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Sense of presence in affordable 3D virtual reality head mounted displays: Impacts on marketing and marketing teaching

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Abstract:

Since almost thirty years, three dimensional virtual reality, which required expensive and cumbersome equipment, has raised interest as it appeared to allow users to feel immersed in virtual environments. In the last two years, affordable head mounted displays have revived the hope that virtual reality might now really be up for a breakthrough. This research aims at looking into the sense of presence perceived by users of these new affordable devices. It observes that all those who participated in this research experienced a high sense of presence for two different types of devices, and that although on average, participants were only moderately inspired in suggesting possible uses of the technology in the future, marketing students were by far, those who were the most creative.

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Introduction

Since the early 90's, three dimensional virtual reality has raised interest as it seemed to provide users with a sense of immersion in virtual environments. Yet, expensive and cumbersome equipment were required and this technology has never delivered on its promises. In the last two years, affordable head mounted displays, which have very recently, or will very soon be launched on the market, have revived the hope that virtual reality might now really be up for a breakthrough. Although in the early 2000's research in the use of Virtual Reality in teaching or in Marketing, had shown interesting results, no literature could be found on the sense of "being there" experienced by users of the new head mounted displays.

Literature review

Virtual reality (VR) environments exist since the 90's, but were mostly implemented in complex, very high cost solutions such as Cave Automatic Virtual Environments (CAVE) with image projection on the 6 walls of a cubic room, motion capture and stereoscopic Liquid Crystal Display (LCD) shutter glasses. Research performed on these expensive solutions showed that users can have a compelling feeling of presence (Biocca, 1997; Klein, 2003). Presence can be defined as the perceptual illusion of 'being there' in a virtual setting while users are in reality physically in another location (Biocca, 1997). Building on Fontaine (1992) Sheridan (1992), Triesman (1963), Triesman & Riley (1969) McGreevy (1992) Barfield & Weghorst (1993) Held & Durlach (1992), Heeter (1992) and Loomis (1992), Witmer & Singer (1994, 1998) have developed a "presence questionnaire" to measure this experience of being present and the influence of possible immersive factors. It relies exclusively on self-reported information. It is still amongst the most popular tools nowadays, to measure the sense of presence (see for example Kim et al, 2014; Wallis & Tichon, 2013)

Research has also proven that VR was efficient in teaching for example in the medical field (e.g. Westwood et al, 1998; Satava, 1993; Seymour et al, 2002) or in technology (e.g. Burdea & Coiffet, 2003; Takahashi & Ogata, 1992). Youngblut & Ohui (2003) also found significant correlations between sense of presence and performance in virtual emergency response training systems using VR

More specifically in marketing, previous research showed that consumers tend to understand products better, prefer them to other products and are more inclined to buy them, when they are presented with 3D advertising (Li et al. 2001, 2002, 2003). Suh and Lee (2005) doing research in VR with CAVE-like equipment, found that consumers show significantly higher levels of actual and perceived product knowledge, product attitude, and purchase intentions with a VR interface. More recently, Mann et al (2015) have research 3D VR in online store environments, Lau and Lee (2016) in fashion advertising, Backhaus et al. (2014) and Lawson et al. (2015) in market research.

A review of the literature since the 1980s has shown that marketing educators strive for excellence in teaching (Smart et al, 2003; Desai et al, 2001; Conant et al, 1988) and that marketing education has been keen on introducing new technologies in classrooms (McCabe & Meuter, 2011; Gray et al, 2012),. Teaching marketing in virtual worlds such as Second Life has been researched (Tuten, 2009; Bal et al., 2010; Emad & Wydler, 2010; Emad, 2011; Halvorson et al., 2011; Halvorson & Emad, 2012; Emad et al., 2012) and was found to enhance the feeling of community among participants (Childless & Braswell, 2006) - especially in distance learning contexts where learners experience a sense of isolation - mainly because virtual worlds create a sense of presence and of co-presence (being there with others) (Wood and Solomon, 2008). However, we were not able to find any literature on the use of VR to teach marketing. Yet, as stated by Smart et al (1999), marketing educators are required to “embrace the technological changes that are sure to continue”.

Indeed, since 2014 and the purchase of Oculus Rift by Facebook for USD 2 billion, it has become obvious that it is only a matter of months before consumer can get their hands, on affordable yet high fidelity head-mounted displays (HMD) with stereoscopic 3D perspective, which they will be able to use to explore VR environments: The market launch of the Oculus Rift is announced for early 2016; Oculus has already launched, in partnership

with Samsung, a HMD compatible with Samsung mobile phones, and at the low end of the price scale, Google has launched a cardboard version of a VR HMD called Google Cardboard. It becomes thus tempting to explore the use of such devices for marketing purposes or to teach marketing.

This research aims at understanding whether the users of these affordable HMD's perceive a sense of presence as compelling as, what previous research on CAVE and more expensive HMD solutions, had highlighted.

Methodology

A survey has been conducted on 296 participants who tried 2 types of HMD: 162 participants used the Oculus Rift DK2[1], 108 participants used the Samsung Gear VR[2], 25 participants used both HMD's and for one participant, the information was not recorded. The participants were recruited in 3 types of occasions: 47 as part of an experiential marketing class, where the devices were presented as possible ways to involve consumers into an immersive experience, 47 as part of an open day at our university and 202 as part of a public exhibition targeting students about to choose their professional orientation, as well as their parents and teachers. Different virtual environments (VE's) were used: 55 participants experienced a VE aiming at gradually scaring them with spiders and other insects, 29 experienced a Jurassic World setting, 76 experienced a Star Wars setting, 76 experienced a virtual private concert in a musician's music studio, 20 experienced comparable underwater settings, with the two different types of HMD's, 19 participants experienced a combination of ski jump and a visit in Japan, 11 participants experienced a combination of Jurassic Word and Star Wars, each with a different type of HMD and lastly, 9 experienced a combination of Star wars and private concert in a singer's music studio, each with a different type of HMD. For 1 participant, the information was not recorded. This combination of different types of HMD and different VE's was aimed at enabling us to verify the impact of the type of HMD and the type of VE, on the perceived sense of presence. There were 78 female participants, 214 male participants and for 4 participants, the information was not recorded. The average age of the respondents was 18, ranging from 11 to 54. Lastly, regarding gaming habits, 41 were not or

[1] Oculus Rift Development Kit 2 https://www1.oculus.com/order/ and http://www.roadtovr.com/farewell-oculus-dev-kits-dk2-now-sold/

[2] Samsung Gear VR https://www.oculus.com/en-us/gear-vr/

very moderate gamers, 100 were medium gamers and 142 were intensive gamers; for 12 participants, the information was not recorded.

The participants were welcomed, received a very brief explanation and were given the HMD to experience the VE for about 5 to 7 minutes, depending on the type of VE setting chosen. After that, they were immediately asked to fill an adapted version of the Witmer & Singer's (1994; 1998) presence questionnaire, where the user self-reports his perception on a scale from 1 to 7 with a semantic anchor at each end as well as in the middle. To simplify the experiment in class and exhibition settings, it was decided to only use VE's that required little to no interaction. Therefore, all the questions related to the use of controls and to the responsiveness of the VE's to the controls, were excluded from the questionnaires, which thus mostly aimed at measuring what Slater & Wilburg (1997) and Slater (2003) call the presence as a human response to sensory immersion

Results:

All the dimensions of the presence questionnaire showed very high results except for the "degree to which the quality of the interface jeopardized the experience", as well as, to a lesser extent, the "perception of the interactions as being natural", the "experience being in-line with reality" and the "ability to examine objects closely". Figure 1 below, shows the boxplots for all presence dimensions.

Comparing the results of the type of HMD used, the gender and the VE, there were no significant differences except, regarding the type of HMD, on the "experience being in line with reality", the "ability to examine the environment", the "ability to identify sounds" and the gamer / non gamer profile of the respondent. Regarding gender, the difference was only significant on the degree to which the respondent felt involved by the visual aspects, as well as by the gamer / non gamer profile of the respondent. Regarding the tested VE, the difference was only significant for the "conformity with reality" and the gamer / non gamer profile of the respondent.

In line with Witmer & Singer (1994; 1998), a score was calculated to assess the sense of presence of the respondents. For comparability purposes, the score was averaged to obtain what we called a "grade", a number between 1 and 7, which allows comparisons between questionnaires, regardless of the number of items

measured. Our results indicate a high presence grade of 5.37 with a standard deviation of 0.797. This grade is higher[3] than the results obtained by Witmer & Singer (1994) in their first attempt at using their presence questionnaire in CAVE environments: in both of their experiments, they had a grade of 4.32 with a standard deviation of 0.729 for one, and 4.51 with a standard deviation of 0.521 for the other.

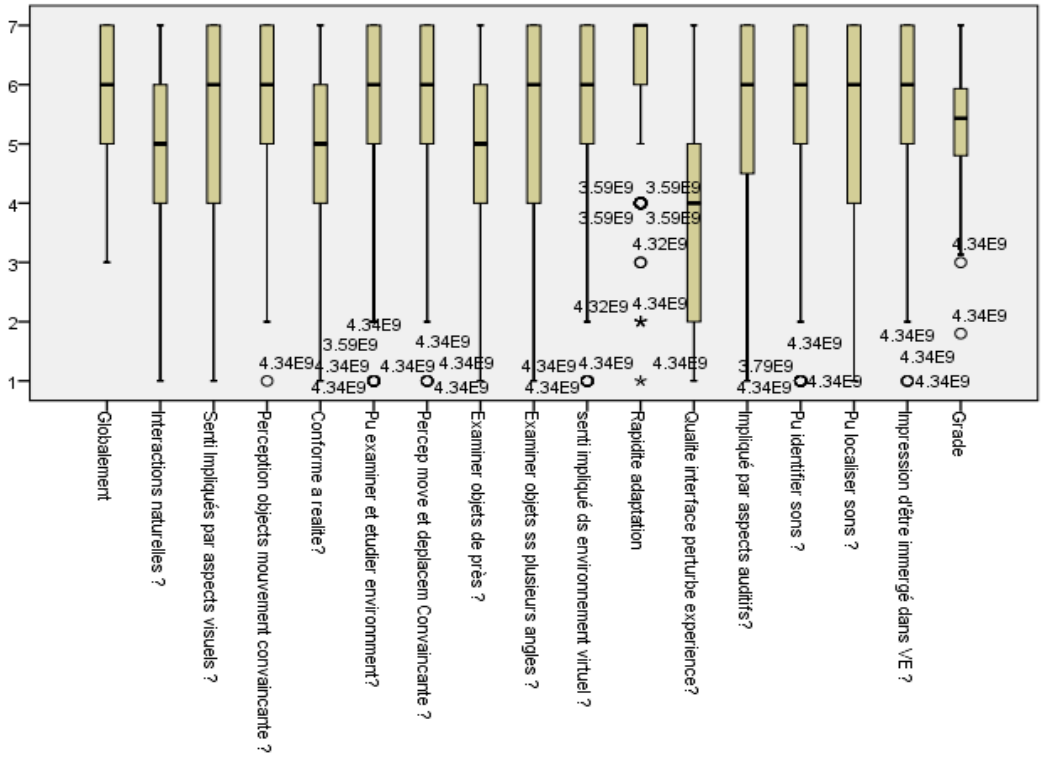

Figure 1: Boxplot of all presence dimensions

Our research showed no significant correlation between the presence grade and the gender, age, VE experienced, type of HMD tested nor with the gamer / non gamer profile of the respondents.

Regarding how respondents envisioned potential uses of VR, overall, only 183, amounting to 61% of the 296 respondents, had ideas to offer, but the percentage of respondents suggesting potential uses, although not correlated with the presence grade, shows significant correlations (all $p<0.01$) with the venue in which the participants were recruited, the age, the gender and the gaming habits of the respondents. Experiential

[3] Significant at < 0.01 compared to both results

marketing students seemed to offer the highest number of ideas, below 20 year olds were less inspired than older respondents, as was the case with males compared to females, and with medium or intensive gamers, compared to non- or moderate gamers. Table 1, shows the detailed results of the number of respondents able to provide suggestions for each group and Table 2 below, shows the correlations results.

Respondents able to provide suggestions as to the potential use of VR HMD's							
By venue		By age		By gender		By gaming habits	
Venue	**Percentage**	**Age range**	**Percentage**	**Gender**	**Percentage**	**Type of gaming habit**	**Percentage**
Public exhibition	49,5%	< 15 y-o	49%	Males	60,30%	Not or moderate gamer	80,5%
Open House	81%	15 to 19 y-o	55%	Females	68%	medium gamer	54%
Experiential Marketing students	96%	20 to 29 y-o	93,40%			intensive gamer	60%
		> 30 y-o	82%				

Table 1: distribution of respondents able to provide ideas on potential use of affordable VR HMD's by survey venue, age, gender and gaming habits

Corrélations

		Vous jouez à des jeux vidéo ? - Réponse :	Grade	Application envisagée?	Age	SexeH1F2	VenueCM1JP2MASetMM3
Vous jouez à des jeux vidéo ? - Réponse :	Corrélation de Pearson	1	-.105	-.184**	-.530**	-.550**	-.489**
	Sig. (bilatérale)		.071	.002	.000	.000	.000
	N	295	295	295	282	292	295
Grade	Corrélation de Pearson	-.105	1	.054	-.061	.068	.053
	Sig. (bilatérale)	.071		.351	.305	.246	.359
	N	295	296	296	282	292	296
Application envisagée?	Corrélation de Pearson	-.184**	.054	1	.309**	.070	.377**
	Sig. (bilatérale)	.002	.351		.000	.233	.000
	N	295	296	296	282	292	296
Age	Corrélation de Pearson	-.530**	-.061	.309**	1	.235**	.683**
	Sig. (bilatérale)	.000	.305	.000		.000	.000
	N	282	282	282	282	281	282
SexeH1F2	Corrélation de Pearson	-.550**	.068	.070	.235**	1	.187**
	Sig. (bilatérale)	.000	.246	.233	.000		.001
	N	292	292	292	281	292	292
VenueCM1JP2MASetMM3	Corrélation de Pearson	-.489**	.053	.377**	.683**	.187**	1
	Sig. (bilatérale)	.000	.359	.000	.000	.001	
	N	295	296	296	282	292	296

**. La corrélation est significative au niveau 0.01 (bilatéral).

Table 2: correlation results for the ability to provide ideas on potential use of affordable VR HMD's by survey venue, age, gender and gaming habits

Conclusion and discussion:

Presence rated high with both the Oculus Rift and the Samsung Gear VR devices, whatever the tested environment, showing that users experienced a high sense of "being there". This is quite promising for the future use of affordable HMD's be it for distance learning, to provide students with the impression of being in a classroom with their instructor, although they might be attending the class remotely, or in a Marketing context, to enable consumers to live an experience regardless of them being in a real physical location or not. It is worth mentioning though, that all the participants to our research were first time VR users and as such, might have had a "WOW" effect. It would be interesting to verify if the sense of presence remains at such a high level after repeated use of the technology by the same individuals.

Comparison with Witmer & Singer's (1994, 1998) results seems to hint that affordable VR HMD's might even provide a higher sense of presence than more expensive anterior versions of VR equipment. This result might maybe be explained if the dimensions excluded from our questionnaire (use of controls and responsiveness of the VR environments to the controls) rated lower than the other dimensions in Witmer and Singer's research and therefore pulled their overall grade down. Having no access to the detailed results of these previous research, we were not able to verify this. Further research on affordable VR HMD's should therefore involve VR environments requiring more interactions and enabling to use the complete presence questionnaire and verify this hypothesis.

Participants were only moderately inspired as to the ways in which VR could potentially be used in the future. However, creativity varied depending on where participants were recruited, how old they were, their gender and their gaming habits. An interesting finding is that Marketing students were the most creative group. This could be either due to the fact that benefits of VR are more obvious to marketers, which is a promising result as to the role this technology will play in the future of the Marketing field. Alternatively, since the HMD was used as part of a course, students might have put an extra effort in trying to find possible applications, despite the fact that the exercise was not graded and responses were anonymous. If this were the case, it suggests that

when putting the effort, VR users can become creative regarding the future benefits the technology can bring. Further research should look into verifying these hypotheses.

Lastly, it would be interesting to research how an experience with 3D VR solutions compares to a similar experience in 2D and in real life, to see if the sense of presence perceived by the same individual really differs. This could be done for example with a marketing lecture, or with an experiential marketing activity. In addition, asking participants to fill personality surveys or what Witmer and Singer (1994, 1998) called the Immersive tendencies questionnaire (ITQ) which measures differences in the tendencies of individuals to experience presence, to see if different user profiles have different senses of presence when using affordable VR HMD's.

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