



The influence of scent on virtual reality experiences: The role of aroma-content congruence

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ABSTRACT

We live in a multisensory world. Our experiences are constructed by the stimulation of all our senses. Nevertheless, digital interactions are mainly based on audiovisual elements, while other sensory stimuli have been less explored. Virtual reality (VR) is a sensory-enabling technology that facilitates the integration of sensory inputs to enhance multisensory digital experiences. This study analyzes how the addition of ambient scent to a VR experience affects digital pre-experiences in a service context (tourism). Results from a laboratory experiment confirmed that embodied VR devices, together with pleasant and congruent ambient scents, enhance sensory stimulation, which directly (and indirectly through ease of imagination) influence affective and behavioral reactions. These enriched multisensory experiences strengthen the link between the affective and conative images of destinations. We make recommendations for researchers and service providers with ambitions to deliver ambient scents, especially those congruent with displayed content, to enhance the sensorialization of digital VR experiences.

1. Introduction

Achieving multisensory digital experiences is the holy grail of human-technology interaction. Recent developments (e.g. [Gloves, 2019](#)) try to achieve the “sensorialization” of the digital environment by stimulating the human senses in ways similar to their stimulation in the real world. Despite the efforts made by researchers and practitioners to deliver multisensory digital experiences, there is still a long way to go before this goal is accomplished ([Petit, Velasco, & Spence, 2019](#)). In fact, providing multisensory experiences in digital environments is one of the future priorities in technology development ([Gartner, 2019](#); [Guinalíu-Blasco, Hernández-Ortega, & Franco, 2019](#); [Spence, 2019](#)). However, current digital experiences are mainly based on audiovisual stimulation, and involve other sensory stimulation to a lesser extent ([Petit et al., 2019](#)). Considering that virtual environments are becoming increasingly important in the customer purchase journey ([Lemon & Verhoef, 2016](#); [Neuhöfer, Buhalis, & Ladkin, 2014](#)), the integration of a wider range of senses to generate holistic experiences may increase the value delivered to consumers ([Spence & Gallace, 2011](#)).

Sensory-enabling technologies (SETs) represent a first step toward the sensorialization of the digital world ([Petit et al., 2019](#)). These technologies deliver sensory inputs to customers while they are

interacting in digital environments. When virtual environments stimulate sensory inputs, users feel as if they are inside the digital world and more easily process information ([Bogicevic, Seo, Kandampully, Liu, & Rudd, 2019](#); [Cowan & Ketron, 2019](#)). According to [Petit et al. \(2019\)](#), Virtual Reality (VR) has a sensorial character which differentiates it from other technologies ([Willems, Brengman, & Van Kerrebroeck, 2019](#)). VR head-mounted displays (HMDs) enable users to receive multisensory information directly through the stimulation of their senses ([Flavián, Ibáñez-Sánchez, & Orús, 2019a](#)). However, as with other, related technologies, current VR experiences stimulate mainly sight and hearing ([Guttentag, 2010](#)), and the role of other sensory stimuli has been less explored ([Serrano, Baños, & Botella, 2016](#)). Adding other sensory cues (e.g. scents, haptics) can generate realistic and immersive experiences ([Meißner, Pfeiffer, Pfeiffer, & Oppewal, 2017](#); [Obrist, Gatti, Maggioni, Vi, & Velasco, 2017](#); [Roschk & Hosseinpour, 2020](#)). Therefore, it will be of interest to understand how VR technologies can be combined with other sensory inputs to enrich multisensory digital experiences ([Loureiro, Guerreiro, & Ali, in press](#)).

Adding scent generates enhanced experiences in multisensory digital environments ([Raisamo et al., 2019](#)). However, there is a lack of studies analyzing the integration of scents into VR experiences and their impact in digital service consumption contexts ([Roschk & Hosseinpour, 2020](#);

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Serrano et al., 2016). Following an imagery fluency approach (Petrova & Cialdini, 2008), this research analyzes the combined influence of olfactory inputs and VR devices on sensory-stimulating pre-experiences in the context of tourist destinations. In addition, despite being one of the most important aspects of scent, congruity is regarded as an unexplored research area in digital environments (Errajaa, Legohérel, & Daucé, 2018). Thus, we examine how scent-content congruity may moderate the influence of multisensory pre-experiences on affective and conative destination image. Combining multiple sensory stimuli is important for creating a consistent sensory destination identity; and a consistent sensory destination identity can, in turn, provide competitive advantage (Agapito, in press; Agapito, Mendes, & Valle, 2013). Our findings aim to contribute to a better understanding of how multiple sensory inputs can deliver holistic digital experiences which foster affective and behavioral reactions (Nibbe & Orth, 2017).

2. Sensorialization of the digital environment

Real-world experiences are multisensory in nature (Citrin, Stem, Spangenberg, & Clark, 2003; Petit et al., 2019). A wide variety of sensory inputs are simultaneously integrated in real-world experiences, and these eventually determine individuals' judgements and behaviors (Krishna, 2012; Spence & Gallace, 2011). The same applies to consumers in purchasing environments (Motoki, Saito, Nouchi, Kawashima, & Sugiura, 2019; Sunaga, Park, & Spence, 2016). This emphasizes the importance of achieving the optimum integration of sensory inputs in the customer experience, particularly with regard to the consistency between the different sensory stimuli (Helmefalk & Hultén, 2017; Krishna, 2012; Lwin, Morrin, & Krishna, 2010; Spence, Puccinelli, Grewal, & Roggeveen, 2014; Velasco, Woods, Petit, Cheok, & Spence, 2016). As customers seek multisensory experiences in their real-life purchase journeys (Meißner et al., 2017), one might wonder if these sensory effects are similar in digital environments, where today's consumers increasingly carry out a significant percentage of their commercial transactions (Statista, 2019).

Traditionally, human-technology interactions in digital environments have relied heavily on the senses of sight and hearing (Guttentag, 2010; Spence, Obrist, Velasco, & Ranasinghe, 2017); hitherto, the use of tactile, olfactory and gustatory stimuli has been rather limited (Gallace & Spence, 2014; Narumi, Nishizaka, Kajinami, Tanikawa, & Hirose, 2011). Consequently, digital environments may inhibit customer experiences due to their limited capacity to provide wider sensory inputs (Petit et al., 2019). With the aim of overcoming this challenge, recent technological developments have sought to communicate haptic, olfactory and even gustatory information (Petit et al., 2019; Spence et al., 2017; Velasco, Obrist, Petit, & Spence, 2018). In fact, the integration of different sensory inputs provides customers with multisensory experiences resembling real-life experiences (Petit et al., 2019), and customers perceive them as natural, immersive and engaging (Meißner et al., 2017). Given the natural lack of multisensory interaction in digital environments, the challenge for researchers and practitioners is, using the latest technological developments, to apply a wider spectrum of sensory inputs, thus extending the audiovisual domain, to more effectively connect the real and digital worlds (Petit et al., 2019; Petit, Cheok, Spence, Velasco, & Karunanayaka, 2015).

2.1. Sensory-enabling technologies: Virtual reality

Recent developments in human-technology interaction have taken further steps toward the achievement of the sensorialization of the digital environment (Petit et al., 2019). The integration of the senses in online experiences is paramount for facilitating multisensory interactive experiences (Spence & Gallace, 2011; Yoganathan, Osburg, & Akhtar, 2019). Sensory-enabling technologies (SETs) provide sensory inputs in digital shopping environments which serve as proxies for the sensory experiences that customers might enjoy in physical environments (Petit

et al., 2019). The multisensory experiences provided by SETs potentially reduce the psychological distance in online consumption (Petit et al., 2019) by helping customers to envision how their future consumption experience might turn out, which represents one of the main challenges for online purchasing (Heller, Chylinski, de Ruyter, Mahr, & Keeling, 2019). This can be done by providing customers with some of the sensory properties of products (e.g. texture, odor or taste) which cannot be transmitted through traditional channels (Petit et al., 2019). The implementation of SETs will be especially important for services (e.g. tourism), as they can overcome the intangibility of the sector (Flavián et al., 2019a, in press; Tusseyadiah, Wang, Jung, & tom Dieck, 2018). SETs can empower potential customers in their service decision-making processes by providing multisensory experiences that act as previews of real experiences (Buhalis et al., 2019).

VR, a key SET, immerses users in a three-dimensional environment where their senses are stimulated (Guttentag, 2010). Consumers demand richer sensorial experiences, using technologies such as VR, that can augment their perceptual abilities, transform their immediate reality and create symbiotic human-technology relationships (Buhalis et al., 2019). Previous VR research has noted its sensory enriching potential in service contexts (e.g. Kim, Lee, & Jung, 2020; Marasco, Buoincontri, van Niekerk, Orlowski, & Okumus, 2018; Martins et al., 2017; Tusseyadiah et al., 2018).

As with related technologies, VR research has mainly involved the use of audiovisual elements (Guttentag, 2010). However, attempts have been made recently to incorporate other senses into VR experiences. Table 1 summarizes the empirical studies conducted in the last 5 years that have analyzed tactile, olfactory and/or gustatory stimuli in VR service experiences.

As can be observed, the empirical research has focused on a variety of services, including entertainment, hospitality, education and patient recovery. As for the senses involved, the incorporation of touch into VR experiences is the most analyzed multisensory integration, with smell and taste being less addressed. Overall, the results from these studies lack consistency regarding the effects of the incorporation of senses into the VR experience. While several studies have shown positive effects (e.g. Jung, Wood, Hoermann, Abhayawardhana, & Lindeman, 2020; Ranasinghe, Jain, & Tram, 2018; Ranasinghe, Jain, Karwita, Tolley, & Do, 2017), others have not (Baus, Bouchard, & Nolet, 2019; Hopf, Scholl, Neuhofer, & Egger, 2020). In the specific context of this research (tourism), the only empirical study that added olfactory and tactile inputs to a destination-based VR experience did not result in higher visitor numbers (Hopf et al., 2020). However, the authors analyzed the joint effect of both sensory stimuli (smell and touch), not the individual effect of each sense. As the two manipulations were introduced simultaneously, the resulting output cannot be assigned to one or the other (Viglia & Dolnicar, in press). Therefore, given that olfactory stimuli have been less integrated into VR research than have tactile stimuli (Baus et al., 2019; Guttentag, 2010), this study focuses specifically on the addition of olfactory input. The addition of suitable odors to VR experiences represents a further step toward the effective sensorialization of the digital environment.

2.2. The role of scent in VR experiences

Since the first attempts to incorporate scents into audiovisual and immersive experiences (Smell-O-Vision, Laube, 1959; Sensorama, Heilig, 1962), there has been increasing interest in the development of digital scent delivery devices; several companies have attempted to market devices, with more or less success (iPhone, Trends, 2014; Scentee, Tech in Asia, 2014; iSmell, Hustle, 2018). Some examples of current developments are Olorama (Olorama, 2020), Aroma Shooter (Shooter, 2020), Portable USB Aroma Diffusers (Soehne, 2020) and Feelreal (Feelreal, 2020). Academic research has also made efforts to integrate olfactory stimuli into digital immersive experiences (e.g. Covarrubias et al., 2015; Dinh, Walker, Hodges, Song, & Kobayashi,

Table 1
Multisensory VR research in services.

Reference	Objectives	Context	Methodology	Findings	Involved senses (apart from audiovisual)		
					Touch	Smell	Taste
Alaraj et al. (2015)	Development of a new haptic-based virtual reality (VR) simulator for neurosurgical training.	Training	Residents tested a VR aneurysm clipping simulator with haptic feedback and evaluated their perceptions.	Residents perceived that this system was useful in preparing them for real-life surgeries and it resembled how the real surgery would be.	✓		
Covarrubias et al. (2015)	Designed a multisensory VR system, based on exercises where interactions with objects happen through gestures and scents, for upper-limb rehabilitation.	Health	Two tests: within-subjects designs (15 healthy users in one study; 2 patients in the other study), who use the VR system with and without HMD. Self-reported measures before and after the experiences.	Participants preferred stereoscopic vision (versus PC), gained confidence in the use of gestures over time, and appreciated odors in terms of pleasantness and congruence.	✓	✓	
Serrano et al. (2016)	Analyzed how a mood-induction procedure implemented with multisensory VR can induce relaxation and generate presence.	Wellness	Lab experiment. Participants were exposed to a VR experience including (or not) olfactory and touch stimuli (together or individually).	All the groups scored high in level of relaxation. When touch was stimulated, relaxation and sense of presence was higher.	✓	✓	
Shapira, Amores, and Benavides (2016)	To test TactileVR, a VR system in which users can interact with physical objects which are represented in the virtual environment.	Entertainment	Lab experiment. Children used this system and evaluated their experience after performing some tasks.	Children took instantly to this system, getting used to interacting and performing certain tasks with it. High satisfaction with the system.	✓		
Baus and Bouchard (2017)	Explored if exposure to an olfactory stimulus affected perceived presence, sense of reality and realism in VR.	HCI; Real Estate	Lab experiment. Participants were exposed to either a pleasant, unpleasant or ambient scent (control) in the VR experience.	Unpleasant odors generate higher levels of presence than pleasant odors.		✓	
Ranasinghe et al. (2017)	Analyzed if the addition of thermal and wind stimuli provided by Ambiotherm help enhance perceptions of presence in a VR experience.	HCI; Entertainment	Lab experiment. Participants were randomly assigned to a VR experience including (or not) thermal and wind stimuli.	The addition of wind and thermal stimuli significantly enhances sensory and realism factors, which contribute to an enhancement of sense of presence.	✓		
Butt, Kardong-Edgren, and Ellertson (2018)	Explored if the use of a VR headset with wearable gloves can improve nurses' learning in a VR game-based training experience.	Training	Lab experiment. Two groups: one learned the procedure in reality, and the other used VR and wearable gloves.	VR elicited higher usability, engagement, enjoyment and focus on the task. They also completed the task more times than the other group.	✓		
Edwards, Bielawski, Prada, and Cheok (2019)	To test how adding haptic stimulation to a VR system improved the learning process of chemistry.	Education	Lab experiment. Participants could build molecules interacting with the bonds and atoms available.	This system supports participants' high engagement, motivation, interest and organic chemistry learning.	✓		
Ranasinghe et al. (2018)	Designed a multisensory wearable VR HMD system	Entertainment	Experiment within-subjects condition. Participants were exposed to a VR journey through the four seasons where the corresponding olfactory and haptic (thermal and wind) stimuli were added.	Results showed that the addition of any sensory modality enhances users' sense of presence in a VR experience and combining them further increased this effect.	✓	✓	
Baus et al. (2019)	Analyzed if visual/scent congruence affected users' perceptions in VR experiences.	HCI; Real Estate	Lab experiment. Participants were exposed to either a pleasant (and congruent scent), and an unpleasant (and incongruent) scent, or an ambient scent (control) in a VR experience.	Pleasant odors congruent with the virtual environment shown generated higher sense of reality. However, it did not affect sense of presence nor realism. Visual/olfactory congruence facilitates scent detection.		✓	
Huang, Huang, and Wan (2019)	Studied if watching the simulation of actual tea color in VR influenced participants' evaluation of the tea taste.	Food & beverage	Lab experiment. Participants tasted an actual tea sample after watching the simulation of the tea color with VR.	The visual representation of VR and the real-world gustatory cues influence participants' taste perceptions of the actual drink when colors are previously selected by them.			✓
Liu, Hannum, and Simons (2019)	Explored how the congruency between the visual, auditory and olfactory cues in a virtual environment affected perceptions of cold brewed coffees.	Food & beverage	Within-subjects lab experiments. In every tasting condition, participants were exposed to different combinations of visual, auditory and olfactory cues in an immersive environment.	Olfactory cues were less recalled than other stimuli. Participants spent more time evaluating the coffees when all the sensory cues were congruent.		✓	✓
Chen, Huang, Faber, Makransky, and Perez-Cueto (2020)	Assessed the combined effect of taste-congruent/incongruent visual cues displayed with VR in beverage perceptions.	Food & beverage	Within-subjects lab experiment. Participants tasted the same beverage while using a VR HMD which displayed different environments.	Perceived sweetness of the beverage was higher when a sweet-congruent VR environment was displayed.			✓
Hopf et al. (2020)	Analyzed how the joint addition of olfactory and tactile stimuli	Tourism	Lab experiment. Olfactory and haptic inputs were simultaneously	Presence is not enhanced in multisensory VR experiences.	✓	✓	

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Table 1 (continued)

Reference	Objectives	Context	Methodology	Findings	Involved senses (apart from audiovisual)		
					Touch	Smell	Taste
Jung et al. (2020)	can result in better VR experiences with a destination. To explore the impact of simultaneously delivered multiple sensory feedback on a VR perceptual-cognitive task.	HCI; Entertainment	added to the experimental group experience when they watched the video of a destination with VR. Within-subjects lab experiment. Participants were exposed to several virtual environments (vision and audio) which included (or not) additional tactile (wind blowing, floor vibration) and olfactory stimuli.	Immersion and intention to recommend the destination are higher in multisensory VR. Multi-sensory VR led to superior states of presence in the virtual environment and user preference. However, the omission of additional sensory inputs resulted in higher confidence levels for the task.	✓	✓	

Source: Own design.

1999; Herrera & McMahan, 2014; Maggioni, Cobden, Dmitrenko, Hornbæk, & Obrist, 2020; Ranasinghe et al., 2018).

Despite the great interest, there remain some barriers to be overcome before digital scent delivery systems can be successfully fully incorporated into VR experiences. First, some of these sophisticated devices have to be worn during the immersive experience, causing their users discomfort and distracting them from the main experience (Jung et al., 2020; Ranasinghe et al., 2018). Second, there is no standard device, mainly due to the complexity of the existing designs, the difficulty in developing storing-mixing-delivery mechanisms, lack of affordability, and the consequent lack of availability to the general public (Herrera & McMahan, 2014; Serrano et al., 2016). For all these reasons the digitalization of scents in digital experiences remains a challenge.

The simplest way to deliver digitized odors into immersive experiences, naturalistically and subtly, is to use ambient scent (Spence et al., 2017). Ambient scent is an aroma that does not emanate from a specific object, but is present in the environment (Spangenberg, Crowley, & Henderson, 1996). Compared to object-specific scents, the implementation of ambient scents is particularly attractive to retailers and service providers because they can enhance customers' overall impressions of experiences (Chebat & Michon, 2003; Mattila & Wirtz, 2001). Moreover, ambient scents have been shown to augment the other senses in digital experiences (Spence et al., 2017). Participants have been placed in realistic digital environments where, while they have not been able to report the existence of a scent, its mere presence affected their evaluations and decisions (Li, Moallem, Paller, & Gottfried, 2007; Maggioni et al., 2020; Uchida, Kepecs, & Mainen, 2006). Thus, the integration of ambient scents into VR environments represents for researchers and practitioners an interesting development, as it has been shown that they can generate favorable experiences that might foster the user's connection with the virtual environment (Cowan & Ketron, 2019; Raisamo et al., 2019).

However, it remains unclear which features of olfactory stimuli can help enrich the overall VR service experience. The few empirical exceptions (see Table 1) lack consensus about the effectiveness of incorporating ambient scents into VR experiences, or did not consider the specific features of scents that can be added to affect the multisensory digital experience (Baus & Bouchard, 2017; Baus et al., 2019; Hopf et al., 2020; Serrano et al., 2016). Thus, there is a need to better understand the role of olfactory stimuli, particularly regarding the features of ambient scents, in customers' VR experiences (Roschk & Hosseinpour, 2020; Serrano et al., 2016).

3. Hypotheses development

The present study focuses on tourism as a particular type of service. Due to the high degree of intangibility of tourism services (Alves, Campón-Cerro, & Hernández-Mogollón, 2019), VR plays an important role in the dissemination of tourist information (Yung & Khoo-Lattimore, 2017). In addition, including other sensory stimuli (apart

from audiovisual input) in the VR experience can bring the digital experience closer to the experience of the real destination (Guttentag, 2010), and communicate a sensory destination identity (Agapito, Mendes, et al., 2013; Agapito, in press).

Fig. 1 shows graphically the proposed relationships regarding the influence of technologies and scents on digital experiences. Specifically, in the context of a destination pre-experience (Beerli-Palacio & Martín-Santana, 2018), the present study analyzes the effect of the interplay between scent inputs and audiovisual digital experiences based on different technologies on users' sensory stimulation (i.e. the activation of users' senses as a consequence of sensory information delivered in a VR experience; Flavián et al., 2019a), and its subsequent influence on affective and conative destination images. The mediating role of ease of imagination on this relationship is also explored.

Recent technological advances have reduced the distance between technologies and the human senses. Human-technology mediation has been affected by this trend (Tussyadiah, Jung, & Tom Dieck, 2017). From a physical perspective, the theory of technological mediation (Ihde, 1990) proposes that embodiment occurs when technologies mediate users' experiences by becoming increasingly integrated into their human senses (Tussyadiah et al., 2017). Thus, technological embodiment can be defined as the degree of integration of a device with the human body (Flavián, Ibáñez-Sánchez, & Orús, 2019b; Flavián et al., in press). In this way, devices actively take part in users' interactions, and allow them to perceive and perform sensory actions in their immediate environment (Tussyadiah et al., 2017). This conceptualization of embodiment differs from others in the HCI domain, which consider embodiment as the users' sense of their own body (e.g. Longo, Schüür, Kammers, Tsakiris, & Haggard, 2008), particularly regarding their capacity to control, to own and to feel self-located with their virtual counterpart in a digital environment (Aldhous, Hetherington, & Turner, 2017; Liepelt, Dolk, & Hommel, 2017; Nimcharoen, Zollmann, Collins, & Regenbrecht, 2018).

The embodiment-presence-interactivity (EPI) cube (Flavián et al., 2019b) distinguishes between external and internal devices. External devices (e.g. PCs) are physically detached from the human body, whereas internal devices (e.g. VR HMDs) are closer to the human senses. As internal devices use effectors which stimulate the receptors of the perceptual human senses (Latta & Oberg, 1994), they are able to generate superior levels of sensory stimulation than external devices (Flavián et al., 2019a). In addition, scents are processed in the primeval areas of the brain, so they are perceived with low cognitive effort (Bone & Ellen, 1999; Herz & Engen, 1996). Thus, scents are directly processed, along with other sensory inputs, in customers' experiences. It has been shown that adding odors to the customer experience produces holistic experiences which engage the human senses (Nibbe & Orth, 2017). In digital environments, sensory (e.g. odors) augmentation can help develop enhanced sensory experiences (Buhalis et al., 2019). Therefore, our first hypothesis reflects previous findings that showed that higher degrees of technology-human body integration in the digital experience,

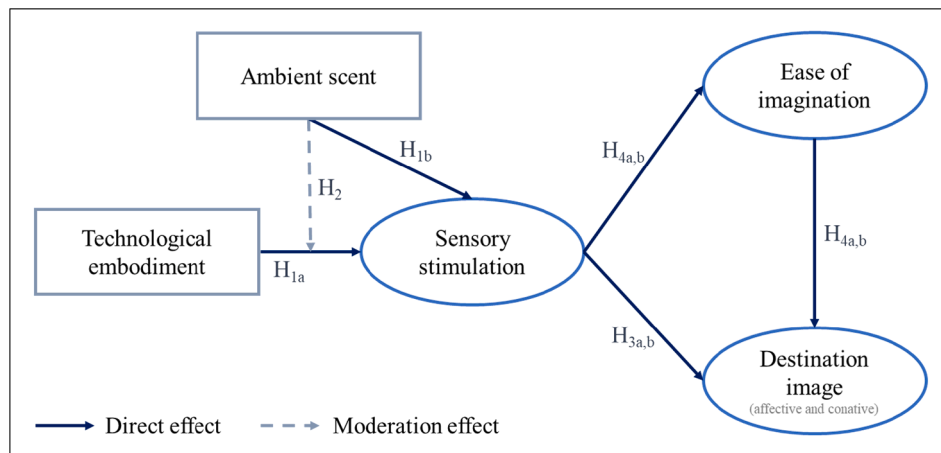


Fig. 1. Ambient scent and embodiment influences on the multisensory digital experience.

and the addition of scents to the digital experience, have positive effects on sensory stimulation:

H1a. The use of embodied (vs. non-embodied) technologies in a digital experience will have a positive influence on users' sensory stimulation.

H1b. The presence (vs. absence) of a pleasant ambient scent in a digital experience will have a positive influence on users' sensory stimulation.

Congruency is the degree to which different cues fit with each other in a particular environment (Helmefalk & Hultén, 2017). Sensory congruency has been defined as the existing fit between the characteristics of the different sensory stimuli of an experience (Krishna, Elder, & Caldara, 2010). Congruent sensory cues, specifically scents, can generate favorable multisensory experiences (Roschk & Hosseinpour, 2020; Roschk, Loureiro, & Breitsohl, 2017). The underlying reasons for this are explained by the theory of cognitive balance (Heider, 1958) and the theory of processing fluency (Herrmann, Zidansek, Sprott, & Spangenberg, 2013; Schwarz, 2004). According to the theory of cognitive balance (Heider, 1958), harmonious or balanced (compared to unbalanced) situations generate favorable reactions in individuals. The theory of processing fluency (Herrmann et al., 2013; Schwarz, 2004) argues that congruent stimuli (versus incongruent stimuli) help individuals more easily process information, which generates positive reactions. The mere presence of a pleasant scent may not be enough to generate better multisensory experiences, but congruency between stimuli is critical in determining the multisensory effectiveness of experiences (Spangenberg, Grohmann, & Sprott, 2005). Therefore, congruency is an important aspect in the cross-modal effects between different sensory inputs that foster the positive effects of aromas in experiences (Spence, 2011). Formally:

H2. The effect of embodiment on sensory stimulation will be higher for an ambient scent congruent (vs. non-congruent) with the audiovisual content of a digital experience.

The mental image that potential visitors have of a destination is a critical factor when they make travel decisions (Baloglu & McCleary, 1999; Beerli-Palacio & Martín-Santana, 2018; Bogicevic et al., 2019). The present study examines the distinction between affective and conative destination images. Affective destination image represents the feelings and emotions felt toward a destination (Lin, Morais, Kerstetter, & Hou, 2007; Pike & Ryan, 2004). The concept of conative destination image is closely linked to the idea of behavioral intentions toward that destination (Hyun & O'Keefe, 2012). Therefore, it can be considered as the main antecedent of how potential tourists will actually behave in the future (Ajzen, 1991; Pike & Ryan, 2004). Multisensory experiences in digital environments enrich the experiences of the potential tourist, and

promote the affective side of the destinations depicted (Ghosh & Sarkar, 2016). In addition, previous research has found that sensory stimulation has a positive influence on behavioral intentions toward a destination (Flavián et al., 2019a). Thus, sensory inputs can affect potential tourists' senses, and promote positive behaviors through emotions, memories, perceptions, and preferences (Krishna, 2012). Therefore:

H3. Sensory stimulation will have a positive influence on (a) the affective image and (b) the conative image of a destination.

We propose that ease of imagination is the mechanism through which sensory stimulation affects users' perceptions of image. Ease of imagination has been defined as the ease with which consumers can create a mental image about how a product might perform (Orús, Gurrea, & Flavián, 2017). These imaginative processes are undertaken through sensory representations of ideas, feelings and experiences with objects which, as a result, influence subsequent evaluations and behavioral intentions (Walters, Sparks, & Herington, 2007). The imagery accessibility approach (Alter & Oppenheimer, 2009; Petrova & Cialdini, 2008) suggests that the ease with which consumers imagine products or consumption situations is an informational cue that influences evaluations and behavioral intentions. This metacognitive experience helps them evaluate alternatives and make their final decisions (Orús et al., 2017). This may be especially important in a service context, given that the intangible nature of services leads consumers to infer how experiences might unfold. This mental representation is sometimes the most important available source on which to base a judgement, acting as a "try-before-you-buy" experience (Guttentag, 2010). When a high number of sensory inputs are stimulated, the enriched sensory information helps users to better imagine how actual experiences will unfold (Wei, Qi, & Zhang, 2019). Thus, VR experiences favor users' imaginative processes by evoking concrete mental representations of simulated environments (Cowan & Ketron, 2019). Furthermore, the addition of a suitable scent can also favor imaginative processes, helping users envision how the real experience will unfold, and facilitate their decision-making processes (Goldkuhl & Styvén, 2007; Uchida et al., 2006). Consequently, when sensorially stimulated, individuals may be expected to easily envisage the destination, and this metacognitive experience will determine their perceived affective and conative images (Bogicevic et al., 2019; Ghosh & Sarkar, 2016). Thus:

H4: Ease of imagination mediates the impact of sensory stimulation on (a) the affective image and (b) the conative image of destinations.

4. Methodology

The hypotheses were tested in a laboratory experiment. The sample consisted of 263 participants (60.1% women; mean age = 21.7), who

were randomly assigned to one of the 2 (technological embodiment: low –PC– vs. high –VR HMD) \times 3 (scent: no scent vs. pleasant and non-congruent –P– vs. pleasant and congruent –P + C) between-subjects conditions, in a factorial design. Cell sizes ranged from 39 to 48 participants. Considering these cell sizes, and the standard approach regarding a significance level of $\alpha = 0.05$, and an expected statistical power of $\beta = 0.80$, we would expect to detect a 1/2.5 standard-deviation change in the outcome variables (Viglia & Dolnicar, in press).

In the experiment the participants were instructed to imagine that they were thinking about visiting a particular destination. In order to avoid biases derived from previous experiences or tourism preferences, two destinations were chosen as the stimuli for the experiment, and randomly assigned to the participants: Venice (Italy) and the Cliffs of Moher (Ireland). The participants first answered a series of control questions regarding their previous experience with the destinations, their preferences for different types of tourism (e.g. nature, sports, city), their previous experiences with 360-degree videos displayed on PCs and VR HMDs, and their previous experience with VR (Flavián et al., 2019a, in press). They were, thereafter, randomly assigned to one of the six experimental conditions. Depending on the condition, they visualized a 360-degree video of the destination through one of the devices (PC vs. VR HMD) in a room with different types of scent (no scent vs. pleasant and non-congruent vs. pleasant and congruent). The original videos were modified to keep their duration (90 s) and sound quality constant. The lab rooms were perfumed with ambient scents when required by the experimental condition.

After undergoing their pre-experience with the destination, the participants moved on to another room where they answered the questionnaire about the variables under study: technological embodiment (four items from Flavián et al., 2019a), sensory stimulation (five items from Witmer & Singer, 1998), ease of imagination (four items from Orús et al., 2017; Weathers, Sharma, & Wood, 2007), affective destination image (three items from San Martín & Del Bosque, 2008) and conative destination image (three items from Bigné, Sánchez, & Sánchez, 2001). The measurements were made on 7-point Likert scales, ranging from “1 = strongly disagree” to “7 = strongly agree”. Before the participants provided their demographic data, they were asked to indicate whether they had noticed any scent in the experimental room (yes vs. no), and to rate any scent in terms of pleasantness, intensity, familiarity and congruency (Errajaa et al., 2018).

4.1. Olfactory stimuli

Following the procedures of Serrano et al. (2016), ceramic diffusers with a small, unscented candle, water, and essence oil of a particular scent, were used to perfume the lab rooms. Current technological developments offer sophisticated devices (e.g., collars, masks, tubes) that allow the user (or the researcher) to have a high degree of control over the olfactory inputs (Noguchi, Sugimoto, Bannai, & Okada, 2011; Ranasinghe et al., 2018). However, as previously stated, most of these methods require the participant to wear special devices which introduce additional nuisance that may distract him/her from the immersive experience (Jung et al., 2020), and may be invasive and/or uncomfortable (Ohtsu, Sato, Bannai, & Okada, 2009; Ranasinghe et al., 2018). These devices are often of complex design, can be expensive, and can be unavailable to the general public (Herrera & McMahan, 2014). Nonetheless, these sophisticated devices can be useful when the task involves using several scents (Lai, 2015; Ranasinghe et al., 2018), or when the olfactory stimulation is object-based (Covarrubias et al., 2015; Dinh et al., 1999; Mochizuki et al., 2004). In our experiment we used one ambient scent to enrich the multisensory experience, given that the videos showed a scene in an outdoor environment where the user did not interact with any specific object. In addition, our purpose was not to make the scent manipulation highly obvious to the participants, but to place them in a realistic situation where the scents would be subtly perceived. Ceramic diffusers provide a natural, non-invasive, simple and

ecological means of introducing ambient scent (Serrano et al., 2016; Yanagida, 2012).

Two scents were introduced into the experimental rooms. To avoid possible problems derived from mixing odors in the environments (Lai, 2015), only one scent was dispersed in any one room. The scents were carefully controlled to ensure that they were uniformly distributed in the rooms (Morrison, Gan, Dubelaar, & Oppewal, 2011). Each experimental room had a surface area of 25 m². Three ceramic diffusers, which were hidden from the participants' views, were spaced equidistantly within each room. It was recognized that, although the destination pre-experience was relatively short (90 s), scent habituation (a scent present over a continuous period causes human adaptation due to a decrease in sensory nerve activity) could be an issue (Noguchi et al., 2011; Ohtsu et al., 2009). To avoid any habituation, the researchers poured a drop of essence oil in the ceramic diffusers in the middle (45 s) of the participants' destination pre-experiences.

The scents were selected to be equivalent in terms of pleasantness, but dissimilar in terms of their congruence with the destination (Errajaa et al., 2018). To take account of safety and allergy concerns, the scents were chosen from the products provided by a specialized company (Lai, 2015). From the company's portfolio, coffee was chosen for Venice and grass for the Cliffs of Moher. In a verification test, five individuals independent of the research project correctly identified the scents; thereafter, we carried out an online survey to confirm the stimuli. The survey participants (N = 118; 46.2% female; mean age = 23.7) were recruited through a market research agency.

The survey contained several questions, using qualitative and quantitative approaches and different measurements (close-ended and open-ended questions), to ensure that the olfactory manipulations were appropriate for use in the main experiment. For the sake of simplicity, only a summary of the results is reported; the complete study is available from the authors on request. First, the participants were asked to associate different objects (food, beverages, and environmental elements) with either Venice or the Cliffs of Moher. Coffee was associated with Venice by 61% of the participants (versus 22.9% with the Cliffs of Moher), whereas 64.4% associated grass with the Cliffs of Moher (versus 5.1% with Venice). Second, the participants were randomly assigned to one of two imagined situations, in which the following story about a trip to Venice (or the Cliffs of Moher) was displayed:

It's 8 am. You just woke up. You are in Venice (Doolin, one of the closest villages to the Cliffs of Moher). You arrived last night to enjoy a few days off after some weeks of hard work. When you open the curtains, you notice it's a wonderful day, that the sun is shining. You open the window and a breath of fresh air with a pleasant scent enters your room... you think: it smells so good! You cannot wait to start enjoying your trip.

The story was similar in both conditions, and only the destination was changed. After they had read the passage, we asked the participants what scent came to their minds based on the content (open-ended question). In the Venice vignette (n = 60) 68 scents were identified; coffee was the most reported (21 times; 30.9%), whereas grass was reported by only 2 participants. In the Cliffs of Moher vignette (n = 58), among the 75 scents reported, grass was the word most used (28 times; 37.3%), and coffee was barely mentioned, indeed, only by one participant. Therefore, both tests (closed options from a list and an open-ended, free association test) showed that coffee was associated by more participants with Venice than it was with the Cliffs of Moher, whereas grass was more associated with the Cliffs of Moher than with Venice.

Third, we used projective techniques to allow the participants to freely associate the destinations to different stimuli (e.g. images, aromas, tastes, beverages). The presentation was counterbalanced so that the participants who read the Venice story were exposed in this section to the Cliffs of Moher, and vice versa. In summary, it was found that both destinations were associated with water-related scents and

images (e.g. sea, canals, beaches, stagnant water), and that these water-related scents had both positive and negative meanings for the participants. These results discouraged the researchers from using water-related scents as experimental stimuli. Overall, coffee was more frequently reported for Venice than for the Cliffs of Moher, and grass was more frequently reported for the Cliffs of Moher than for Venice.

These qualitative results were confirmed quantitatively using closed-ended questions. On 7-point scales, the participants rated the coffee and the grass scents in terms of pleasantness (unpleasant-pleasant, unlikable-likeable, irritating-delightful; Cronbach α > 0.96). The average values were calculated to create a measure of pleasantness. The results of a one sample T test, taking the mid-point of the scale (4) as the reference value, showed that both coffee ($M = 5.88$, $SD = 1.46$; $t_{(116)} = 13.936$; $p < 0.001$) and grass ($M = 5.67$, $SD = 1.57$; $t_{(116)} = 11.512$; $p < 0.001$) were rated as pleasant scents. The difference between the aromas was not significant, according to a related samples T test ($p = 0.280$).

In addition, the participants assessed the degree of congruence between the scents and the destinations. We asked the participants to indicate, on 7-point semantic differential scales, to what extent each scent was more (1) related, (2) congruent, (3) fitted, and (4) appropriate, to each destination (1 = Venice, and 7 = Cliffs of Moher) (Cronbach α > 0.94). The average values were calculated. The results of one sample t-tests, taking the mid-points of the scales (4) as reference values, showed that the coffee scent was significantly more congruent with Venice than with Ireland ($M = 2.57$, $SD = 1.61$, $t_{(116)} = -9.606$, $p < 0.001$), whereas the opposite was the case with the grass scent ($M = 6.34$, $SD = 0.90$, $t_{(116)} = 28.054$, $p < 0.001$). Altogether, these results confirmed the suitability of the scents for the main experiment.

5. Results

5.1. Manipulation checks

To validate the scales, regular procedures were performed using SmartPLS 3 (Ringle, Wende, & Becker, 2015). Specifically, we checked that the loadings of all the items were superior to 0.7, and that the Cronbach's α s and composite reliabilities of the variables were greater than 0.7 and 0.65, respectively. In addition, both convergent and discriminant validity criteria were met (Hair, Black, Babin, Anderson, & Tatham, 2010). Following validation of the scales, the average values of the items were calculated and the resulting scales were used to perform the analyses. We controlled for possible differences in the variables under study based on type of destination and scent. No significant differences were found, so the data from both destinations (Venice and the Cliffs of Moher) were merged. Thus, the Venetian digital experience and a grass scent represented the "pleasant" condition (P), whereas the coffee scent accounted for the "pleasant and congruent" condition (P + C); the opposite was applied to the digital experience with the Cliffs of Moher: the coffee scent was the "pleasant" condition (P), while the grass scent represented the "pleasant and congruent" condition (P + C).

Independent t-tests were carried out to check the manipulations. The results showed that technological embodiment was significantly higher for participants in the VR HMD condition ($M = 5.37$, $SD = 1.01$) than in the PC condition ($M = 3.09$, $SD = 1.29$; $t_{(261)} = 15.929$, $p < 0.001$). In addition, both scents were similar in terms of pleasantness ($M_P = 5.29$, $SD_P = 1.35$; $M_{P+C} = 5.31$, $SD_{P+C} = 1.44$; $p = 0.935$), intensity ($M_P = 5.44$, $SD_P = 1.48$; $M_{P+C} = 5.51$, $SD_{P+C} = 1.36$; $p = 0.734$), and familiarity ($M_P = 4.64$, $SD_P = 1.58$; $M_{P+C} = 4.85$, $SD_{P+C} = 1.67$; $p = 0.408$). However, the degree of congruity of the scents with the destinations differed significantly, being higher for the pleasant + congruent scent than for the pleasant scent ($M_P = 3.35$, $SD_P = 1.66$; $M_{P+C} = 5.23$, $SD_{P+C} = 1.51$; $t_{(171)} = 7.759$, $p < 0.001$). These results confirmed that the manipulations were correctly executed and perceived by the participants.

5.2. Hypotheses testing

H1 and H2 were tested through a univariate ANOVA, with sensory stimulation as the dependent variable and the experimental treatments as the independent factors. The ANOVA results revealed that sensory stimulation was significantly higher for participants in the VR HMD condition ($M = 5.62$, $SD = 1.00$) than in the PC condition ($M = 3.97$, $SD = 1.38$; $F_{(1, 262)} = 139.480$, $p < 0.001$). In addition, the presence of a pleasant ambient scent significantly influenced the participants' sensory stimulation ($F_{(2, 262)} = 13.571$, $p < 0.001$). With no scent, sensory stimulation was lower ($M = 4.30$, $SD = 1.37$) than with a pleasant scent ($M_P = 5.18$, $SD_P = 1.38$; $M_{P+C} = 4.90$, $SD_{P+C} = 1.50$). A post-hoc HSD Tukey test showed that the difference between the scents was not significant ($p = 0.230$). Thus, H1a and H1b were supported. Furthermore, the embodiment \times scent interaction was significant ($F_{(2, 262)} = 5.043$, $p < 0.01$). As can be observed in Fig. 2, the effect of embodiment on sensory stimulation was stronger when the scent was congruent with the destination, which supports H2.

The macro PROCESS v3.1 for SPSS v26 was used to test H3 and H4. The macro PROCESS is a user-friendly, path analysis modeling system that uses OLS regression procedures and estimates indirect effects to assess the significance of mediation (Hayes, 2018). The macro can be used with small samples with irregular sampling distributions, given that it uses bootstrapping methods to estimate indirect effects (Hayes, Montoya, & Rockwood, 2017). PROCESS allows researchers to analyze direct, indirect, and total effects simultaneously with the total sample and does not require subgroup analysis (Hayes, 2018). This modeling tool is freely available for SPSS, SAS, and R statistical packages (Macro, 2020).

We designed a customized model based on the conceptual diagram shown at Fig. 1. Two separate conditional process models were ran, using perceived affective image and conative image as the dependent variables, respectively. The device (VR HMD = 1; PC = 0) was included as the independent variable; sensory stimulation and ease of imagination were the mediators. The scent manipulation was included as the moderator. Taking into account that the moderator was a multi-categorical variable, two dummy variables were created (W1: 1 = presence of scent, 0 = no scent; W2: 1 = pleasant + congruent scent; 0 = otherwise). The participants' previous experience with the destination, with 360-degree videos, and with VR, and their preferences for the types of tourism displayed on the videos, were included as covariates.

Table 2 shows the results of the analyses. First, the regression on sensory stimulation replicated the results of the ANOVA regarding the direct and interaction effects of the experimental treatments. In support of H3, sensory stimulation positively influenced affective image (H3a) and conative image (H3b) (Table 2).

Regarding H4, the analysis revealed that sensory stimulation had a direct impact on ease of imagination. Ease of imagination had a significant, positive effect on affective image and conative image (Table 2). Importantly, the bootstrap results for the indirect effects of the VR HMD

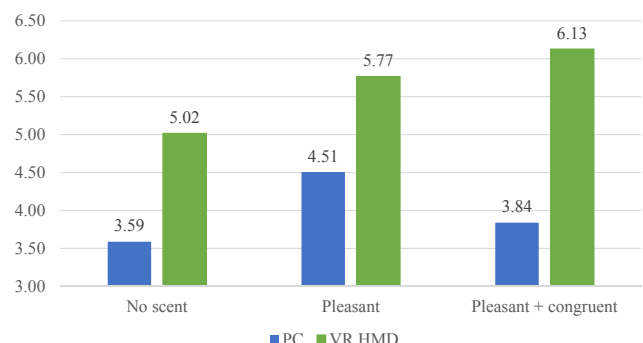


Fig. 2. Embodiment \times scent interaction on sensory stimulation.

Table 2

Results of the conditional process models on destination image.

Predictor: Sensory stimulation	Coeff.	SE	<i>t</i>	<i>p</i>	LLCI	ULCI
Constant	3.228	0.398	8.122	0.000	2.445	4.010
Device (VR HMD vs. PC)	1.434	0.239	6.004	0.000	0.964	1.905
W1 (Scent: yes vs. no)	0.961	0.245	3.921	0.001	0.480	1.443
W2 (P + C aroma vs. otherwise)	−0.607	0.245	−2.896	0.014	−1.089	−0.123
Interaction: Device × W1	−0.162	0.342	−0.471	0.638	−0.836	0.513
Interaction: Device × W2	1.010	0.350	2.896	0.004	0.323	1.698
Prev. exp. destination	0.297	0.158	1.883	0.061	−0.014	0.607
Preference type of tourism	0.043	0.060	0.709	0.478	−0.076	0.160
Prev. exp. 360-degree videos	0.041	0.061	0.675	0.500	−0.078	0.161
Prev. exp. VR	−0.321	0.211	−1.518	0.130	−0.737	0.095
Model Summary	R² = 0.422; F_(9, 253) = 20.510, <i>p</i> < 0.001					
Predictor: Ease of imagination	Coeff.	SE	<i>t</i>	<i>p</i>	LLCI	ULCI
Constant	1.705	0.363	4.700	0.000	0.991	2.420
Device (VR HMD vs. PC)	0.124	0.150	0.868	0.392	−0.161	0.410
Sensory stimulation	0.523	0.050	10.557	0.000	0.426	0.621
Prev. exp. destination	0.028	0.132	0.215	0.832	−0.231	0.288
Preference type of tourism	0.163	0.051	3.215	0.002	0.063	0.263
Prev. exp. 360-degree videos	0.041	0.051	0.806	0.421	−0.059	0.142
Prev. exp. VR	0.138	0.178	0.774	0.439	−0.213	0.488
Model Summary	R² = 0.437; F_(6, 256) = 33.113, <i>p</i> < 0.001					
Predictor: Affective image	Coeff.	SE	<i>t</i>	<i>p</i>	LLCI	ULCI
Constant	1.395	0.350	3.994	0.000	0.707	2.083
Device (VR HMD vs. PC)	−0.140	0.134	−1.045	0.297	−0.404	0.124
Sensory stimulation	0.262	0.055	4.778	0.000	0.154	0.370
Ease of imagination	0.438	0.058	7.578	0.000	0.323	0.551
Prev. exp. destination	−0.171	0.122	−1.407	0.161	−0.411	0.069
Preference type of tourism	0.078	0.048	1.624	0.106	−0.017	0.172
Prev. exp. 360-degree videos	0.030	0.047	0.642	0.521	−0.063	0.124
Prev. exp. VR	−0.038	0.165	−0.232	0.817	−0.362	0.286
Model Summary	R² = 0.473; F_(7, 255) = 32.706, <i>p</i> < 0.001					
Predictor: Conative image	Coeff.	SE	<i>t</i>	<i>p</i>	LLCI	ULCI
Constant	0.363	0.384	0.952	0.342	−0.390	1.121
Device (VR HMD vs. PC)	−0.294	0.147	−1.999	0.047	−0.585	−0.004
Sensory stimulation	0.170	0.060	2.822	0.005	0.051	0.289
Ease of imagination	0.637	0.063	10.039	0.000	0.512	0.762
Prev. exp. destination	−0.182	0.134	−1.357	0.176	−0.445	0.082
Preference type of tourism	0.040	0.053	0.762	0.447	−0.064	0.144
Prev. exp. 360-degree videos	0.123	0.052	2.356	0.019	0.020	0.225
Prev. exp. VR	−0.316	0.181	−1.748	0.082	−0.672	0.040
Model Summary	R² = 0.494; F_(7, 255) = 35.564, <i>p</i> < 0.001					
Bootstrap results for indirect effects	<i>Effect</i>	BootSE	BootLLCI	BootULCI		
Device → Sensory stimulation → Ease of imagination → Affective image						
No scent	0.328	0.087	0.183	0.521		
Pleasant scent	0.291	0.092	0.145	0.499		
Pleasant + Congruent scent	0.523	0.110	0.334	0.762		
Device → Sensory stimulation → Ease of imagination → Conative image						
No scent	0.478	0.115	0.280	0.721		
Pleasant scent	0.424	0.124	0.216	0.702		
Pleasant + Congruent scent	0.761	0.139	0.514	1.052		

Note: *n* = 263. Confidence interval calculated at 95% significance. Bootstrap sample size = 5000. BootLLCI: lower limit confidence interval; BootULCI: upper limit confidence interval.

on affective image and conative image, through sensory stimulation and ease of imagination, were significant for the three scent conditions, given that a zero value was not included in the 95% confidence intervals (Table 2). The path VR HMD → sensory stimulation → ease of imagination → destination image was significant, thus supporting mediation and H4. Interestingly, the index of the moderated mediation of W2 (pleasant + congruent scent vs. otherwise) was significant for both affective image (*index* = 0.231, 95% bootstrap confidence interval with 5000 samples [0.072, 0.418]) and conative image (*index* = 0.337, 95% bootstrap confidence interval [0.101, 0.586]), revealing that the serial mediation was stronger when the scent was pleasant and congruent with the destination, compared to the other conditions (Table 2).

5.3. Post-hoc analysis

Previous research has found a positive relationship between the

affective and conative images of destinations (Agapito, Valle, & Mendes, 2013; Hyun & O'Keefe, 2012). Thus, we explored whether this link may be affected by the characteristics of the multisensory experience. Embodied VR technologies can reinforce the mental representation of destinations and, thus, foster the relationship between affective and conative images (Agapito, in press; Flavián et al., 2019a). In addition, this effect may be stronger when the ambient scent is congruent with the destination. When there is a match between the different stimuli (i.e. scent and destination displayed), users' reactions are more positive (Herrmann et al., 2013; Schwarz, 2004). Therefore, if the scent dissipated in a VR experience is congruent with displayed content, the link between the affective and the conative image may be strengthened.

To test this possibility, a moderation model was executed in which the relationship between affective and conative image was moderated by the two manipulations. We used the macro PROCESS (Model 3; Hayes, 2018). After controlling for the effects of the covariates, it was

found that the three-way interaction was significant ($\text{coeff.} = 1.074$, $t_{(247)} = 3.174$, $p < 0.01$). Fig. 3 shows the link between both destination images corresponding to the PC vs. VR HMD scenarios in each of the three scent conditions. The relationship was stronger, and the differences between PCs and VR more evident, when the digital experience was accompanied by a congruent scent, compared to the other conditions.

6. Discussion and implications

The results of the analysis show that embodied devices (VR HMD) generate higher sensory stimulation than external devices (PC). The degree of integration between the device and the human senses may explain why VR technologies are able to deliver sensory information effectively (Flavián et al., 2019a). Therefore, technological embodiment should be taken into account in the analysis of the effects of VR on multisensory digital experiences. Pleasant ambient scents improve sensory stimulation, as the number of senses involved in the digital experience increases. Moreover, this research showed that congruency between a pleasant scent and content displayed generates a better multisensory digital experience than is generated by pleasant but non-congruent scents. This is in line with the theories of cognitive balance (Heider, 1958) and processing fluency (Herrmann et al., 2013; Schwarz, 2004), and with previous research about the effect of scents in offline consumption environments (for a review, see Roschk & Hosseinpour, 2020). We have extended this finding to digital experiences with VR technologies.

Furthermore, digital experiences with enhanced multisensory stimulation improve the affective and conative images of destinations. For a service product (e.g. tourist destination), it is important to produce multisensory digital experiences that will generate positive affective and

conative reactions (Flavián et al., 2019a, in press; Ghosh & Sarkar, 2016). We found that ease of imagination mediates the impact of sensory stimulation on the affective and conative images of a destination. Embodied technologies stimulate the users' senses, and this stimulation helps them better imagine how the actual product or experience will turn out (Neuburger, Beck, & Egger, 2018). The resulting mental representation favors affective and conative reactions toward the displayed environment (Bogicevic et al., 2019). Interestingly, these effects are strengthened by the presence of a congruent ambient scent. Therefore, the addition of a new sensory input (i.e. scent), especially if it is congruent with the content displayed, is important in the facilitation of the consumer's mental imagery process (Ghosh & Sarkar, 2016) and for generating positive outcomes in the digital experience. Nevertheless, it should be noted that the mediation was partial, and sensory stimulation still had a direct effect on destination image. Increasing sensory stimulation, in itself, influences users' affective and behavioral responses toward a destination (Ghosh & Sarkar, 2016).

Finally, in line with previous research (Agapito, Valle, et al., 2013; Hyun & O'Keefe, 2012), we explored the link between affective and conative destination image in a post-hoc analysis. When a VR experience is accompanied by a congruent ambient scent, compared to other devices (PCs), or other olfactory cues (non-congruent scent, or no scent), the relationship between affective and conative images is significantly reinforced. Therefore, our findings show an additive effect of VR and congruent olfactory inputs in strengthening the link with destination images in digital experiences. In this way, a persuasive sensory destination identity can be offered to potential tourists that can affect their subsequent affective and conative reactions (Agapito, Mendes, et al., 2013; Agapito, in press).

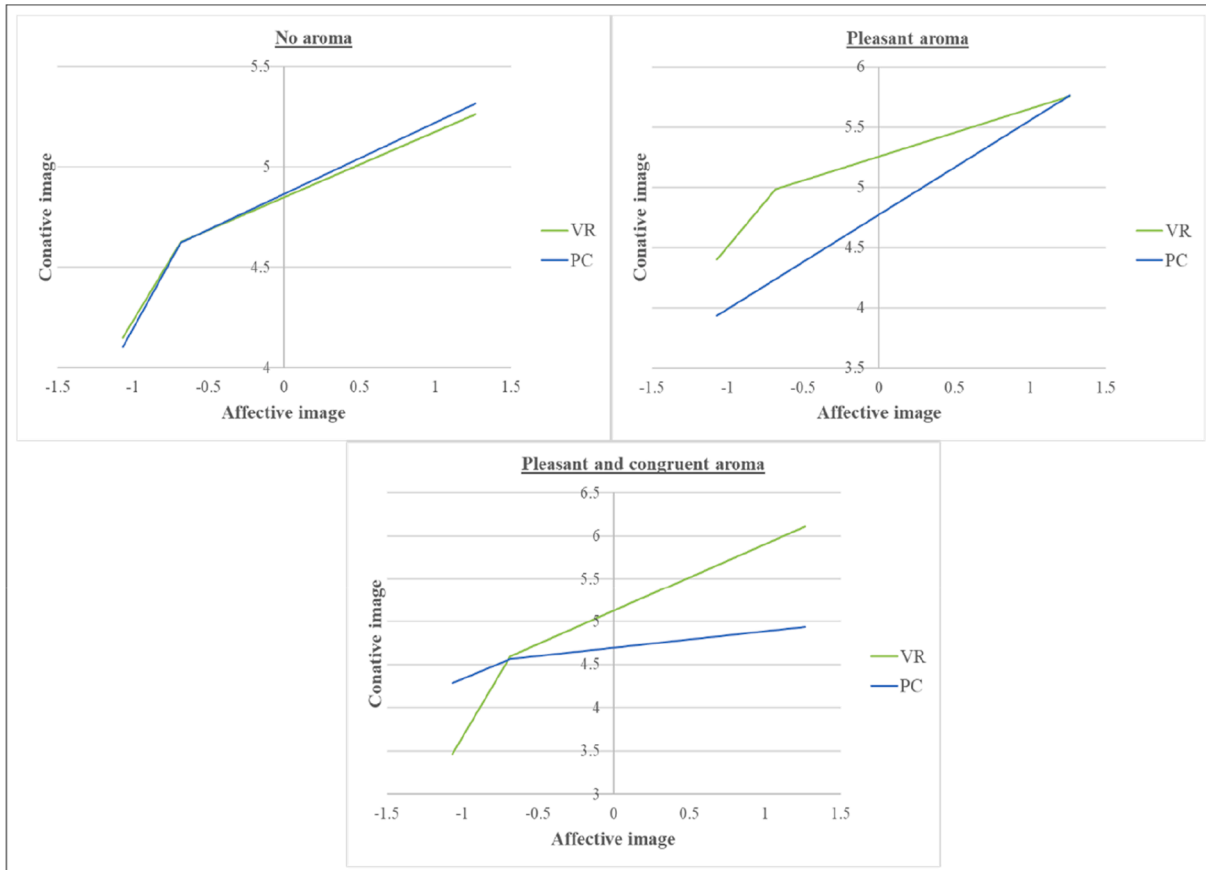


Fig. 3. Embodiment \times scent interaction on the link between affective and conative destination image.

6.1. Managerial implications

The findings of this research can help service providers generate effective multisensory digital experiences. Adding pleasant and congruent ambient scents that complement the audiovisual stimuli in VR promotes affective and behavioral reactions toward a destination. As previous research has noted, diffusing scents is the simplest way to digitize them (Spence et al., 2017). Therefore, destination managers might use olfactory inputs to enhance the multisensory experience provided by VR. Ambient scents can be spread through ceramic diffusers in non-invasive and ecological procedures (Serrano et al., 2016). Given the difficulty in generating vicarious experiences in tourist experiences (Tussyadiah et al., 2018), combining congruent olfactory stimuli with VR may help create effective multisensory digital experiences. By firing the users' imaginations, the gap between virtual and real-world experiences can be reduced, favoring affective and behavioral reactions. Special events (e.g. tourism fairs) and travel agencies may benefit from these findings and develop a competitive advantage by providing potential consumers with superior added-value propositions. However, this is not a simple task. Using scents in closed, public spaces (e.g. exhibition centers, travel agencies) can be troublesome as the scents might mix with other odors in the environment; this may cause confusion in the user, who may not be able to differentiate between the odors. Also, the ventilation systems of these spaces may spread the scents into the outside environment, habituating users to them before the VR interaction and, even, cause air contamination issues (Lai, 2015). A possible solution to these challenges could be to use isolated cabins for the entire multisensory experience.

Similarly, tourism managers might use other sophisticated devices (e.g. Shooter, 2020; Olorama, 2020) to enhance the effectiveness of the olfactory stimuli in their VR experiences. The application of pleasant and congruent scents in multisensory VR experiences represents a new level in sensory stimulation for these nascent technologies. In line with previous findings in offline environments (Morrison et al., 2011; Spangenberg et al., 2005), digital experiences can also benefit from the application of multisensory stimuli, and appropriate scents can intensify the positive reactions that customers have in digital environments.

Nevertheless, if congruency is the key to the generation of better multisensory digital experiences, the question for managers is what represents a congruent scent for their specific service experience? Recently, Nespresso launched a new line of coffee capsules inspired by Italian cities and landmarks (e.g. *Ispirazione Venezia*; Nespresso, 2020). Marriott International sprays scents matching the destinations offered in its travel program in the vicinity of advertisements displayed in public places (e.g. coconut aroma for Greece; MobileMarketing, 2020). Thus, if companies wish to use olfactory sensory inputs in their commercial offerings, to obtain the best results they should identify the scents congruent with their products. In a nutshell, although a pleasant scent can improve the digital multisensory experience, congruency is key to fostering positive customer reactions.

7. Limitations and future research lines

This research has several limitations that can be overcome in future studies. First, the empirical study consisted of an experiment performed in an artificial laboratory setting. This method may overcome most of the limitations of one-off cross-sectional data obtained from survey research with no randomization, and lab experiments ensure a higher degree of control and internal validity than other types of experiment (Viglia & Dolnicar, in press). However, future efforts should be made to increase external validity and, thus, the veracity and robustness of the findings. One way to achieve this is through increasing the realism of the experiment: although our manipulations of the independent variables (technological embodiment, ambient scent) can be considered as realistic, the context (hypothetical travel situation) and the environment (experimental rooms) of the experiment were artificial, which hinders

the generalizability of the results (Morales, Amir, & Lee, 2017). Field experiments, natural experiments and quasi-experiments, which are carried out in real settings with actual consumers (or prospective tourists) have the potential to increase the external validity of the effects found in the present study. Another way to improve the robustness of the findings would be to use behavioral measures, instead of self-reported measures, as dependent variables (Morales et al., 2017; Viglia & Dolnicar, in press). Although this may be difficult to accomplish in some cases (ease of imagination, affective attitude), future studies might employ neurophysiological techniques to capture the sensory stimulation of participants (e.g. eye-tracking for visual stimulation), and use data, ex post facto, about tourists' actual destination choices, instead of just their behavioral intentions.

Second, some issues regarding the olfactory stimulation of the multisensory experience in the experiment should be highlighted. The present study used ambient scents, vaporized through simple ecological devices (ceramic diffusers; Yanagida, 2012), to introduce the manipulation subtly and provide the participants with a natural, non-invasive experience. However, as previously mentioned, technological developments offer highly effective methods and devices to enrich the olfactory component of VR experiences (Ranasinghe et al., 2018). These methods allow users to interact with the odors in the virtual environment, are more reactive to users' actions (e.g. coffee scent is vaporized when the user approaches a coffee machine; Dinh et al., 1999), can be focused on specific objects (e.g., fruits with their corresponding odors; Mochizuki et al., 2004), and can prevent scent habituation (Ohtsu et al., 2009). Future research might investigate the comparative effects of these methods on the user's multisensory VR experiences. In addition, we analyzed the positive side of pleasant scents, both congruent and non-congruent with displayed content, in a digital experience. Future research should also explore the negative side of pleasantness and congruency. For instance, the consumer may encounter a situation in which a congruent scent may be unpleasant. In fact, the participants in the online survey carried out to choose the olfactory stimuli reported stagnant water from canals as a scent associated with Venice. Thus, it would be interesting to compare the resulting multisensory digital experience with the same situation and a pleasant, but non-congruent, scent (e.g. vanilla).

In a similar vein, while this study analyzed the pleasantness dimension of scents, future studies should incorporate the arousal dimension into the examination of olfactory stimulation in multisensory digital experiences (Chebat & Michon, 2003; Maggioni et al., 2020; Roschk & Hosseinpour, 2020). Although a manipulation of both dimensions independently (pleasure and arousal) may be difficult to achieve (Spangenberg et al., 1996), it would be interesting to keep congruity constant and test whether a relaxing or an arousing aroma (e.g. lavender versus grapefruit; Mattila & Wirtz, 2001) influenced ease of imagination and destination image. Previous research has shown that the processing of olfactory stimuli may facilitate the construction of overall sensory images (Uchida et al., 2006). Other characteristics of ambient scents, such as intensity (Chebat & Michon, 2003; Maggioni et al., 2020; Spangenberg et al., 1996), would also be worth investigating.

Finally, previous research has suggested that the stimulation of multiple senses may, in fact, have a detrimental effect on consumer experiences (Malhotra, 1984; Petit et al., 2019). Too much sensory stimulation may cause sensory overload and, thus, induce a negative customer experience (Malhotra, 1984; Petit et al., 2019). There is a dearth of research into sensory overload (Krishna, 2012), thus it would be interesting to examine the balance between different sensory stimuli; the results of this further research might provide superior experiences (Cowan & Ketron, 2019; Petit et al., 2019).

Declaration of Competing Interest

The authors declare that they have no known competing financial

interests or personal relationships that could have appeared to influence the work reported in this paper.

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