; thus supporting H2a). It transpires that higher perceptions of presence increased the intention to visit in real life (adjusted $R^2 = 0.301$, $\beta = 0.779$, $p < 0.001$; confirming H2b).

Testing H2c relied on a test of mediation, using the Hayes' (2017) macro (PROCESS Model 4) with 5000 bootstraps and percentile confidence intervals (CI). The results revealed a complementary mediating role of attitude toward the product ($CI_{95\%} [0.387; 0.580]$) in the relation between presence experience and intention to visit for real. First, presence significantly and positively affected the mediator, that is, attitude toward the product ($a = 0.705$; $t = 19.04$; $p < 0.001$). Second, when controlling for presence effect, the mediator (attitude toward the real estate product), significantly and positively influenced visit intention ($b = 0.682$; $t = 11.98$; $p < 0.001$). Finally, when controlling for the impact of attitude toward real estate product, the total effect of presence on visit

Table 2

Results from GLM (with and without repeated measures) comparing responses of participants who viewed photos and those who used the VR technology.

		Condition 1: (Photos)	Condition 2: (VR)	Within-subject contrasts	Between-subject effect
		M (SD)	M (SD)	F (3,228)	F (1, 230)
		(n = 109)	(n = 123)		
Presence	Property1	3.33 (0.776)	3.94 (0.717)	4.47**	50.99***
	Property 2	3.25 (0.779)	3.80 (0.636)		
Attitude	Property1	3.32 (0.857)	3.49 (0.780)	7.95**	4.39***
	Property 2	3.12 (0.863)	3.29 (0.797)		
Behavioral intent (visit)	Property1	3.23 (1.11)	3.49 (1.07)	2.64	2.82*
	Property 2	3.16 (1.10)	3.29 (1.10)		
Playfulness		3.98 (1.13)	4.72 (1.23)		22.01***
Attitude toward the service provider		3.33 (0.59)	3.81 (0.61)		37.47**

All variables were measured on a 5-point scale ranging from "Not at all" (1) to "Definitely" (5), except Playfulness, which was measured on a 7-point scale.

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$.

All interactions between Within and Between effects were non-significant.

intention was significant and positive ($c = 0.371$; $t = 6.14$; $p < 0.001$). Therefore, H2c is supported by the results.

Regarding participants' attitude toward the service provider, compared to the photos condition, a more positive attitude emerged in the VR condition (respectively $M = 3.33$ vs. $M = 3.81$; see Table 2), thus supporting H3b. Additionally, the results show that this attitude toward the service provider was positively impacted by playfulness (adjusted $R^2 = 0.129$, $\beta = 0.193$, $p < 0.001$; supporting H3a).

The authors added age as a covariable in the GLM procedure because age was not equivalent across experimental conditions. The main effect of the presentation on presence ($F(1,230) = 44.89$, $p < 0.001$), playfulness ($F(1,230) = 20.18$, $p < 0.001$), and attitude toward the service provider ($F(1,230) = 32.14$, $p < 0.001$) remained unchanged. Virtual reality always had a significantly more positive effect regardless of age, however, after age was added as a covariable, the effect on attitude toward the product became the only significant variable at 0.1 ($F(1,230) = 1.79$, $p < 0.1$) and the effect on intention to visit was no longer significant.

Additionally, the authors tested the moderating impact of the participant's individual variables such as gender, experience with and knowledge of real estate, and familiarity with new technologies as shown by GLM (with repeated measures or not, considering the different measures and including these individual variables as fixed factors). Although the authors observed a direct effect of gender on presence ($F(1,230) = 4.38$, $p < 0.05$) and attitude toward the real estate product ($F(1,230) = 5.94$, $p < 0.05$), the main effect of presentation mode remained unchanged on presence ($F(1,230) = 53.25$, $p < 0.001$), attitude toward the real estate product ($F(1,230) = 5.04$, $p < 0.05$), behavioral intent to visit ($F(1,230) = 3.01$, $p < 0.1$), playfulness ($F(1,230) = 22.41$, $p < 0.001$), and attitude toward the service provider ($F(1,230) = 37.01$, $p < 0.001$).

In terms of real estate expertise (past experience with and knowledge of real estate), the authors observed a direct effect on presence ($F(1,230) = 4.88$, $p < 0.05$) and attitude toward the product ($F(1,230) = 2.87$, $p < 0.1$), but not on playfulness, attitude toward the service provider, and visit intention. However, the main effect of presentation mode remained unchanged on presence ($F(1,230) = 54.09$, $p < 0.001$), attitude toward the product ($F(1,230) = 4.98$, $p < 0.05$), intention to visit ($F(1,230) = 3.12$, $p < 0.01$), playfulness ($F(1,230) = 22.17$, $p < 0.001$), and attitude toward the service provider ($F(1,230) = 36.45$, $p < 0.001$). The authors did not find any moderating (interaction between expertise and presentation mode) effects to be significant.

Finally, familiarity with new technologies was revealed to be an interesting variable. This variable had a direct effect on all the key variables: presence ($F(1,230) = 23.38$, $p < 0.001$), attitude toward property ($F(1,230) = 9.90$, $p < 0.05$), intention to visit ($F(1,230) = 9.23$, $p < 0.05$), playfulness ($F(1,230) = 5.87$, $p < 0.001$), and attitude toward the service provider ($F(1,230) = 16.74$, $p < 0.001$). However, the main effect of the presentation mode was nearly unchanged with a significant impact on presence ($F(1,230) = 46.88$, $p < 0.001$), attitude toward property ($F(1,230) = 3.03$, $p < 0.1$), playfulness ($F(1,230) = 5.87$, $p < 0.001$), and attitude toward the service provider ($F(1,230) = 33.65$, $p < 0.001$). Interestingly, interaction effects were observed on presence $F(1,230) = 10.62$, $p < 0.001$ and attitude toward property $F(1,230) = 3.78$, $p < 0.05$. Familiarity with new technologies appeared to reinforce the positive effect of the VR mode on presence and attitude toward property.

6. Discussion

This study addresses how a widely available VR technology may positively impact CX as well as consumers' attitudes toward products and service providers. For this purpose, the study had participants searching for a property on a fictitious real estate agency website that presented them with two properties. While one group of participants explored the properties through a series of photos, the other group

explored them using a non-immersive VR technology offering an interactive 360° visit.

The results highlighted the significant impact of the presentation mode (i.e., photos vs. VR) on customers' "visiting" experience of the real estate products. Compared to the photos condition, the VR condition was associated with an enhanced positive experience that increased the feeling of presence and playfulness. The VR presentation also resulted in improving consumers' attitude toward the products and intention to visit the properties. Finally, it positively affected the attitude toward the service provider (even more so than the attitude toward the products), in line with Ladhari (2015), highlighting the importance of designing services with CX in mind and shifting the focus from a rational-benefit approach to a more experiential perspective.

The results also show that attitude toward the properties acts as a mediator between presence and behavioral intention (i.e., intention to visit the product in real life). In addition, the impact of using VR was not restricted to consumers' experience and attitude toward the product, as these also translated into more positive attitudes toward the service provider (predicted by playfulness - adjusted $R^2 = 0.129$, $\beta = 0.193$, $t = 5.89$, $p < 0.001$).

The authors used the control variables (i.e., gender, real estate expertise, and familiarity with new technologies) to test potential moderation effects, although they most often had a direct effect on the experience variables (such as presence or playfulness) and on attitude toward the product, and did not significantly modify the effects observed in the presentation mode effect (photos vs. VR). Thus, except for gender and familiarity with new technologies, both of which reinforce the positive impact of VR presentation presence and on attitude toward the product, most potential moderating effects were non-significant.

6.1. Theoretical implications

Researchers have devoted increasing attention to customer experience and its role on attitudes. This study responds to recent calls to better understand and improve consumers' experience in the service sector (e.g., Ostrom et al., 2015). The present study focused on CX, while also complementing this "organism" level of the S-O-R model with consumers' responses in terms of attitudes and behavioral intentions. At the "stimulus" level, the findings show that even non-immersive (and widely usable) VR technologies could have significant impacts on customer experience and responses. At the "organismic" level, this study highlights the interest in considering the concept of playfulness (in addition to presence-related items) in order to examine CX further to the stimuli presentation. This is further supported by playfulness being considered appropriate in the study of human-technology interactions (Ahn et al., 2007; Lin et al., 2005; Serenko and Turel, 2007; Poncin et al., 2017).

Additionally, at the "response" level, while previous studies have addressed various concepts such as brand attitude, product knowledge, or purchase intentions (e.g., De Gauquier et al., 2018; Suh and Lee, 2005), the present study emphasizes that customer perception toward the service provider (if applicable) might also be considered as being potentially affected by the use of VR technology. Another contribution of the present study relates to improved understanding of the relationships between experience-related factors and crucial customer attitudes. Specifically, this study provides support for the role of experience (i.e., presence and playfulness) on attitudes (toward the product and the service provider), and for the effect of these attitudes on behavioral intention—in this instance, the intention to visit the properties in real life. Furthermore, this study emphasizes the mediating role that attitude toward the product plays in the relationship between presence and behavioral intention. The present study argues for the S-O-R framework, in that it implies that the focus should lay not only on customer experience (psychological state level), but also various outcomes from the use of VR technology (Loureiro et al., 2018; Suh and Prophet, 2018).

6.2. Managerial implications

On a practical level, this study emphasizes the importance of offering consumers an enhanced experience of promoted products in order for practitioners to positively impact consumers' attitudes and behavioral intention. In addition, the results highlight that a VR experience may have an even stronger positive impact on perceptions of the service provider (than the products themselves). Using VR technology might therefore be especially important when products are accompanied by a substantial service dimension (e.g., real estate agencies), as it may be an effective means of complementing an enhanced CX with twofold positive outcomes (i.e., attitude toward the product as well as the service providers themselves).

The value of this latter outcome for the real estate industry is further strengthened in light of the "search, experience, or credence" continuum of goods, on which all goods (or services) can be placed depending on how difficult it is for consumers to evaluate them (Darby and Karni, 1973). Previous research has shown that real estate agencies clearly relate to credence services (as do legal or medical services, for instance), characterized by having important properties not easily detectable by consumers which means that they are forced to mostly rely on the advice of the seller (e.g., Bester and Dahm, 2018; Bishop and Megicks, 2002; Hsieh et al., 2005). Stated differently, as a major credence services issue relates to the expert seller knowing more about the properties of the service than the uninformed consumer himself (Bester and Dahm, 2018), consumers' attitude toward the service provider is of crucial importance. Consistently, large sections of the credence goods or services literature focus on the problem of truthful reporting by the expert (Bester and Dahm, 2018). This makes the positive impact of using VR on the attitude toward the real estate agency especially valuable.

Furthermore, such a positive attitude might arguably increase the repurchase intentions of consumers, which is essential for providers of professional services (Le and Supphellen, 2017). The scope of these practical implications is arguably enlarged by the twofold benefits of customer experience being provided to consumers who have greater familiarity with new technologies, and by the use of a widely available VR technology that does not require any specific equipment (e.g., head-mounted device) other than a computer or tablet.

These managerial implications are of importance considering that VR may help practitioners to tackle two major contemporary challenges. On the one hand, an increasing body of scientific literature emphasizes that customers are increasingly demanding and expect compelling experiences (e.g., Sipe and Testa, 2018). Hence, VR technology appears to be more effective in terms of intention to visit for real, which is the main objective of the first online virtual visit. On the other hand, in most countries real estate agencies face fierce market competition (Komosny et al., 2017). Such a difficult context confers special value on any opportunity to differentiate from competitors and to effectively enhance customer experience and attitudes. However, in light of the dramatic development in the use of VR applications, it could be argued that using VR technologies is about to become a more common practice in many business sectors. With regard to real estate specifically, reports have forecast that the virtual reality and augmented reality markets could exceed \$2.5 billion by 2025 (e.g., Goldman Sachs, 2016). This development might thus result in putting non-users at a competitive disadvantage.

6.3. Limitations and research perspectives

A limitation of this work is that certain measures relied on ad hoc or a limited number of items. This approach was adopted because of a lack of consistency in the literature in the measurement of certain concepts (e.g., presence; see for example Tussyadiah et al., 2018) and because increasing the number of items would have further increased the duration of this field study.

Moreover, the presentation of the properties focused on visual

information and did not provide the type of factual information typically included in real estate advertisements (e.g., price, living surface, number of rooms, heating system). Arguably, this lack of rational information might not have been conducive to higher-level processes in attitude formation and decision-making, which may have resulted in affectively-grounded concepts having higher weight (e.g., playfulness).

Another limitation is that the present study did not examine the impact of VR technology on changes in users' knowledge of properties (e.g., layout of the rooms, building materials). Recent research suggests that including an informational dimension should be considered by future studies. In tourism, for instance, authors have shown that experiencing destinations through VR may induce the construction of a mental image of destination attributes and its affordance (Govers et al., 2007; Nicoletta and Servidio, 2012), and may place a potential tourist in a better position to make an informed decision (Sussmann and Vanhegan, 2000, 2018; Tussyadiah et al., 2018). Still, with regard to the types of VR impacts that can be measured, further insights might also be provided by indirect methods such as neurophysiological techniques. For instance, pupil dilation or galvanic skin response analysis could provide relevant data regarding, respectively, the affective valence and intensity regarding customers' visiting experience and attitudes (e.g., Juvrud et al., 2018; Ramsøy et al., 2017).

The study's focus on a specific product/service category inevitably involves another limitation: it is unclear whether the findings may readily apply to other business areas. Furthermore, within the real estate sector, the impacts of the VR technology used may differ according to the kinds of properties. VR technologies may arguably be of specific interest for higher-standing properties, for which it might be particularly impactful to provide customers an improved experience of their attractiveness. Comparing the impact of VR technologies depending on the properties standing was not addressed in the present experiment and certainly deserves attention in future studies.

Future studies could also examine the potential moderating effects of various personality traits (e.g., openness to experience, extroversion vs. introversion) on VR experience and outcomes. Finally, an obvious avenue for future research is extending the present experiment to immersive VR technologies, such as head-mounted displays. It could be assumed that the deeper immersion that would result from such technologies would further increase the resulting impacts (for instance, with regard to the inclination to visit the properties in real life).

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jretconser.2020.102175>.

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