The olfactory dimension in virtual reality experiences in tourism: effects on flow, authenticity, and behavioral intentions

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Abstract: The present study aims to measure the effects of scents during VR experiences on consumer attitudes and behavior. Using a 360-degree VR tourism video in French Polynesia, we conducted an experiment (currently being processed). Using a structural equation model, current results show that scents have a positive impact on embodiment, flow and authenticity. Some of these results have never been considered in marketing before. From a managerial point of view, the diffusion of scents is very important because it increases authenticity, and its mere presence influences the perception and decision to purchase the offer, particularly in the tourism sector.

Keywords: « authenticity »; « behavioral intentions »; « embodiment »; « flow »; « tourism marketing »; « virtual reality »

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INTRODUCTION

Virtual reality (VR) is ideal for promoting tourist destinations (Tussyadiah *et al.*, 2018), as it increases the realism of virtual situations tenfold thanks to its multisensoriality (sight, hearing, proprioception, etc.) (Wen and Leung, 2021). To this end, the more the human senses are stimulated, the more the individual feels that he or she is the virtual protagonist, physically, mentally, and emotionally (ibid.), inducing a sense of embodiment. Experiencing a situation as an actor leads to (almost) immediate awareness and makes VR a potentially effective sensory marketing tool for raising flow (Lavoie and Main, 2019) and authenticity (Flavián *et al.*, 2020).

Only few studies have taken in account the olfaction in a VR experience (e.g., Flavián *et al.*, 2021). On the one hand, multisensory stimuli - olfactory and proprioceptive, among others - can induce a sense of embodiment (Perez-Marcos, 2018), immersion or flow (Lavoie and Main, 2019), and realism or authenticity (Flavián *et al.*, 2021). On the other hand, when congruent with the offer and pleasant, "scents can influence purchase intentions [...] and products" (Frikha, 2011, p. 17) and modify consumer behavior. The aim of the research is to understand the extent to which olfaction during VR experiences can engage consumers with the offer in terms of the embodiment and flow felt, as well as the authenticity of the perceived offer.

LITERATURE REVIEW

The relationship of embodiment on flow

The feeling of embodiment corresponds to the conviction that users are physically, mentally, and emotionally involved in the VR experience (Leveau and Camus, 2023), to the point of no longer dissociating their avatar from their own person (Piran *et al.*, 2020). Embodiment is characterized by the feeling of being the initiator of the avatar's movements through one's own body (agency)

and the impression of owning the body, through good synchronization of gestures from the real environment in the virtual environment (Roth *et al.*, 2020). Flow is linked to the cognitive immersion felt by the user (Jennett *et al.*, 2008), with a strong state of immersion (Csikszentmihalyi, 1990). With VR, the more sensory interactions and natural interaction mechanisms there are, the more psychologically immersed users will feel. VR experiences using natural sensorimotor interactions lead users to psychological immersion (Foloppe, 2017; Hamdi-Kidar et Maubisson, 2012) that enhance the embodiment felt by users in the virtual environment (Flavián *et al.*, 2019). Thus, the embodiment leads to psychological immersion (ibid., 2020) in the sense of mental absorption (Brown *et al.*, 2004) related to the flow state (Csikszentmihalyi, 1990). Thus, our first hypothesis is:

H_1. The embodiment triggered in a VR experience has a positive effect on user flow.

The relationship of flow on authenticity

According to Pine (2024 in Leveau, 2024), “authenticity is today's consumer sensibility, where what people buy and who they buy it from is primarily determined by their perceptions of authenticity. People no longer want what's fake, but what's authentic, and perhaps more than ever in tourism” (p. 1). Studies have shown that VR generates a greater sense of authenticity than any other medium (Oncioiu and Priescu, 2022). Authenticity in tourism is characterized by the natural and non-artificial aspect of the offer (Camus, 2004). Sensory cues such as digitalized odors can induce a sense of psychological immersion or flow that reinforces the realistic and authentic perception of the offer (Flavián *et al.*, 2021). Thus, we formulate the following hypothesis:

H_2. The flow in a VR experience has a positive impact on the perceived authenticity of the offer.

The relationship of authenticity on consumers intentions

Embodying a character in a VR experience improves behavioral intentions towards the intention to visit the destination. Indeed, physically interacting with the offer constitutes a real "trial before purchase" (Tussyadiah *et al.*, 2018, p. 141), which improves authenticity and purchase intention (Camus, 2011). So, we propose the following hypothesis:

H_3. Authenticity has a positive impact on consumers intention to visit the destination (**H_{3a}**) and to stay at the hotel (**H_{3b}**) discovered during the VR experience.

Olfaction's moderating role

VR devices integrate sensory interfaces that restore sensory information (images, sounds, smells, etc.) to the user (Fuchs, 2018). Olfactory interfaces simulate smells. The perception of odors can be stimulated by small electrical impulses and olfactory diffusers (*ibid.*). Stimulating human senses such as scents in VR experiences cognitively engages the user until they feel fully immersed (Wen and Leung, 2021). At the same time, "adding other sensory cues (e.g. scents, haptics) can generate realistic and immersive experiences" (*ibid.*, p. 289), which means that the perceived offer seems more authentic (*ibid.*). Hence this fourth hypothesis:

H_4. Olfaction in the VR experience positively impact the relation between flow and authenticity.

Finally, authenticity positively affects purchase intentions of consumers (Camus, 2004). In the case where scents are closer to the offer and better represent it, the consumer intentions toward the offer are stronger (Frikha, 2011). If previous studies have demonstrated this weight on products (e.g., Branca *et al.*, 2023), we also assume it for services, so:

H_5. Olfaction in the VR experience positively impact the relation between authenticity and consumers intention to visit the destination (**H_{5a}**) and to stay at the hotel (**H_{5b}**) discovered.

The theoretical model of the research

Figure 1 represents the theoretical model

[Here Figure 1]

RESEARCH METHODOLOGY

The VR experience occurs in the InterContinental Tahiti Resort & Spa (IHG Group) located in Papeete (Tahiti, French Polynesia). We also promote Tahiti's natural environment in the VR

experience. We have captured real environments in several tourist locations and the hotel, using a 360° camera. These immersive 360° videos are broadcast using a VR headset.

In our VR experience, we diffuse smells of monoi and sea (vs. no smells).

We collected 50 questionnaires. Table 1 gives descriptive data on the sample of respondents.

[Here Table 1]

To measure embodiment, we use the scale we developed specifically for experiential marketing contexts (Leveau *et al.*, 2024). The scale is composed of three factors (physicality, thoughts and affects) with four items for each. For flow, we have adapted the one of Heutte *et al.* (2016) and composed of three items. For authenticity, we have also adapted the one of Camus (2004) composed of three items. And, for the intention to visit the destination for real and to stay at this hotel, the one of Bigné *et al.* (2001). The measurement scales, using a visual analogue scale (from 0 to 100 points), are presented in appendix A. Chi^2 and Fisher tests (SPSS v26) were used to check the subsample for homogeneity on gender, occupation, age, and education. Based on the test outcomes, we concluded that the sample was normalized.

The current sample is composed of 50 participants. Statistical tests using a principal component analysis (PCA) and a confirmatory factor analysis (CFA) were realized. Table 2 presents the results obtained after the pretest phase.

[Here Table 2]

All statistical tests for PCA, CFA and discriminant validity are satisfactory.

RESULTS

The quantitative study we currently have realized to check the hypotheses. First, we carried out a regression analysis in keeping with structural equation modeling based on the partial least squares approach (Wold, 1985). Table 3 presents the results obtained using.

[Here Table 3]

For the structural model, all the hypotheses were supported ($p<0.05$; Table 3).

We used the multigroup analysis to measure the influence of the qualitative moderating variable (scents vs. no scents) using the test of permutation (Chin, 2003). A multigroup analysis has the advantage of being simple and robust (*ibid.*) and gives more reliable results. For this study, we ran 2,000 simulations to gain a very robustly representative estimate. Table 4 presents the results.

[Here Table 4]

The results of the multigroup analysis test (Table 4) show that scent diffusion modulates the flow relationship with authenticity (H_4). Hypothesis H_4 is supported. However, Hypothesis H_5 is rejected.

CONCLUSION

Our research question addresses the influence of scent diffusion during a VR experience on embodiment, flow, authenticity and consumer's' behavioral intentions. The quantitative study conducted with a sample of 50 people finds that embodiment leads to flow and authenticity. Depending on the results, we could see results never considered in the field of marketing. First, findings confirm previous studies (e.g., Leveau and Camus, 2023; Wen and Leung, 2021). Results also show that authenticity positively impacts behavioral intentions for services (Branca *et al.*, 2023, for tourism offers confirming previous studies (Camus 2004). Then, the multigroup test reveals that the moderating of scents positively impacts the relationship between flow and authenticity. Although there is work on the effect of olfaction in VR (Flavián *et al.*, 2021), to our knowledge there is no marketing research on this effect. Finally, there is no impact of odors on the relationship between authenticity and behavioral intentions. From a theoretical point of view, this study aims to determine whether olfaction strengthens the individual-avatar relationship and induces more flow and authenticity. The authenticity perceived leading to purchase intentions of the offer promoted (Camus, 2011). So, scent diffusion is very important cause it raises the authenticity, and its mere presence affected their evaluations and decisions to buy the offer, in particular in tourism.

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TABLES

TABLE 1: DESCRIPTION OF THE SAMPLE AND COMPARISON OF SUBSAMPLES

	Standing	Sitting	Total	Chi^2 (F)	dol	p-value
	25	25	50			
Gender				.089	1	.765
Female	64%	36%	66%			
Male	68%	32%	34%			
Occupation				.104	1	.747
Executive	24%	28%	26%			
Student	76%	72%	74%			
Age	28	27	27	(.137)	1	.713
Education				.835	3	.841
High school diploma or -	20%	16%	18%			
Bachelor's degree	32%	44%	38%			
Master's degree	36%	28%	32%			
> Master's degree	12%	12%	12%			

Note: *Chi^2: Pearson chi-square test; F: Fisher test; dol: Degree of liberty; p-value: Significant at: ***p<0.001; **p<0.01; and *p<0.05*

TABLE 2: SCALE VALIDATION

Measurement scale	λ	KMO	Sig.	α	ρ	AVE
Emb. – Physicality		0.605	0.000	0.784	0.862	0.613
Physicality1	0.690					
Physicality2	0.756					
Physicality3	0.836					
Physicality4	0.829					
Emb. – Thoughts		0.721	0.000	0.782	0.865	0.607
Thoughts1	0.840					
Thoughts2	0.900					
Thoughts3	0.618					
Thoughts4	0.701					
Emb. – Affects		0.731	0.000	0.850	0.901	0.694
Affects1	0.820					
Affects2	0.833					
Affects3	0.809					
Affects4	0.863					
Flow		0.623	0.000	0.771	0.933	0.689
Flow1	0.915					
Flow2	0.894					
Flow3	0.694					
Authenticity		0.717	0.000	0.843	0.906	0.761
Authenticity1	0.878					
Authenticity2	0.895					
Authenticity3	0.836					

Note: *λ: Factorial loadings; KMO: Kaiser-Meyer-Olkin index; Sig.: significance in Bartlett's test sphericity; α: Cronbach's Alpha; ρ: Dillon-Goldstein's rho; AVE: average variance extracted*

TABLE 3: PARTIAL LEAST SQUARES RESULTS

Effects (Hypotheses)	R^2	β	SE	t	Pr > |t|	f^2	Result
Physicall. Emb. → Flow (H_{1a})	0.646	0.278	0.127	2.20	0.033(*)	0.105	Supported
Thoughts Emb. → Flow (H_{1b})	0.646	0.318	0.140	2.28	0.027(*)	0.113	Supported
Affects Emb. → Flow (H_{1c})	0.646	0.303	0.139	2.18	0.035(*)	0.103	Supported
Flow → Authenticity (H_2)	0.373	0.611	0.114	5.24	***	0.595	Supported
Authenticity → Visit intention (H_{3a})	0.163	0.404	0.132	3.06	0.004(**)	0.195	Supported
Authenticity → Stay hotel (H_{3b})	0.291	0.539	0.122	4.43	***	0.410	Supported

***Note**: R^2: Pearson's correlation coefficient; β: regression coefficient (path coefficient); SE: standard error; t: Student's t-test; Pr > |t|: significant at: ***p<0.001; **p<0.01; and *p<0.05*

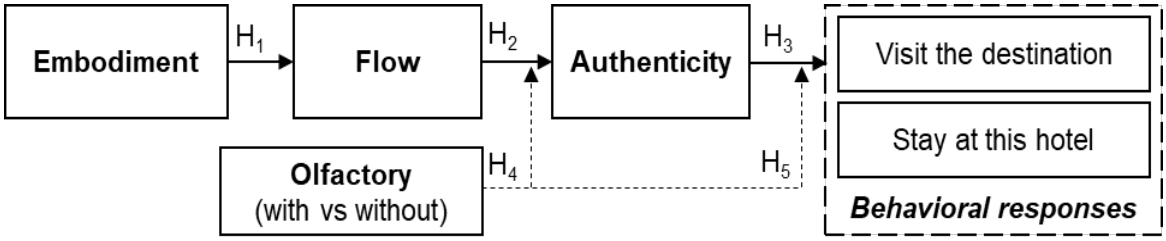
TABLE 4: MODERATION EFFECT RESULTS

Scents effect on:	p-value	β odor *vs.* β no odor	≠	Result
Flow & Authenticity (H_4)	.024(*)	0.701 vs. 0.330	0.371	Supported
Authenticity & Visit intention (H_{5a})	0.752	0.332 vs. 0.405	0.073	Rejected
Authenticity & Stay hotel (H_{5b})	0.971	0.544 vs. 0.534	0.010	Rejected

***Note**: p-value significant at: ***p<0.001; **p<0.01; *p<0.05; β: regression coefficients (path coefficient)*

FIGURE

FIGURE 1: THE THEORETICAL MODEL OF THE RESEARCH



APPENDIX

APPENDIX A: MEASUREMENT SCALES

Authors	Factors	Items	
Leveau, 2024	Physicality	The virtual body's movements were synchronized with my own. I felt like the virtual character. My movements, myself and the virtual body were one and the same. The (physical) interaction gave me the impression of being in the virtual body.	
Leveau, 2024	Cognitive	Through the virtual body, the thoughts I had would have been different from mine in the same situation (reversed). I can say that my thoughts were identical to those of the virtual character. I was expressing my (own) thoughts through the virtual character. My thoughts in the virtual body depended on the virtualized situation in which I found myself.	
Leveau, 2024	Emotions	The emotions I felt corresponded perfectly to the interactions in the virtual environment. I was expressing my own emotions through the virtual character. In the virtual body, I felt my own emotions. In the virtual environment, I was able to feel the same emotions as in the real world.	
Heutte *et al.*, 2016	Flow	I had the impression that I was really in the virtual environment. I was completely involved (absorbed) in the virtual environment. I didn't realize that time was passing.	
Camus, 2004	Authenticity	Cultural authenticity is reflected in the virtual experience. The natural environment is reflected in this tourism destination. This tourist resort seems unnatural and artificial to me (inversed).	
Bigné *et al.*, 2001	Behavioral intentions	*For the destination:*	I'd like to discover and visit this destination for real.
		For the hotel:	I would enjoy staying at this hotel very much. I would really like to sleep in the room featured here.