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Enhancing the customer experience with virtual and augmented reality: The impact of content and device type

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ABSTRACT

Virtual and augmented reality are changing how companies interact with customers. However, previous research has paid little attention to compare their effectiveness. This study focuses on the perceptions of presence elicited by different types of contents (real or digital) and embodied devices (head-mounted display or smartphone), and their impact on user's pre-experiences with hotels. Results from a lab experiment show that contents with high levels of factual realism (360-degree videos) have a positive influence on perceptions of presence, ease of imagination, and visual appeal, and on booking intentions. These effects are stronger when high embodied devices (head-mounted displays) are applied. Additionally, presence positively influences ease of imagination and visual appeal, which mediate the impact of content on booking intentions. These findings stress the importance of inducing presence as a key driver for behavioral intentions in hospitality. The comparative influence of conventional VR and AR experiences is also discussed.

1. Introduction

The development of Virtual Reality (VR) and Augmented Reality (AR) technologies, referred to as the umbrella term Extended Reality (XR), is shaping company-customer relationships in innovative ways. In VR, users are fully immersed in a three-dimensional environment, triggering a real time stimulation of their senses (Guttentag, 2010; Hollebeek, Clark, Andreassen, Sigurdsson, and Smith, 2020). In AR, users are located in the physical environment and digital information is superimposed over their actual surroundings (Azuma, 1997; Rauschnabel, He, and Ro, 2018). After a period of rapid growth and development of XR technologies, a correction phase begun in 2018 (TechRepublic, 2018). In 2019, XR developers entered a professionalism and maturity stage in which, apart from launching more sophisticated devices, the creation of content and industry applications has become critical (LEK, 2019). In fact, it is expected that this stage will lead to sustainable progress over the next few years in the industry value, projected at an annual growth of 63% until 2025 (Zion Market Research, 2019). In view of the potential importance of these technologies, researchers and practitioners need to better understand how consumers respond to XR experiences to effectively address the current challenges and develop valuable propositions.

Hospitality shares certain attributes with other services (intangibility, heterogeneity, and inseparability of production and consumption; Parasuraman, Zeithaml, and Berry, 1985) that make the provision of optimal customer experiences essential (Alves, Campón-Cerro, and Hernández-Mogollón, 2019; Patrício, Fisk, and Falcão e Cunha, 2008; Teixeira et al., 2012). Booking an accommodation (e.g., hotel) is a primary element in any travel decision (Camilleri, 2018) and it involves high levels of risk and uncertainty (Casaló, Flavián, Guinalíu, and Ekinci, 2015; Guttentag, 2010). For potential guests, the information search stage is especially important (Sun, 2014). Their hospitality experiences entail high financial costs, so they strive to assess the available information to make the most suitable decision (Flavián, Ibáñez-Sánchez, and Orús, 2020). With the aim of offering superior added-value propositions, the hospitality industry has been especially immersed in the new technological wave, and new technological advances are altering their management processes (Buhalis et al., 2019). In this sense, XR technologies empower potential guests by allowing them to virtually sample the hotel services before experiencing them in real life (Bogicevic et al., in press; Loureiro et al., in press; Pillai et al., in press), acting as effective tools for information dissemination (Yung and Khoo-Lattimore, 2017; Loureiro et al., 2020a). Thus, potential guests can use XR technologies to obtain valuable information that simplifies their hotel decision-making processes (Israel, Zerres, and Tscheulin, 2019).

Despite the relevance of VR and AR technologies in the hospitality

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industry, there is a lack of research that empirically compares their effectiveness. Recently, few studies have addressed the implementation of VR in the hotel industry. These studies have analyzed the effectiveness of watching hotel-related contents with VR headsets/head-mounted displays (HMD) (Israel et al., 2019); others have compared viewing similar contents with VR HMD versus other devices (Bogicevic, Liu et al., 2021; Bogicevic, Seo, Kandampully, Liu, and Rudd, 2019; Flavián et al., 2020; Leung, Lyu, and Bai, 2020). Previous research has also confirmed the combined effect of textual online reviews and VR, which promotes booking intention (Zeng, Cao, Lin, and Xiao, 2020). However, previous tourism literature has mostly considered these technologies as a whole and do not differentiate between the content displayed and the device used (Flavián et al., 2020; Marasco et al., 2018; Tussyadiah et al., 2018b). The effects of the message (contents), along with the medium (devices), in XR experiences, is an unexplored research area (Li and Chen, 2019; Suh and Prophet, 2018), particularly the in hospitality industry (Flavián et al., 2020).

With the aim filling these gaps, this research analyzes the effects of the type of content (real or digital), together with the use of different devices (HMD or smartphones), on consumer's XR hotel pre-experiences. Specifically, following the Embodiment-Presence-Interactivity –EPI– Cube (Flavián et al., 2019a), we explore how viewing contents that differ in terms of perceived factual realism (real or digital), using devices with different levels of embodiment (head--mounted displays –HMD– or smartphones) during the XR experiences elicit perceptions of presence, ease of imagination and visual appeal, as well as booking intentions. Additionally, the influence of presence (directly and indirectly through ease of imagination and visual appeal) on booking intentions is analyzed. By comparing the effects of conventional VR and AR experiences by distinguishing the effects of contents and devices, the results of this research contribute to a better understanding of the underlying processes that explain potential guests' experiences with XR technologies in the pre-experience stage of the purchase journey. Managerially, the separate and comparative analysis of the type of content and its interplay with the device used in the XR experiences will allow hotel providers to generate better value propositions to their potential customers.

2. Theoretical framework and hypotheses

This research is grounded in the EPI Cube developed by Flavián et al. (2019a). The EPI Cube classifies technologies according to three factors that directly intervene in a human-technology interaction (HTI) (Dix, 2017): a technological factor (embodiment), a human factor (presence) and a behavioral factor derived from the HTI (interactivity). The three factors generate a three-dimensional cube where all the actual and potential technologies can be placed in accordance with their corresponding levels of these dimensions. All the technologies of the EPI Cube can be used in potential touchpoints with customers, so companies should manage their use along the different stages of the customer journey to improve and offer added-value propositions (Neuhofer, Buhalis, and Ladkin, 2014).

Previous research has addressed the role played by the technological dimension of the EPI Cube, i.e. embodiment, which is defined as the degree of integration of the technology with the human body (Flavián et al., 2019a). Specifically, it has been shown that technological embodiment has the capacity to increase the immersion of XR experiences, as well as to stimulate users at the sensory and emotional level (Flavián et al., 2019b, 2020). In this study, we focus on the human dimension of the EPI Cube, i.e. psychological presence, with the aim of moving forward the empirical validation of this theoretical proposal. Reaching presence allows potential guests to obtain insightful "try-before-you-buy" experiences (Tussyadiah et al., 2018b) and places them in a better position to evaluate their future travel experience (Wei, Qi, and Zhang, 2019), what plays an essential role in intangible industries as tourism and hospitality (Lee, Lee, Jeong, and Oh, 2020). Additionally, the levels of behavioral interactivity are kept low (control over the navigation with no capacity of modifying the surrounding environment; Flavián et al., 2019a) since in hospitality pre-experiences it is assumed that potential guests cannot modify the product (e.g., preview different rooms/facilities, but cannot choose the color of the curtains or the position of the bed). Thus, this research focuses on the human dimension of the EPI cube, perceptions of presence, while controlling for the moderating influence of technological embodiment and keeping behavioral interactivity at low levels (Flavián et al., 2019a).

Psychological presence is traditionally defined as the subjective state of being in a particular environment (Steuer, 1992), a perception which is not necessarily associated with the use of a specific technology (Hyun and O'Keefe, 2012; Thornson, Goldiez, & Lee, 2009). Therefore, despite the relevance of the medium for reaching this perception, the users' interpretation is essential to develop a sense of presence (Baños et al., 2004). Previous research has analyzed the role of technologies to induce presence states (e.g., Slater, 2009; Tussyadiah et al., 2018b; Lee et al., in press; Witmer and Singer, 1998). Several factors, including media content and device, are important to develop a sense of presence (Thornson et al., 2009). Hence, for this research, presence is defined as the subjective experience of users feeling "present" in the technology-mediated environment displayed (Steuer, 1992; Witmer and Singer, 1998). Following the EPI Cube (Flavián et al., 2019a), psychological presence is regarded as a continuum ranging from the feeling of being "here" (low presence), where the actual experience is taking place (physical environment), to the sense of being "elsewhere" (high presence), that is, wherever the technology-mediated experience is transporting the individual (virtual environment). This latter state of feeling present "elsewhere" is reached by users' consciousness being transported to the remote environment viewed, completely distinct from where they actually are (Kim and Biocca, 1997; Sanchez-Vives and Slater, 2005). This research compares how VR and AR can elicit feelings of presence by distinguishing between the content and the device implemented. Additionally, it is explored the different effects of the content alongside the device on the perceptions during the experience (ease of imagination and visual appeal) and behavioral intentions.

2.1. The direct effect of the type of content

These days, technological advances allow users to interact with many different types of contents, from cartoons and fantasy worlds to hyper-realistic contents. This research aims to advance in the scarce literature about the impact of the content in XR experiences (Li and Chen, 2019) by considering real and digital contents. In particular, we expect that differences in the perceived factual realism of the content of XR pre-experiences will affect the users' perceived presence. Several authors stress that one of the components of presence is the similarity of the content to the real world (Lombard and Ditton, 1997; Schubert, Friedmann, and Regenbrecht, 1999). Realistic contents can lead to a state of perceptual presence (Slater, 2003). However, how users perceive realism is not a unidimensional construct (Cho, Shen, and Wilson, 2012; Pouliot and Cowen, 2007). On the one hand, perceived realism can be conceived as the extent to which the users judges the content viewed as something that can been also observed in the real world (Atkin, 1983), or in other words, how well the content is plausible and *simulates* a real object (McGloin, Farrar, and Krcmar, 2011). This dimension can be referred to as perceived psychological realism (Pouliot and Cowen, 2007). On the other hand, perceptions of factual realism are defined as the judgments as to whether the content is made up or not (Nichols, 1991), that is, whether it is based on real persons, objects or events, or it has been artificially constructed (Cho et al., 2012; Pouliot and Cowen, 2007).

Due to recent technological advances, digitally constructed 3D content can be highly realistic in terms of plausibility, looking no different from a high-resolution image. Thus, we may expect no differences between the real and the digital content in terms of psychological realism;

instead, both contents are expected to differ in terms of perceived factual realism. Specifically, 360-degree videos, rather than being digitally constructed, are filmed in the real world and display factual situations (Martínez-Navarro, Bigné, Guixeres, Alcañiz, and Torrecilla, 2019). Consequently, we expect that this type of content takes users to real environments (Wagler and Hanus, 2018), leading to higher perceptions of presence than digital content, as users may sense that they are placed in real locations (Willems, Brengman, and Van Kerrebroeck, 2019). If the users perceive that the content showed is based on the real world, rather than being digitally constructed, their sense of presence will be enhanced. Thus:

H_1. : Viewing real (versus digital) contents will have a positive impact on the perceptions of presence.

Ease of imagination is a metacognitive experience consisting of how easily users perceive that a product is and how it will perform, which serves to evaluate the experience and make consumption decisions (Orús, Gurrea, and Flavián, 2017). We expect that viewing real content may allow users to more easily generate a mental preview of the environment displayed, compared to digital contents. When users perceive that a content is based on real facts and objects, the cognitive effort required to imagine the scenario presented is lower because they do not have to visualize or pretend that what is being displayed is plausible in a suspension of disbelief (Pouliot and Cowen, 2007). Thus, viewing real contents may facilitate their imagination processes (Huang, Backman, Backman, and Chang, 2016). Additionally, visual appeal is an evaluation of the experience in which visual elements are exhibited within the content displayed in the technology-mediated environment (Kirillova and Chan, 2018). The factual realism of the content shown to users affects their subsequent evaluations (Cho et al., 2012). Therefore, considering visual appeal as an essential evaluation of the experience in intangible industries as hospitality (Kirillova and Chan, 2018), real content (compared to digital) can be more appealing for users by adding visual richness to the experience (Wagler and Hanus, 2018). Furthermore, behavioral intentions are the main antecedent of actual behaviors (Ajzen, 1991). By offering a powerful simulation of how the actual experience would be with factual contents, potential customers may feel in a better position to make their decisions (Wagler and Hanus, 2018), leading to higher purchasing intentions compared to less reality-based contents. Thus, it is proposed that viewing real (compared to digital) contents will positively affect perceptions and behavioral intentions:

H2. : Viewing real (versus digital) contents will have a positive impact on the ease of imagination.

H3. : Viewing real (versus digital) contents will have a positive impact on the perceptions of visual appeal.

H4. : Viewing real (versus digital) contents will have a positive impact on booking intentions.

2.2. The moderating effect of technological embodiment

Technological embodiment is regarded as an inherent feature of every technology and it refers to the degree of integration of the device with the human body (Flavián et al., 2019a). The theory of technological mediation (Ihde, 1990) considers technological embodiment as situations in which the devices mediate users' experiences by extending the natural capabilities of their bodies, allowing them to carry out sensorial and bodily actions (Ihde, 1990; Tussyadiah et al., 2018a). This dimension has been acknowledged as an essential feature of devices for the creation of immersive experiences (Flavián et al., 2019b) and the generation of higher levels of sensory stimulation due to the closeness between the device and the senses (Flavián et al., 2021). The technological embodiment continuum of the EPI Cube (Flavián et al., 2019a) distinguishes between external (unattached to the human body) and internal devices (more attached to the human body). Previous studies have verified that individuals perceive different levels of embodiment according to the device employed, and these perceptions subsequently influence the overall user experience (e.g., Flavián et al., 2020). In this research, we consider the main devices which are currently implemented in XR experiences: HMDs and smartphones (Brito and Stoyanova, 2018; Tussyadiah et al., 2018b). Consequently, we focus on the intermediate positions of the continuum and analyze the moderating effect of the technological embodiment between low-medium positions (portable external devices, i.e., smartphones) and medium-high positions (wearable devices, i.e., HMD; Tussyadiah et al., 2018a) in the direct relationships proposed above.

Specifically, the presence continuum of the EPI Cube (Flavián et al., 2019a) argues that internal devices can improve psychological presence to a greater extent than external devices, mainly due to its immersive properties. The existing boundaries between the users and the experience when using external devices require them to make an extra mental effort to feel present in the environment displayed. Furthermore, the effect of viewing real content on ease of imagination can be reinforced with embodied devices due to the immersive and sensory capabilities of technological embodiment (Flavián et al., 2019b; 2021), what helps customers create a solid mental preview of the real experience (Cowan and Ketron, 2019; Loureiro et al., 2019). Similarly, as internal devices support the sensory-stimulating experiences due to their closeness with human senses (Biocca, 1997; Petit, Velasco, and Spence, 2019), they can strengthen the visual appeal of the experience with the real content viewed, whose main component is naturally visual (Van Kerrebroeck, Brengman, and Willems, 2017). Finally, the persuasiveness of viewing real contents can be strengthened with embodied devices due to their capacity to empower customers by providing immersive "try-before-you-buy" experiences with the content displayed, which fosters their behavioral intentions (Marasco et al., 2018; Tussyadiah et al., 2018b). Thus, it is proposed:

H5. : The effect of viewing real (versus digital) contents on (a) presence, (b) ease of imagination, (c) perceptions of visual appeal, and (d) booking intentions will be stronger with HMDs than with smartphones.

2.3. Mediating effects

In this research, presence is proposed as the underlying mechanism through which viewing real (compared to digital) content, in combination with a high embodied device, can affect potential guests' perceptions, subjective experiences, and behavioral intentions. Actual content allows customers to place themselves effectively in the environment displayed (Wagler and Hanus, 2018), so once they have processed this information and felt "there", it is easier for them to create a mental image of how the real experience would be, making the experience tangible (Cowan and Ketron, 2019). Additionally, by feeling present in the technology-mediated environment, customers can better perceive its sensory properties (Petit et al., 2019; Wagler and Hanus, 2018). This is particularly true for the visual stimuli, which are essential in any technological experience (Guttentag, 2010; Spence, Obrist, Velasco, and Ranasinghe, 2017). Consequently, the perceptions of visual appeal can be favored as psychological presence increases. Furthermore, as customers are transported to the environment displayed in their pre-experience with the real content, the actual experience is evoked, so they are provided with a robust "try-before-you-buy" experience that fosters their subsequent behavioral intentions (Wagler and Hanus, 2018). Finally, ease of imagination and visual appeal are expected to mediate the effect of presence on booking intentions. By feeling present in the technology-mediated environment, potential guests can more easily imagine how the real experience would be (Cowan and Ketron, 2019), and this state ultimately determines their subsequent behavior (Wei et al., 2019). In addition, when customers feel present in the technology-mediated experience, they can better perceive its visual appeal (Petit et al., 2019; Wagler and Hanus, 2018), which promotes the

attractiveness of the environment displayed and encourages their willingness to engage in positive behaviors (Chung, Han, and Joun, 2015; Marasco et al., 2018). Overall, the following mediating effects are proposed:

H6. : The effect of viewing real (versus digital) contents on (a) ease of imagination, (b) perceptions of visual appeal and (c) booking intentions will be mediated by presence.

H7. : The effect of presence on booking intentions will be mediated by (a) ease of imagination and (b) perceptions of visual appeal.

Fig. 1 shows the research model and the proposed hypotheses.

3. Methodology

3.1. Sample, design and procedure

A lab experiment was carried out to test the hypotheses. Following previous studies analyzing users' experiences with XR technologies (e.g., Bogicevic, Liu et al., 2021; Bogicevic, Seo et al., 2019; Suh and Prophet, 2018), a non-probabilistic convenience sample of 206 college students (65.0% female; mean age = 20.67) was recruited. Apart from being a valid and homogeneous group in terms of age and education levels, which increases the internal validity of lab experiments (Flavián, Gurrea, and Orús, 2016), students are considered as the leading group of users of emerging technologies (Parboteeah, Valacich, and Wells, 2009) and seem to be especially interested in XR technologies (Cognizant, 2019). The participants were instructed to imagine that they were going to visit a specific city (Venice) and were about to choose an accommodation. First, the researchers explained them the context of the study and handed out the first part of the questionnaire containing a series of control questions. After that, participants were told that, with the aim of selecting a proper accommodation for their trip, they were going to watch information about a hotel room from a well-known chain. The name of the chain was concealed to avoid brand preference biases. After watching the hotel room information, the participants answered the second part of the questionnaire including the main variables of the study and their socio-demographic information.

The experimental treatments were introduced in the pre-experience with the hotel room. Specifically, participants were randomly assigned to one of the experimental conditions in a 2×2 between-subjects factorial design, in which they viewed the hotel room with different combinations of contents (real vs. digital) and devices (HMD vs. smartphone) (see Fig. 2). With this experimental design, the aim of the study is to recreate conventional VR and AR experiences to compare their effects, while controlling for whether the differences are due to the type of content and/or device. This way, in the "real-HMD" condition, participants (n = 51) viewed a 360-degree video of the room with a HMD. This condition represented a conventional VR experience (see top left quadrant of Fig. 2), given that these type of videos are currently widespread (Bujić, Salminen, Macey, and Hamari, 2020), while the use of HMD is required to have fully-immersive VR experiences (Beck et al., 2019; Loureiro et al., in press). Previous research has considered this combination as a standard VR experience (e.g., Leung et al., in press; Tussyadiah et al., 2018b; Zeng et al., in press). On the opposite, the "digital-smartphone" condition (n = 53) recreated an AR experience (see bottom right of Fig. 2), where the participants viewed a digital representation of the hotel room which was superimposed over a printed marker. A baseline AR experience consist of viewing digital information, which is superimposed on the physical environment (Chylinski et al., 2020), usually by means of smartphones (McLean and Wilson, 2019). This combination of content-device is frequently applied in AR experiences (e.g., IKEA Place, Pokémon Go). Finally, in the "real-smartphone" condition (top right quadrant of Fig. 2), participants (n = 52) viewed the same 360-degree video with a smartphone, and in the "digital-HMD" condition (n = 50; see bottom left Fig. 2), the same digital content was viewed with a HMD. The number of cases per experimental condition exceeded the values recommended by Seltman (2018). All the materials belonged to the research group to keep the environmental factors constant (e.g., screen sizes and resolution).

An internal protocol was developed to standardize the experiences in the different experimental conditions. Before receiving the experimental treatment, the participants were given explanations about the experience they were going to have, corresponding to the type of content and device they were randomly assigned to. The devices were shown and the researchers showcased the type of head and body movements that the participants could do to view the content. After this introduction, we made sure that all the participants were in the right position before starting the experience corresponding to the experimental treatment. In addition, they were asked to pay attention to the different elements of the hotel room, for which they should look at all directions in detail. During their experience, they should also turn at least once around themselves (real content) or the marker (digital content) to view the content. The researchers were present at all times during the experience to ensure that these requirements were met.

3.2. Manipulation of independent variables

Regarding the manipulation of content in the main experiment (Fig. 2), in the real content condition, participants watched a 360-degree video showing the different parts of a hotel room (bedroom with desk and closet, bathroom) from different perspectives and angles. The video was manipulated to keep the duration constant (45 s), add background music, and control for extraneous factors (e.g., people appearing in the scenes were removed). During the experience, the participants were free to explore the hotel room with 360-degree vision by moving their arms (smartphone) or their head (HMD) around. In the digital content condition, participants viewed a digital representation of a hotel room similar to the one that was used in the real content condition. This representation was superimposed over a printed marker that was previously recognized by an app (Fig. 2). Participants had the same time (45 s) to explore the different parts of the room (bedroom and bathroom) by moving around the virtual representation while shifting their arms (smartphones) or their head (HMD) to view the content (e.g., getting closer/away), and the same background music as in the real content condition was played during the experience. The participants' experience ended when the music stopped.

We carried out two online surveys to confirm the manipulation of the type of content. The aim of the first survey was to check the differences in the perceived realism of the contents, while controlling for other confounding variables. As previously stated, the content (real versus digital) was expected to differ in terms of perceived factual realism; that is, even though both contents could resemble a hotel room in the real world (similar levels of psychological realism), the real content should be perceived as based on reality to a higher extent than the digital content. Participants (N = 87) were recruited through a market research agency and were prescreened to have a similar profile as the participants in the main experiment (64.4% female; mean age = 21.3). The participants were randomly assigned to view one video about the hotel room. In the real content condition, the participants viewed the same video as in the main experiment. In the digital content condition, a video of the digital representation of the room that was used in the main experiment was recorded. In both cases, the navigation was controlled so that the participants were not free to move around and explore the different parts of the room.[1] Both videos lasted for 45 s and included the same background music as in the main experiment. We strictly controlled the pace of the participants' experience to ensure that all of them had time to explore the different elements of the room and thus avoid differences due to the information provided. After viewing the video, the

[1] The videos can be watched by accessing this link: t.ly/5ov1.

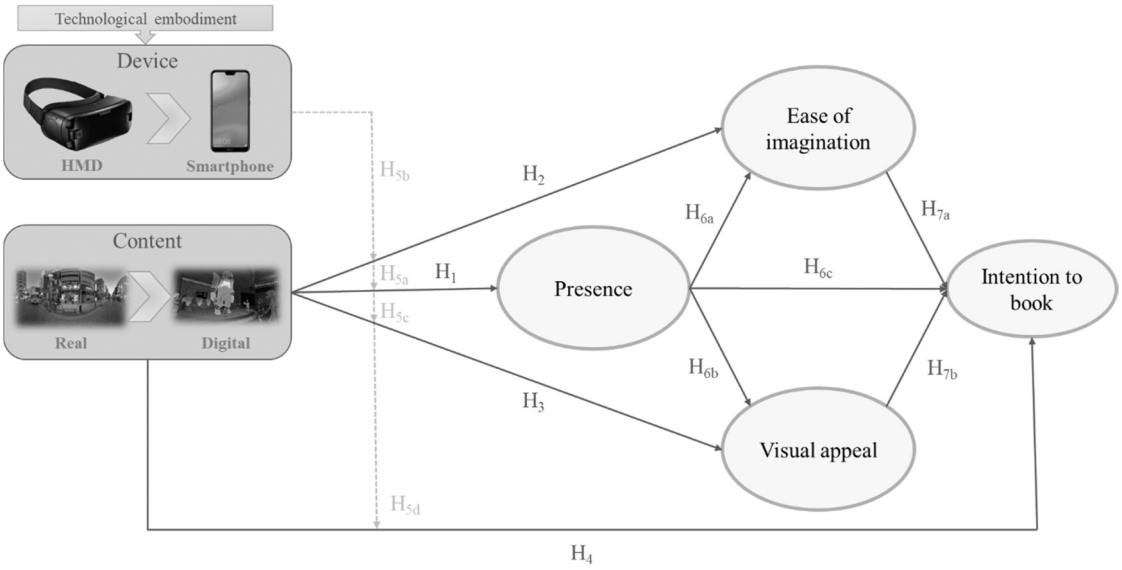

Fig. 1. Research model.

participants answered a series of questions.

For the sake of simplicity, only a summary of results is reported.[2] The participants rated the video in terms of the perceived realism. Specifically, 7-point Likert questions (from 1 = totally disagree, to 7 = totally agree) were used to ask the participants about their perceived psychological realism (3 items adapted from McGloin, Farrar, and Krcmar, 2011; α = 0.91) and factual realism (3 items adapted from Pouliot and Cowen, 2007; α = 0.84) of the video. The average values of the items were calculated and tested for differences. The analysis showed that perceived psychological realism was high and not significantly different depending on the video (M_{real} = 5.74, SD_{real} = 1.06; M_{digial} = 5.67, SD_{digial} = 1.33; $F_{(1, 86)} = 0.031$, $p = 0.86$). However, the real video was perceived as significantly more realistic in terms of factuality ($M = 6.11$, $SD = 1.06$) than the digital video ($M = 5.49$, $SD = 1.32$; $F_{(1, 86)} = 5.661$, $p < 0.05$). Thus, even though both contents were perceive as resembling a real hotel room, the real content was perceived as it existed in the physical reality to a greater extent than the digital content.

The survey also contained questions to control for extraneous variables that could affect the experimental treatment. Specifically, we checked whether the contents could differ in terms of the quantity and the quality of information. An information inventory was provided for the participants to pick as many elements as they could remember of the room in the video (e.g. bed, closet, desk, shower, WC). The number of elements recalled by participants in the real content video ($M = 9.38$, $SD = 1.91$) did not differ significantly from those in the digital content video ($M = 8.92$, $SD = 2.07$; $F_{(1, 86)} = 1.057$, $p = 0.31$). Regarding the perceived information quality, the participants indicated (from 1 = totally disagree, to 7 = totally agree) the extent to which information provided was (1) relevant, (2) reliable, (3) easy to recall, and (4) sufficient (α = 0.74; Muylle, Moenaert and Despontin, 2004). The average value of the real video ($M = 4.85$, $SD = 1.02$) did not significantly differ from the digital video ($M = 5.01$, $SD = 1.18$; $F_{(1, 86)} = 0.585$, $p = 0.45$). Thus, both contents were perceived as equally informative. Finally, the participants assessed the vividness of the video, defined as the extent to which the information attracts users' attention, appeals to their imagination, and is sensory and emotionally interesting (Keller and Block, 1997; Nisbett and Ross, 1980). We asked seven 7-point Likert scales about the video's vividness (α = 0.90; Orús, Gurrea, and Flavián, 2017). Again, no significant differences were found between the real ($M = 4.40$, $SD = 1.23$) and the digital video ($M = 4.72$, $SD = 1.05$; $F_{(1, 86)} = 1.397$, $p = 0.24$). Altogether, the results of this survey allowed us to ensure that the contents were successfully manipulated in terms of perceived factual realism.

As can be noticed, it was not possible for the researchers to find real and digital contents about the same hotel room; two different rooms had to be chosen as the stimuli from the available resources of the hotel chain. The second online survey was carried out in order to confirm that both rooms were perceived as similar in terms of number of elements displayed, layout, and likeability. In this survey, participants (N = 42 recruited through a market research agency; 57.1% female; mean age = 21.7) viewed the two videos in a within-subjects design. The visioning was counterbalanced (19 participants viewed the real content video and then the digital content video; 23 followed the opposite order) to control for order effects. After viewing the videos, they indicated which video was more (1) real, and (2) artificial (from 1 = the real video, to 7 = the digital video).[3] As in the previous study, the real video was perceived as more real ($M = 2.40$, $SD = 1.83$; significantly different from the middle point of the scale −4- according to a one-sample *t*-test: $t_{(41)} = -5.633$, $p < 0.01$), and the digital video as more artificial ($M = 5.81$, $SD = 1.78$; $t_{(41)} = 6.574$, $p < 0.01$). In addition, the participants indicated (from 1 = very dissimilar, to 7 = very similar) to what extent the rooms were similar in terms of number of elements ($M = 4.93$, $SD = 1.49$; significantly different from the middle point of the scale: $t_{(41)} = 4.044$, $p < 0.01$) and of distribution of elements ($M = 5.07$, $SD = 1.16$; $t_{(41)} = 6.007$, $p < 0.01$). Finally, they were asked which room they liked the most (from 1 = the room showed in the real content video, to 7 = the room showed in the digital content video). We observed no significant differences in the participants' preferences ($M = 3.86$, $SD = 2.35$; not significantly different from the middle point of the scale: $t_{(41)} = -0.393$, $p = 0.70$). These results confirm that the contents differed in the perceived factual realism, but that both rooms were perceived as similar and equally likeable.

As for the manipulation of the device, smartphones and HMDs were chosen as they involve different levels of technological embodiment. According to the EPI Cube (Flavián et al., 2019a), smartphones represent low-medium embodied technologies, while HMDs possess medium-high levels of technological embodiment. Previous research has

[2] The complete study can be requested from the authors.

[3] To avoid biases in the participants' responses, the real and digital content videos were labeled as "video A" and "video B", respectively.

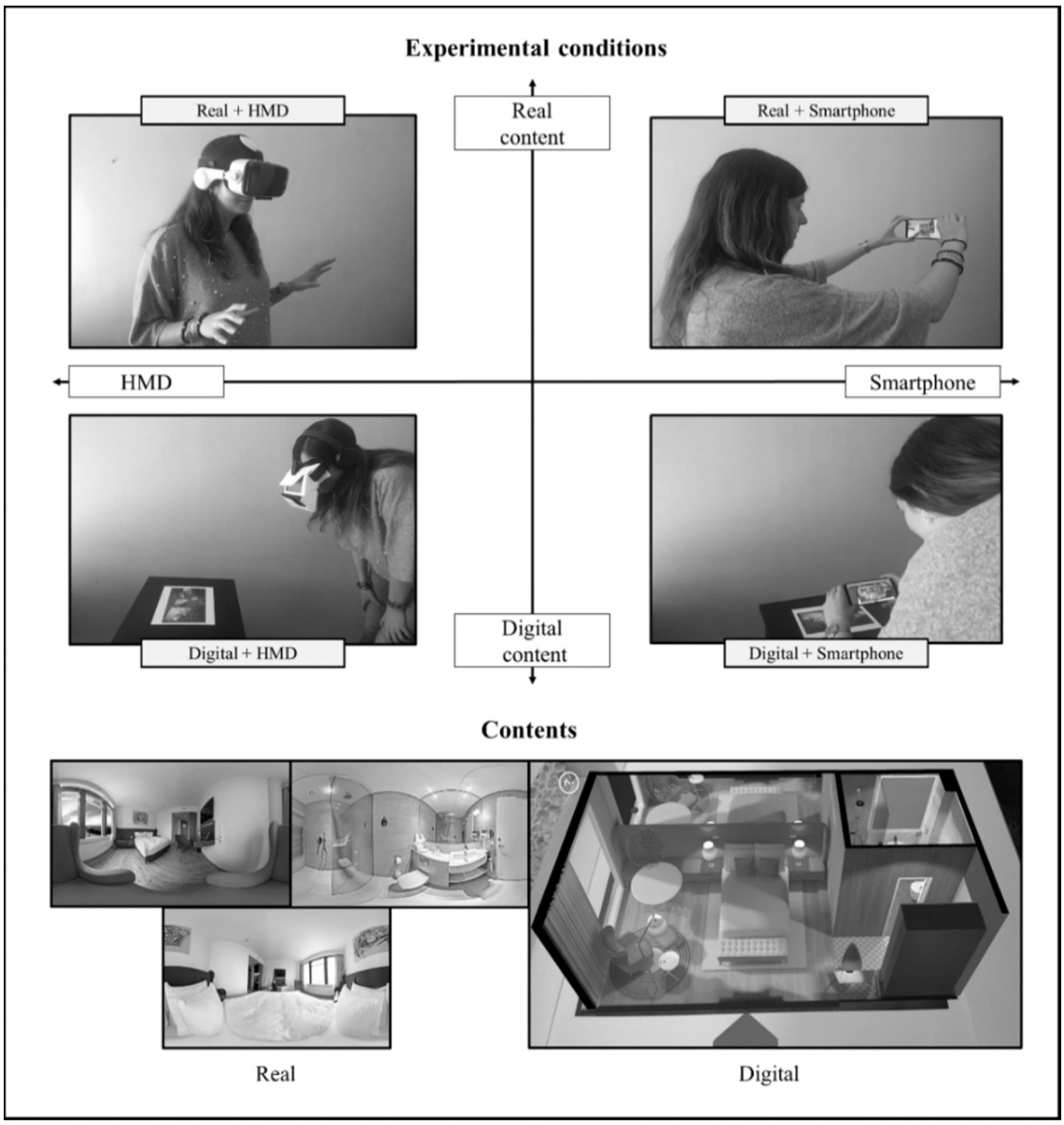

Fig. 2. Experimental conditions and contents.

empirically confirmed that these devices differ in terms of technological embodiment (Flavián et al., 2020). By considering devices associated to different levels of technological embodiment, our aim is to verify that this human-device integration is effectively perceived by users and has an impact on their technology-mediated experience. In the experiment, the participants were asked three 7-point Likert items (from 1 = totally disagree, to 7 = totally agree) about whether the device: (1) was nearly integrated into their body; (2) became part of their actions; and (3) was an extension of their body ($\alpha = 0.91$; Flavián et al., 2019b). Using the average value of the items, the results of an independent samples *t*-test showed that perceived technological embodiment was significantly higher for participants in the HMD condition ($M = 5.13$, $SD = 1.389$), compared to the participants in the smartphone condition ($M = 4.32$, $SD = 1.291$; $t_{(204)} = 4.310$, $p < 0.001$). This result ensures the manipulation and confirms that smartphones are low-medium embodied devices and HMDs are medium-high embodied devices. As previously noted, although other devices could have offered a more extreme manipulation of technological embodiment, which would be helpful to find clearer effects in the experiment, smartphones and HMDs have been acknowledged as the most used devices in experiences with XR technologies (Brito and Stoyanova, 2018; Tussyadiah et al., 2018b). Thus, the results of the analysis could be more applicable to real customer experiences.

3.3. Measurement instruments

The Appendix shows the full list of questions and items used in the questionnaire. First, control questions were asked related to the participants' previous experience in the destination, the importance of several attributes when booking a hotel, and their previous experience with VR and AR technologies. Regarding the measurement of the dependent variables, previously validated scales were used to measure the levels presence (four items adopted from Slater, Usoh, and Steed, 1994; Usoh, Catena, Arman, and Slater, 2000), ease of imagination (three items adopted from Nowlis, Mandel, and McCabe, 2004; Orús et al., 2017), visual appeal (three items adopted from Chung et al., 2015; Oh, Fiore, and Jeoung, 2007), and booking intentions (three items adopted from Casaló, Flavián, and Guinalíu, 2010; Chiang and Jang, 2007). All the items used seven-point Likert scales. The scales were validated following the standard procedures of Hair, Black, Babin, Anderson, and Tatham (2010). Once this process was undertaken, the average values were

calculated to obtain the measures used to test the hypotheses.

4. Analysis and results

To test hypotheses H_1 to H_4, we conducted a 2 (device: HMD vs. smartphone) × 2 (content: real vs. digital) multivariate analysis of covariance (MANCOVA). This analysis examines several dependent variables simultaneously and it is recommended when the dependent variables are correlated (Pearson correlation coefficients ranged from 0.487 to 0.732, all *ps* < 0.001) (Hair et al., 2010). The participants' previous experience in the destination (1 = yes, 0 = no) and with the technology used in their corresponding condition, as well as the importance they attached to the room when booking a hotel (see Appendix), were included as covariates. Results showed significant multivariate effects of the type of content (*Wilks's* $\lambda = 0.739$; $F_{(4,\ 196)} = 17.323$, $p < 0.001$). device (*Wilks's* $\lambda = 0.893$; $F_{(4,\ 196)} = 5.863$, $p < 0.001$) and the content × device interaction (*Wilks's* $\lambda = 0.876$; $F_{(4,\ 196)} = 6.912$, $p < 0.001$). The control variables had no significant multivariate effects (all *ps* > 0.05).

The descriptive data of the direct effects, as well as the results of the univariate ANCOVAs for each dependent variable are reported in Table 1. Supporting the hypotheses, the real content produced significantly higher perceptions of presence (H_1), ease of imagination (H_2), visual appeal (H_3) and intentions to book (H_4) (Table 1). Moreover, the interaction effect between content and device was significant for all the dependent variables, supporting H_5. The Fig. 3 shows the interaction effects. Post-hoc Bonferroni tests were carried out to examine the differences per each experimental condition. Overall, viewing real contents using HMDs generated significantly the highest perceptions; however, the real (versus digital) content affected the participants' intention to book regardless of the device. In addition, the digital contents produced significantly the lowest perceptions when they were viewed with a HMD. The type of content did not produce any significant difference when it was viewed using a smartphone, with the exception of presence (Fig. 3).

The macro PROCESS v3.3 (Hayes, 2018) was used to test H_6 and H_7. A customized moderated mediation model was built according to the proposed research model (Fig. 1). The content (real = 1, digital = 0) was the independent variable (X), and the intention to book was the dependent variable (Y). Presence, ease of imagination and visual appeal were the mediators (M), and the device (HMD = 1, smartphone = 0) was the moderator (W). The covariates (previous experience in the destination and with the technology, importance attached to the room quality) were also included in the model. The results of the conditional process model appear on Table 2. Given that only the importance attached to the room for booking a hotel had positive effects on booking intentions (*coeff.* = 0.153, *SE* = 0.06, $t_{(196)} = 2.600$, $p < 0.05$), the effects of the covariates are removed from the table (all *ps* > 0.12).

The effects on presence replicated those obtained in the ANCOVA. However, the direct effect of the type of content, as well as the content × device interaction, on the rest of variables disappeared when the mediators were included in the regressions. Specifically, the effects on ease of imagination and visual disappeared when presence was included in the model, which had a significant impact on both variables (Table 2). As for intention to book, only ease of imagination and visual appeal had significant effects. Bootstrap analyses with 5000 subsamples were carried out to estimate the significance of the indirect effects, taking into account the type of device (conditional indirect effects). The results confirmed mediation in all cases: presence mediated the relationship between the type of content and ease of imagination, visual appeal, and intention to book, as the zero value was not included in the confidence intervals. Hypotheses H_{6a}, H_{6b} and H_{6c} were thus supported. Moreover, the causal paths *content → presence → ease of imagination → intention to book* and *content → presence → visual appeal → intention to book* were significant, supporting H_{7a} and H_{7b} (Table 2). In addition, the moderated mediation was confirmed, as all the indirect effects were stronger for participants who used the HMD than for those who used the smartphone (Table 2).

5. Discussion

The results of the analysis show that viewing real contents provokes a higher sense of presence than digital contents. This result is contrary to the findings of Martínez-Navarro et al. (2019), who note that there are no differences in terms of presence between real and digital contents in VR experiences. This different finding may be due to the research context, given that Martínez-Navarro and colleagues focus on a tangible industry (retailing) and they do not control for the perceptions of the psychological and factual dimensions of realism. Hospitality services are featured by a high degree of intangibility (Gómez-Suárez and Veloso, 2020; Parasuraman et al., 1985); thus, it seems that for intangible industries, the factual realism of the contents is critical to increase the level of psychological presence. Our results shed light on the impact of XR content by highlighting the importance of providing customers with real contents in online hotel pre-experiences. In fact, our results align with Wagler and Haus (2018), who note that watching a 360-degree video of a tourism product generates the same presence reactions as the real physical experience. Therefore, it is essential to create reality-based contents to induce users' sense of "being there" instead of "being here" (Tussyadiah et al., 2018b).

Table 1
Descriptive data and results of the univariate ANCOVAs for direct effects.

		Presence		Visual appeal		Ease of imagination		Intention to book	
Content	Device	M	SD	M	SD	M	SD	M	SD
Real	Smartphone	4.35	1.25	5.40	0.92	5.50	1.11	5.17	0.92
	HMD	6.00	1.00	6.18	0.70	6.25	0.77	5.59	1.05
	Total	5.17	1.40	5.79	0.90	5.87	1.03	5.28	1.11
Digital	Smartphone	3.61	1.60	5.18	1.26	5.03	1.45	5.00	1.19
	HMD	3.48	1.36	4.65	1.34	4.64	1.43	4.57	1.20
	Total	3.54	1.48	4.92	1.32	4.84	1.44	4.69	1.26
Total	Smartphone	3.98	1.47	5.29	1.10	5.26	1.31	4.97	1.17
	HMD	4.75	1.74	5.42	1.31	5.46	1.39	5.00	1.28
	Total	4.36	1.65	5.35	1.21	5.36	1.35	4.98	1.22
ANCOVA		$F_{(1,\ 205)}$		$F_{(1,\ 205)}$		$F_{(1,\ 205)}$		$F_{(1,\ 205)}$	
	Exp. destination	1.107		1.766		3.502 *		3.116	
	Exp. device	1.516		0.109		0.009		0.060	
	Imp. room quality	0.395		0.779		0.608		2.608 *	
	Content	65.698 *		29.872 *		35.020 *		13.729 *	
	Device	17.970 *		0.723		0.930		0.024	
	Content × device	24.673 *		18.967 *		11.656 *		10.775 *	

* $p < 0.01$.

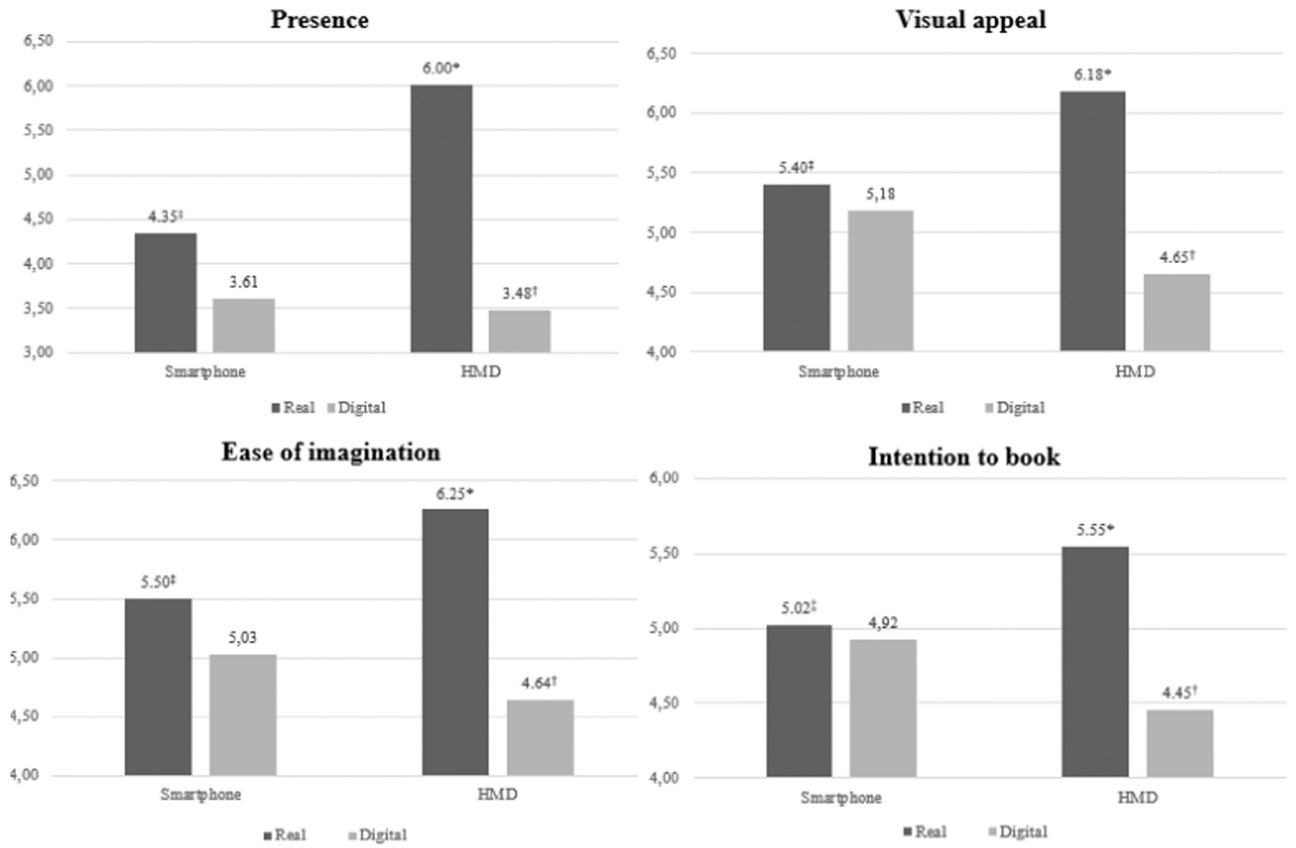

Fig. 3. Content × device interaction effects. ***Note***: * Significant differences between the real-HMD and the rest of experimental conditions in all the dependent variables (all ps < 0.05) with the exception of intention to book (the difference with the real-smartphone condition was non-significant, $p = 0.13$); † Significant differences between the digital-HMD condition and real-smartphone condition in presence, visual appeal and ease imagination (ps < 0.05), but not in intention to book ($p = 0.08$). The difference between the digital-HMD and the digital-smartphone conditions was not significant for presence ($p = 1.00$), visual appeal ($p = 0.08$), ease of imagination ($p = 0.63$), and intention to book ($p = 0.27$); ‡The type of content in the smartphone group did not produce significant differences (visual appeal: $p = 1.00$; ease of imagination: $p = 0.31$; intention to book: $p = 1.00$), with the exception of presence ($p < 0.05$).

Additionally, the results reveal that the content of the experience influences the users' perceptions, subjective experiences, and behavioral intentions. Specifically, compared to digital contents, real contents allow customers to easily imagine how the real-world experience would be (Huang et al., 2016). Our results show that this effect takes place because users feel present in the environment displayed (mediation of presence). Previous studies have verified the relationship between presence and imagination, most of them noting that imagination affects presence (e.g., Bogicevic, Seo et al., 2019). However, Cowan and Ketron (2019) propose that this relationship can be bidirectional. Our research considers the subjective experience related to the ease of imagining, which is a metacognition (Orús et al., 2017), so we establish that presence leads to a greater ease of imagining the consumption experience. Moreover, real contents add richness to the experience, which enhances the visual appeal of hospitality pre-experiences (Wagler and Hanus, 2018). According to the mediation analysis, this effect is explained by psychological presence. In line with the propositions of Petit et al. (2019), the presence elicited by the content viewed with XR technologies enhances the sensory properties of the environment displayed; our results indicate that this may be translated into an improvement of the visual appeal of the experience.

Furthermore, viewing real contents favors the participants' behavioral intentions. The similarity of the content to the real environment places customers in the situation displayed (psychological presence), what puts them in a better position to make their decision (Wagler and Hanus, 2018). Our results extend previous findings by showing that the effect of psychological presence on booking intention is mediated by ease of imagination and perceptions of visual appeal. When customers reach a state of presence in the virtual environment, this helps them imagine the real experience, affecting their subsequent decisions (Wei et al., 2019). Additionally, after feeling present in the technology-mediated environment, the enhanced visual appeal positively influences the potential guests' behavioral intentions (Marasco et al., 2018).

The moderating role played by the device when viewing the content of the XR experience is also analyzed. The direct effects on the perceptions are stronger when high embodied devices (HMDs) are used (in comparison with less embodied devices, i.e., smartphones). Specifically, when real contents are viewed with HMD, the psychological presence, the subjective ease of imagination and the perceived visual appeal are the highest, compared to the rest of experimental conditions. In line with the presence continuum of the EPI Cube (Flavián et al., 2019a), the immersive properties of embodied devices strengthen the sense of presence after viewing real contents. Previous research has found that using HMDs allows customers to have powerful "try-before-you-buy" experiences (Tussyadiah et al., 2018b), facilitating their imaginations about how the real experience would be (Bogicevic, Seo et al., 2019). Similarly, the use of these embodied devices enable users to obtain rich visual experiences (Petit et al., 2019), enhancing the perceptions of visual appeal (Van Kerrebroeck et al., 2017). However, when viewing real content, the difference between using HMDs or smartphones in booking intentions was not significant. Prior research has noted that these embodied devices enhance the overall experience, but their effect is reduced at the purchase stage (Farah et al., 2019; Flavián et al., 2019b). Nevertheless, the results of the moderated mediation show that the effect of the real content on booking intentions is mediated by presence,

Table 2
Results of the analysis of the moderated mediation models.

Predictor	Coeff.	SE	*t*	*p*	LLCI	ULCI
Presence						
Constant	3.043	0.54	5.598	0.000	1.971	4.114
Content	0.644	0.27	2.376	0.018	0.109	1.178
Device	-0.056	0.27	-0.210	0.834	-0.588	0.475
Content × Device	1.851	0.37	4.967	0.000	1.116	2.586
Model Summary	**$R^2 = 0.379$; $F_{(6, 199)} = 20.172$, $p < 0.001$**					
Ease of imagination						
Constant	2.760	0.46	5.961	0.000	1.847	3.673
Content	0.167	0.22	0.766	0.445	-0.262	0.595
Device	-0.376	0.21	-1.762	0.080	-0.797	0.045
Content × Device	0.302	0.31	0.965	0.336	-0.315	0.919
Presence	0.468	0.06	8.335	0.000	0.357	0.578
Model Summary	**$R^2 = 0.423$; $F_{(7, 198)} = 20.723$, $p < 0.001$**					
Visual appeal						
Constant	3.177	0.38	8.362	0.000	2.428	3.926
Content	-0.122	0.18	-0.686	0.493	-0.474	0.229
Device	-0.495	0.17	-2.826	0.005	-0.840	-0.150
Content × Device	0.398	0.26	1.553	0.122	-0.108	0.905
Presence	0.505	0.05	10.966	0.000	0.414	0.596
Model Summary	**$R^2 = 0.513$; $F_{(7, 198)} = 29.766$, $p < 0.001$**					
Intention to book						
Constant	0.843	0.49	1.716	0.088	-0.125	1.811
Content	-0.139	0.20	-0.703	0.483	-0.529	0.251
Device	-0.236	0.19	-1.197	0.233	-0.625	0.153
Content × Device	0.210	0.28	0.739	0.461	-0.351	0.772
Presence	0.080	0.06	1.218	0.225	-0.049	0.209
Ease of imagination	0.251	0.07	3.346	0.001	0.103	0.399
Visual appeal	0.305	0.09	3.342	0.001	0.125	0.485
Model Summary	**$R^2 = 0.426$; $F_{(9, 196)} = 16.171$, $p < 0.001$**					
Conditional	***Effect***	**BootSE**	**BootLLCI**		**BootULCI**	
Indirect effects of X on Y						
Content → Presence → Ease of imagination						
Smartphone	0.301	0.15	0.024		0.615	
HMD	1.167	0.22	0.775		1.624	
Index of moderated mediation	0.866	0.22	0.470		1.624	
Content → Presence → Visual appeal						
Smartphone	0.325	0.16	0.009		0.632	
HMD	1.260	0.19	0.921		1.653	
Index of moderated mediation	0.935	0.22	0.553		1.402	
Content → Presence → Intention to book						
Smartphone	0.226	0.12	0.016		0.475	
HMD	0.876	0.19	0.521		1.288	
Index of moderated mediation	0.650	0.18	0.330		1.054	
Content → Presence → Ease of imagination → Intention to book						
Content	0.076	0.05	0.003		0.178	
HMD	0.293	0.11	0.094		0.546	
Index of moderated mediation	0.217	0.09	0.061		0.438	
Content → Presence → Visual appeal → Intention to book						
Content	0.099	0.06	0.002		0.234	
HMD	0.385	0.13	0.104		0.637	
Index of moderated mediation	0.285	0.11	0.076		0.637	

Note: n = 206. Confidence interval calculated at 95% of significance. Bootstrap sample size = 5000. BootLLCI: lower limit confidence interval; BootULCI: upper limit confidence interval.

and this mediating effect is stronger when embodied devices are applied.

Our results concur with previous findings from the literature, but also point that HMDs may not necessarily enhance the customer's experience for all types of contents; when digital content is superimposed over the user's physical environment, HMDs seem to produce a negative impact. The combination of digital content with HMD results in an overall worse experience compared to the other experimental conditions. When customers use embodied devices, it is difficult for them to separate the device from the environment (Tussyadiah et al., 2018a), so the suitable integration of the digital content with the physical environment is essential. The digital content that is displayed with embodied devices should fit within the context in which the experience is taking place (e.g., digital information superimposed over the tourist attractions) to enhance the experience. If that is not the case (digital representation of a hotel room superimposed over a printed marker), a mismatch can be generated that may cause a mental discomfort in customers. This cognitive dissonance (Festinger, 1957) may lead them to sense lower levels of presence and an overall worsening of the experience in terms of perceptions and behavioral intentions.

In consideration of all the above, the aim of this paper is to compare the effectiveness of VR and AR by distinguishing between the effects of the type of content and the device. To do so, we take into account that viewing real content with HMDs represents a standard VR experience (Bujić et al., 2020; Loureiro et al., in press), while displaying digital content with smartphones can be considered as a baseline AR experience (Chylinski et al., 2020; McLean and Wilson, 2019). The results show that real contents enhance the perceptions, subjective experiences, and behavioral intentions in XR experiences. It is worth mentioning the important role of psychological presence, which drives potential guests' perceptions and booking intentions. In general, these effects are strengthened when embodied devices are applied. On the whole, our research takes a step forward by confirming the superiority of VR (real contents and HMD) compared to AR (digital contents and smartphones) to provide customers with the most valuable hotel XR pre-experiences.

6. Conclusions and Implications

Despite the increasing relevance of VR and AR technologies in hospitality, few studies have analyzed and compared their influence on potential guests' pre-experiences (Bogicevic, Seo et al., 2019). For instance, Flavián et al. (2020) examine the affective route underlying hospitality pre-experiences with VR by considering how technological embodiment affects emotions and engagement. This research complements this view by focusing on psychological presence and analyzing the cognitive route (ease of imagination and perceptions of visual appeal) that underlie potential guests' pre-experiences with XR technologies. This research also takes a broader approach to compare VR and AR by distinguishing between the content and the device implemented in these experiences, which has been noted as an unsolved matter in previous literature (Li and Chen, 2019). Taking into account the results of this empirical study, AR is posited as an effective tool for showing tourist attractions (e.g., Chung et al., 2015); yet, it may not be so effective for tangibilizing hospitality service offers. For this purpose, using VR experiences, with real contents and devices integrated with the human body (HMD), seems to generate better results. Thus, this research stresses that the VR combination (real content with HMD) is more effective than the other conditions (including AR) to generate successful experiences.

Additionally, as theory-driven research in XR technologies is needed to better understand how they affect the customer journey (Yung and Khoo-Lattimore, 2017), this research takes a step forward in the empirical validation of the EPI Cube (Flavián et al., 2019a). Prior literature has analyzed the effects technological embodiment (e.g., Flavián et al., 2020), while this study complements it by focusing on psychological presence. Our results stress the role of presence to create effective tourism pre-experiences with XR technologies. We contribute to previous research by showing that perceived factual realism is an important feature of the XR content to generate this state of presence. Furthermore, we extend prior investigation on the consequences of presence (e.g. enjoyment; Tussyadiah et al., 2018b; Willems et al., 2019) by revealing that the ease of imagination and the visual appeal elicited by presence drive potential guests' booking intentions. Thus, by adding the human dimension (psychological presence) and considering the moderating role of the technological dimension (embodiment), we show that the EPI Cube can be a suitable theoretical model to classify existing and potential technologies, as well as to analyze HTI.

6.1. Managerial implications

This research offers ways to help practitioners improve potential guests' pre-experiences with a hotel room. First, our findings show that using real contents (360-degree videos) places customers in the environments displayed more effectively, empowering them in their booking decisions. Unlike tangible industries (e.g., retail), where the type of content seems not be so important for eliciting a higher sense of "being there" (Martínez-Navarro et al., 2019), for hospitality services it is essential to offer reality-based previews to generate this perception. These 360-degree videos may even resemble real-world experiences (Wagler and Hanus, 2018). Therefore, it is advisable for hotel managers to use this type of format (360-degree videos) which may be cheaper to produce than digital animations or applications, and it is gaining great popularity among customers (Martínez-Navarro et al., 2019), particularly when showcasing hotel rooms (Leung et al., in press).

Service designers and developers must choose the combination of contents and devices that better fits their potential customers' needs to offers technology-enhanced experiences (Flavián et al., 2019a). Our results highlight that when hotel managers use real contents to present their products, embodied devices (HMD) are the most effective for transmitting this information. These conventional VR experiences offer valuable "try-before-you-buy" experiences which induce states of presence in the environment displayed. Perceiving oneself in the physical location (hotel room) facilitates imaginations about the real experience and improves the attractiveness of the experience, which generate favorable booking intentions. Thus, this combination empowers the customer experience by creating a new experience which is related to his or her current goals (i.e., looking for information about the hotel) (Flavián et al., 2019a). Good practices in this regard can be already found in the hotel industry (e.g., Best Western Hotel & Resorts; Best Western, 2016). Companies may integrate this type of VR experiences in online channels (e.g., webpages, mobile apps) and physical outlets (e.g., travel agencies, stands in shopping malls), as well as combining them with other formats (e.g., textual online reviews; Zeng et al., in press), to generate superior value propositions.

In case of digital contents, it seems that embodied devices (HMD) are not as effective as smartphones (standard AR experience). Thus, hotel managers may encourage the use of less embodied technologies, such as smartphones, to generate better pre-experiences with their products. This combination of digital contents using smartphones (AR condition) can be considered a directly supported experience (Flavián et al., 2019a), given that the technological experience offers a direct assistance to the customer's goals at this stage of the journey (information search). The reason may be that customers are widely used to using their smartphones throughout their purchase journeys (Orús, Gurrea, and Ibáñez-Sánchez, 2019), particularly with AR (Park and Stangl, in press), but the process of AR HMD adoption is still in its early stages and may generate negative reactions (Rauschnabel et al., 2018). Additionally, it should be noted that while AR may be effective in situations when the focus of the experience is the physical environment (Chung et al., 2015), it may not be as effective when the focus is on the digital information itself. In this latter case, the real environment may distract the consumer from the main experience (i.e., viewing the digital content), thus diminishing the value of the experience as a whole.

6.2. Limitations and future research lines

This research has several limitations that should be addressed with future research. First, the study used a convenience sample of college students, so our results may be applicable to the youngest generations. Previous research has considered them as a valid target to investigate users' experiences with XR technologies (e.g., Bogicevic, Liu et al., 2021; Suh and Prophet, 2018), being of particular interest due to their large potential spending capacity (Morgan Stanley, 2019) and their great interest in XR technologies (Cognizant, 2019). However, previous research has noted that socio-demographic characteristics (e.g. age, educational level) may influence attitudes and perceptions toward XR experiences (Errichiello et al., 2019). Thus, future research should perform studies with representative samples (probabilistic sampling methods, broader set of ages and profiles) to compare these results across different types of individuals and generalize the results. Second, the artificial conditions of the lab ensure control and internal validity, but field studies are required to increase the external validity of the research. Furthermore, it would be interesting to collect both objective (e.g., eye tracking) and self-reporting (e.g., aided recall) measures to ensure that participants experienced all the aspects of the room in the main experiment. Third, this research is focused on the human dimension of the EPI Cube, while controlling for the effects of technological embodiment and keeping the behavioral dimension (interactivity) constant at low levels (Flavián et al., 2019a). Future studies should thus analyze interactivity to offer a complete view of the processes that take place with the use of XR technologies in HTI. Fourth, this research has considered conventional VR and AR experiences (distinguishing between content and device) to compare their effectiveness in the pre-experience with a service product (hotel room). Despite verifying that the rooms displayed in the experimental conditions were perceived as similar and equally likeable, future studies should use real and digital contents about the same stimulus/object. As for the real content, 360-degree videos were considered due to their wide availability and variety, which has increased its popularity among users, turning them into the benchmark in current XR experiences (Martínez-Navarro et al., 2019). Regarding the digital content, a digital representation of the hotel room was displayed. Our results show that the real content is perceived as more factual than the digital content. This will happen as long as both contents are clearly distinguishable. However, considering the potential developments in the creation of sophisticated XR content (LEK, 2019), future digital content may reach such a level of realism that it might be difficult to distinguish it from the real world. In this situation, the perception of factual realism may not differ and therefore both contents may have similar effects. In this way, it may be interesting that future studies analyze the feasibility of such developments in terms of economic investments, given that it may be more practical to use a high-quality video of the real content. By its very nature, developing digital content makes sense when the purpose is to depict elements that cannot be captured otherwise in the real world (e.g. different perspectives, reconstruct areas that no longer exist). Thus, even if digital content is hyper-realistic, consumers must notice that it is digitally generated to add value to the experience; even if it does not generate as much presence as real content, it surely has other benefits that will have to be further explored. Additionally, the incorporation of other possible XR devices (e.g. tablets, cave assisted virtual environments) can enrich this comparative analysis. Finally, future research is needed to understand how these XR technologies operate throughout all the stages of the consumer journey (before, during and after the experience), and in other service contexts (e.g., promoting restaurants or tourist attractions) to generalize the results.

Declarations of interest

None.

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Appendix

Indicate your experience in Venice as a tourist:

Experience in Venice
I have not been there, and I have not thought about going
I have not been there but I would like to go
I have been there and I would not go back
I have been there and I would not mind going back

Rate from 1 (not important) to 7 (very important) the importance you give to the following aspects when booking a hotel room:

Aspects of a hotel
Room
Reception
Services (e.g., gym, swimming pool)
Location
Restaurant
Value for money

Indicate your degree of experience with 360º videos on the following devices, from 1 (I have never watched them on this device) to 7 (I am very used to watching them on this device).

Device
PC Desktop
Smartphone
Tablet
Head-mounted display

Indicate your degree of experience with AR on the following devices, from 1 (I have never used it on this device) to 7 (I am very used to using it on this device).

Device
Smartphone
Head-mounted display

Indicate from 1 (strongly disagree) to 7 (strongly agree) the extent to which you agree with the following sentences in relation to your hotel experience with (experimental condition; EC).

Presence *(adapted from* Slater et al., 1994*;* Usoh et al., 2000*)*
In the (EC) generated world, I had a sense of "being there".
During the time of the (EC) experience, I often thought that I was actually in the virtual world.
There were times during the (EC) experience when I felt that the virtual world became my reality.
During the (EC) experience, I often thought that I was really standing in the virtual world.
Visual appeal *(adapted from* Chung et al., 2015*;* Oh et al., 2007*)*
The (EC) experience has generated an attractive environment.
The environment as seen in the (EC) experience is visually appealing.
The (EC) experience has generated an animated environment.
Ease of imagination *(adapted from* Nowlis et al., 2004*;* Orús et al., 2017*)*
After the (EC) experience…
…, it is easy for me to imagine how the hotel would be.
…, it is easy for me to picture myself in the hotel.
…, it is easy for me to picture myself enjoying the hotel.
Intention to book the hotel room *(adapted from* Casaló et al., 2010*;* Chiang and Jang, 2007*)*
After watching the content in the (EC)…
…, if I intended to visit the destination, my desire to book at this hotel would be high.
…, if I intended to visit the destination, the possibility of booking at this hotel would be high.
…, if I intended to visit the destination, it is likely that I would book at this hotel.

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