

Proposal for an instrument to measure embodiment in VR marketing experiences

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Abstract:

The present study aims to propose a new psychometric tool for measuring embodiment in a marketing context. After a qualitative study (n=15), we obtained a three-factor construct composed of 18 items. Using a VR escape game application, we then carried out two quantitative studies. Statistical tests in the first one (n=206) verified the validity and reliability of the scale. The second one (n=160) validated the final embodiment scale, reduced to 12 items. A structural equation model was also used to assess the scale's positive impact on consumer behavior in a marketing context. The embodiment scale is the first to be proposed in the marketing field and provides a tool for future studies in experiential and digital marketing to measure the effects of embodiment more precisely. From a managerial point of view, the new embodiment scale will be very useful for analyzing customer engagement and feelings in a digital marketing context, and for improving digital experiences.

Keywords: “consumer behavior”; “embodiment”; “experiential marketing”; “purchase decision”; “tourism”; “virtual reality”

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INTRODUCTION

A great deal of research has recently studied the effect of virtual reality (VR) experiences on consumers engagement, particularly for tourism offers (e.g., Flavián *et al.*, 2021; Wen and Leung, 2021). Thanks to VR, individuals “can interact in real time and move physically within the virtual world” (Hoyer *et al.* 2020, p. 59), like current physical interactions occurring in a real store. The feeling of embodiment in VR experiences has a positive influence on consumer enjoyment, immersion, as well as on behavioral intentions towards the offer (e.g., Leveau, 2022; Marasco *et al.*, 2018; Pasanen *et al.*, 2019). Embodiment is very important because it has an impact on consumers' purchasing decisions (Wen and Leung, 2021). However, there are no measurement scales of embodiment in marketing and those existing in other fields (e.g., Roth and Latoschik, 2020) are not sufficiently satisfactory and do not accurately measure the concept of embodiment as we define it in experiential marketing (Leveau and Camus, 2023). Currently, embodiment scales focus solely on its physical (Roth and Latoschik, 2020) and technological (Flavián *et al.*, 2019) dimensions, whereas embodiment includes psychological and emotional dimensions (Piran *et al.*, 2020). Here, to address this gap, we consider both the physical, cognitive, and affective dimensions. This is why the aim of this research is to develop a new scale to measure the multidimensionality of the feeling of embodiment in experiential marketing. Based on a qualitative study and two quantitative studies, this study presents the new embodiment scale for consumer experiences.

LITERATURE REVIEW

To embody literally means ‘to enter into the flesh’. Embodiment is a concept currently mobilized in VR and user perception research (Kiltner *et al.*, 2012; Roth *et al.*, 2020; Galvan Debarba *et*

al., 2017). VR allows the user to feel as if they are becoming the protagonist of the virtual experience, which tends to foster a sense of truly embodying the avatar within the virtual environment (Spanlang *et al.*, 2014). Thus, if the transfer of the body to the avatar operates during the VR experience, thoughts and affects may probably too (Raggiotto and Scarpi, 2022) in which the user's surrogate mind and body (Flavián *et al.*, 2020).

Table 1 first presents the main scales used in the literature to measure embodiment.

[Here Table 1]

We note that four of these scales come from the computer and engineering sciences (Galvan Debarba *et al.*, 2017; Gorisse *et al.*, 2018; Piran *et al.*, 2020; Roth and Latoschik, 2020) and two from tourism marketing (Flavián *et al.*, 2019, 2020). All these studies focus entirely on the physical dimension of embodiment, having agency and body ownership as common factors. Nevertheless, our qualitative study and literature review confirm that, in marketing, embodiment has affective and psychological dimensions (Elder and Krishna, 2012; Krishna, 2013; Krishna and Schwarz, 2014).

QUALITATIVE STAGE: RESEARCH METHODOLOGY AND RESULTS

First, we conducted a qualitative study (n=15) to better understand the concept of embodiment in a marketing VR experience. The qualitative study relying on a VR experience entitled: "National Geographic Explore VR". Participants (Table 2) take a seat in a kayak for a ride among the icebergs, playing the role of explorer. The interviews were semi-directive. The average duration of the interviews was 45 minutes.

[Here Table 2]

For conducting the qualitative data analysis, we chose the descending hierarchical classification. This lexicometrical method (Scholz, 2019) allowed identification of three categories of discourses which reflected the three dimensions of embodiment. The statistics showed that 45.1% of the corpus analyzed represent the physical factor of embodiment. This

first category comprises words such as “take”, “try” and “sit”, which are physical dimensions. Then, 36.7% of the corpus analyzed represent the cognitive factor of embodiment. This second category comprises words such as “feeling”, “think”, and “mind”, which are psychological dimensions. Finally, 18,2% of the corpus analyzed represent the affective factor of embodiment. This first category comprises words such as “pleasant,” “calm”, and “fear”, which are affective dimensions. After analyzing the qualitative study, we identified three embodiment factors: physicality, thoughts and affects. The physicality factor is defined by four items representative of agency and body ownership as existing scales and due to the results of our qualitative study. The factor related to thoughts is defined by four items representative of mental projections in the virtual mind just like the physical factor related to the virtual body. The factor related to emotions is defined by four items representing the emotional transfer in the body and virtual mind of the embodied avatar as for the physical factor.

QUANTITATIVE STAGE

Our objective is to assess the psychometrical construct scale. At this end, we performed two quantitative studies using IBM SPSS (v26) and Xlstat (2019).

First experimentation: research methodology and results

At the first stage, we defined eighteen items. We followed the Bartikowski *et al.* (2006) translation/back-translation methodology to propose its version in English. And we used a 7-point Likert scale to harmonize its construction.

We carried out experimentation to evaluate the scale using the “The Room VR: A Dark Matter” application with the Meta Quest 2 VR headset. This VR application is a VR escape game to allow more advanced sensorimotor interactions in the virtual environment. British Institute of Archaeology, London, 1908, the disappearance of a renowned Egyptologist triggers a police investigation. Participant is the police investigator in charge of the inquiry. The player has ten

minutes to find the clues and solve the game's first enigma (complete the first level). To do this, he acts in the virtual environment as if he were there (opening drawers, reading clues, turning cranks, etc.). Appendix 1 shows the experimental setup. Table 3 gives descriptive data on the sample of respondents.

[Here Table 3]

Chi² and Fisher tests were used to check the subsample for homogeneity on gender, occupation, age, and education. Based on the test outcomes, we concluded that the sample (n=206) was normalized. We performed statistical tests using a principal component analysis (PCA) and a confirmatory factor analysis (CFA) to validate the measurement instrument related to embodiment. Tables 4 and 5 present the results obtained.

[Here Table 4]

The Promax factorial rotation (Tab. 4) allows us to recover the three factors consecutive to the feeling of embodiment. Nevertheless, we deleted six items from the original one (Appendix 2).

[Here Table 5]

The CFA showed that Cronbach's alpha (α) and Dillon-Goldstein's rho (ρ) values and Kaiser-Meyer-Olkin's (KMO) indexes (Kaiser and Rice, 1974) were all above the 0.7 level.

In addition, average variance extracted (AVE) values are above the recommended 0.5 level for convergent validity (Fornell and Larcker, 1981). These results satisfy the scale's reliability requirements. Discriminant validity (Voorhees *et al.*, 2016) is then presented Table 6.

[Here Table 6]

Discriminant validity is satisfactory (indexes<0.85) (Hair *et al.*, 2020).

Second experimentation: research methodology and results

The second quantitative study (n=160) confirmed the scale's robustness, using the same VR application as the first. Table 7 shows the sample's normality (n=160).

[Here Table 7]

PCA and CFA statistical tests are also satisfactory (Table 8).

[Here Table 8]

After Promax factorial rotation, all three embodiment factors and all items are retained. In addition, all PCA and CFA indices are satisfactory (Table 8). Then, to test the embodiment scale, we also performed a regression analysis in accordance with structural equation modeling based on the partial least squares (PLS) approach (Figure 1).

[Here Figure 1]

We therefore examined the effect of immersion in embodiment, essential in marketing to engage the customer in an offer (Leveau and Camus, 2023). We adapted the scale from Flavián *et al.* (2019). Table 9 presents the regression results to the PLS analysis.

[Here Table 9]

Results (Table 9) shown that the embodiment factors of physicality, thoughts and emotions have a positive ($\beta > 0$) and significative ($p < 0,05$) effect on immersion.

CONCLUSION

A review of the existing literature and a qualitative study will enable us to gain a better understanding of the concept of embodiment in VR marketing experiences.

The quantitative study revealed multidimensional embodiment scale of eighteen items. The first experiment recovered the three embodiment factors by reducing the scale to twelve items (four items for each factor). The second experiment enabled us to validate the scale and demonstrate its robustness in consumer experiences. From a theoretical point of view, the embodiment scale will constitute a substantial contribution to be used in future research in marketing. From a managerial point of view, the new embodiment scale will be very useful for analyzing customer engagement and feelings in a digital marketing context, and for improving digital experiences. Nevertheless, we have only carried out one VR application, and future studies will need to re-use it for other digital marketing experiences.

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TABLES

TABLE 1: MEASUREMENT SCALES OF THE EMBODIMENT EXISTING IN THE LITERATURE

Authors	Dimensions	Factors
Galvan Debarba <i>et al.</i> (2017)	Physical	4 factors: Agency, body ownership, self-location, and more bodies. 4 items (1 item each).
Gorisse <i>et al.</i> (2018)	Physical	3 factors: Agency, body ownership, and self-location. 10 items.
Flavián <i>et al.</i> (2019)	Technological	4 items linked to body ownership.
Flavián <i>et al.</i> (2020)	Technological	3 items linked to body ownership.
Piran <i>et al.</i> (2020)	Physical	6 factors: Positive body connection and comfort, body unencumbered adjustment, agency and functionality, experience and expression of sexual desire, attuned self-care, and resisting objectification. 34 items.
Roth and Latoschik (2020)	Physical	3 factors: Agency, body ownership, and (body) change. 12 items (4 items each).

TABLE 2: DESCRIPTION OF THE SAMPLE

Gender	Age	Education	Occupation
Female: 8 Male: 7	20-29: 5 30-39: 6 40-49: 2 50-59: 2	High school diploma or -: 1 Bachelor's degree: 3 Master's degree: 7 > Master's degree: 4	Student: 4 Blue-collar worker: 1 Executive: 6 White-collar worker: 1 Middle manager: 3

TABLE 3: DESCRIPTION OF THE SAMPLE AND COMPARISON OF SUBSAMPLES

	Total	Chi ² (F)	dof	p-value
	206			
Gender		1.246	1	.264
Female	52.4%			
Male	47.6%			
Occupation		1.468	7	.983
White-collar worker	11.2%			
Blue-collar Worker	1.0%			
Entrepreneur	9.7%			
Middle manager	16.5%			
Retired	1.8%			
Unemployed	2.4%			
Executive	20.9%			
Student	36.4%			
Age	34	(1.241)	1	.272
Education		0.851	3	.837
High school diploma or -	25.2%			
Bachelor's degree	34.5%			
Master's degree	33.5%			
> Master's degree	6.8%			

Note: Chi²: Pearson chi-square test; F: Fisher test; dof: Degree of liberty; p-value: Significant at: ***p<0.001; **p<0.01; and *p<0.05

TABLE 4: PROMAX ROTATION - STRUCTURE MATRIX

Factors	1. Physicality	2. Thoughts	3. Emotions
Factor 1 items'			
Physicality1	0.904		
Physicality2	0.872		
Physicality4	0.886		
Physicality5	0.863		
Factor 2 items'			
Thoughts1		0.916	
Thoughts3		0.811	
Thoughts4		0.858	
Thoughts6		0.779	
Factor 3 items'			
Emotions1			0.877
Emotions3			0.865
Emotions4			0.834
Emotions5			0.881

TABLE 5: VALIDATION OF THE SCALE OF EMBODIMENT

Measurement scale	λ	KMO	Sig.	α	ρ	AVE
Factor 1 – Physicality		0.841	0.000	0.922	0.945	0.811
Physicality1	0.838					
Physicality2	0.841					
Physicality4	0.764					
Physicality5	0.804					
Factor 2 – Thoughts		0.835	0.000	0.890	0.926	0.772
Thoughts1	0.692					
Thoughts3	0.789					
Thoughts4	0.827					
Thoughts6	0.780					
Factor 3 – Emotions		0.767	0.000	0.901	0.931	0.758
Emotions1	0.761					
Emotions3	0.730					
Emotions4	0.757					
Emotions5	0.786					

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 6: DISCRIMINANT VALIDITY

Factors	Physicality	Thoughts	Emotions
Physicality	1	0.588	0.593
Thoughts	0.588	1	0.526
Emotions	0.593	0.526	1

TABLE 7: DESCRIPTION OF THE SAMPLE AND COMPARISON OF SUBSAMPLES

	Total 160	Chi ² (F)	dof	p-value
Gender		.225	1	.635
Female	51.9%			
Male	48.1%			
Occupation		3.470	7	.838
White-collar worker	13.8%			
Blue-collar Worker	1.3%			
Entrepreneur	9.4%			
Middle manager	15.6%			
Retired	1.9%			
Unemployed	1.9%			
Executive	18.1%			
Student	38.1%			
Age	33	(.103)	1	.749
Education		0.979	3	.806
High school diploma or -	28.1%			
Bachelor's degree	35.6%			
Master's degree	30.6%			
> Master's degree	5.6%			

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

TABLE 8: VALIDATION OF THE SCALE OF EMBODIMENT

Measurement scale	λ	KMO	Sig.	α	ρ	AVE
Factor 1 – Physicality		0.815	0.000	0.929	0.950	0.826
Physicality1	0.831					
Physicality2	0.834					
Physicality4	0.847					
Physicality5	0.790					
Factor 2 – Thoughts		0.846	0.000	0.904	0.933	0.777
Thoughts1	0.717					
Thoughts3	0.774					
Thoughts4	0.825					
Thoughts6	0.792					
Factor 3 – Emotions		0.802	0.000	0.899	0.932	0.774
Emotions1	0.792					
Emotions3	0.754					
Emotions4	0.765					
Emotions5	0.787					

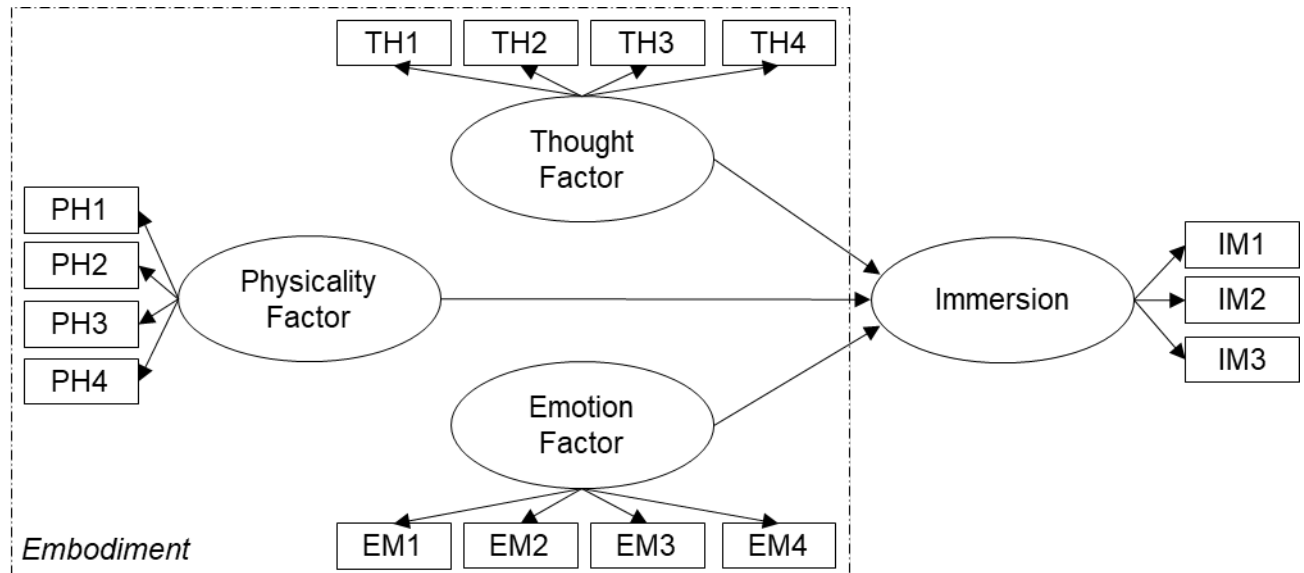
TABLE 9: PARTIAL LEAST SQUARES RESULTS

Effects	R^2	β	SE	t	Pr > t	f^2
Physicality → Immersion		0.397	0.081	4.90	***	.154
Thoughts → Immersion	0.712	0.240	0.072	3.34	***	.071
Emotions → Immersion		0.276	0.074	3.72	***	.088

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 * $p < 0.05$

FIGURES

FIGURE 1: THEORETICAL MODEL



APPENDICES

APPENDIX 1: SCREENSHOTS OF THE VIRTUAL ENVIRONMENT



APPENDIX 2: EMBODIMENT MEASUREMENT SCALE

Factors	Items
Physicality	<p>The virtual body's movements were synchronized with my own.</p> <p>I felt like I was controlling the virtual body.</p> <p>My movements, myself, and the virtual body were one and the same.</p> <p>The (physical) interaction gave me the impression of being in the virtual body.</p>
Cognitive	<p>Through the virtual body, the thoughts I had would have been different from mine in the same situation (reversed).</p> <p>I can say that my thoughts were identical to those of the virtual character.</p> <p>I was expressing my (own) thoughts through the virtual character.</p> <p>My thoughts in the virtual body depended on the situation I was in.</p>
Emotions	<p>The emotions I felt were consistent with the interactions in the virtual environment.</p> <p>I was expressing my own emotions through the virtual character.</p> <p>In the virtual body, I felt my own emotions.</p> <p>In the virtual environment, I could feel emotions as in the real world.</p>