TRUST AND CYBERSICKNESS IN VR-MARKETING – INVESTIGATING IPD AND CYBERSICKNESS, AND THEIR EFFECTS ON TRUST, CUSTOMER VALUE, NPS, CROSS- AND UP-SELLING

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ABSTRACT

VR (virtual reality) is rapidly gaining attention from academia and the business world. The cost for hardware is diminishing, and consumer HMDs (head-mounted displays) are becoming increasingly affordable, thereby driving the popularity of this technology. Because immersive experiences can foster positive emotions, VR has also gained the attention of marketing departments. However, the virtual world comes with a risk of systems akin to motion sickness, and in VR, this is known as "cybersickness". In this study, cybersickness and its effects on customer-related constructs such as trust, customer value, cross- and up-selling, and NPS (net promoter Score) are experimentally tested. The IPD (interpupillary distance) is manipulated, and an SSQ (simulator sickness questionnaire) is used to test for sickness. Since cybersickness negatively affects customer value, NPS, and consumer trust in the vendor, we conclude that it is necessary to prevent this to ensure monetary and non-monetary customer values remain high.

KEYWORDS

VR,Cybersickness, IPD, Trust, Customer Value, NPS

1. INTRODUCTION

VR is becoming increasingly popular in production, product design of physical products (Farsi et al., 2020), and entire factories (Grieves, 2014) have digital twins. VR and AR (augmented reality) are fuelling the future of business (Wen, 2019), and even IoT and smart city concepts are considering extended reality (XR) (Andrade & Bastos, 2019) and investigating this emerging technology. When exploring virtual worlds, users immerse themselves in a digital space and respond emotionally to this experience. Therefore, it is no surprise that this has caught the attention of academia and business alike. Hard- and software, as well as knowledge and skills for implementing these experiences, come at a cost, and the latter in particular are rare. However, the price of HMDs is diminishing (Economist, 2020), and with the growing use of this technology, it is becoming increasingly accessible. Furthermore, drivers of the adoption of HMDs are composed of utilitarian as well as hedonic benefits, while health and privacy issues exist as barriers (Herz & Rauschnabel, 2019).

A link between enjoyment in VR and purchase intention has also been found (Manis & Choi, 2019). Indeed, VR can positively influence spatial presence, which in turn affects enjoyment (Shafer et al., 2018), and enjoyment diminishes the tendency towards cybersickness (Israel et al., 2019). Despite these positive effects, VR does not come without its problems, and understandably, cybersickness negatively affects (Shafer et al., 2018) the attractions of a virtual world.

This study investigates customer-related constructs such as trust, customer value, cross- and up-selling, and NPS as these are relevant specifically to both marketing and commercial success in general.

The paper is structured as follows: A literature review is initially conducted before the research questions and hypotheses are derived. We then describe the methodology and data collection before moving on to the analysis, discussion, concluding results, and implications.

2. LITERATURE

Empirical evidence suggests that positive effects of VR and AR can be seen in education (Garzón et al., 2019; Radu, 2014; Reisoğlu et al., 2017), smart cities (Lv et al., 2016), health care and medicine (Barsom et al., 2016), teamwork (Salvetti et al., 2018), premium and luxury retailing (Harren et al., 2019), and in VR-supported e-commerce (Papadopoulou, 2007). Nevertheless, the latest research on AR (Rese et al., 2017) and VR (Tussyadiah et al., 2018) suggests that hedonic and affective aspects should be taken into account, and trust will also be considered in this study. In a travel planning situation, immersion promotes positive behavioural intentions (Disztinger et al., 2017), so purchasing intentions and concepts related to products or services are included in this study.

Trust is generally called for when websites are visited, and this plays a role when interacting with artefacts (Beatty et al., 2011; Kim et al., 2008; Kim & Peterson, 2017). Furthermore, trust can positively affect our online purchasing actions (Chang & Chen, 2008; Kim & Peterson, 2017; Tang et al., 2012) and also has a role in virtual environments. VR has the potential to build (Kugler et al., 2019; Salantri, 2018) and even rebuild trust (Shahrdar et al., 2019). Similarly, AR can also build trust (Bilgili et al., 2019), which in turn has a positive impact on consumer purchase intentions (Lu et al., 2016) and satisfaction (Das, 2016; Papadopoulou, 2007). This tends to affect business success in general and, specifically, customer value (e.g. purchase intention).

The concept of customer value can be categorised into market and resource potentials (Tomczak & Rudolf-Sipötz, 2006). The former contains monetary aspects (e.g. purchases and cross- and up-selling), whereas the latter includes non-monetary elements (e.g. information- and referral potential such as word of mouth) (Tomczak & Rudolf-Sipötz, 2006). Hippner and Wilde differentiate between transaction and relation potentials of customers (Hippner et al., 2011; Hippner and Wilde, 2006), while the former are monetary and the latter aspects of a non-monetary nature (e.g. referral, information, and cooperation potential). Word-of-mouth (WOM) recommendation is an example of a non-monetary customer value.

Empirical evidence suggests that cross-selling is enhanced by face-to-face interaction and not by mediated communication (Värlander & Yakhlef, 2008). Nevertheless, the effects of trust on cross-selling behaviour are pointed out by Värlander and Yakhlef (2008). Consequently, as VR has the potential to build (Kugler et al., 2019; Salantri, 2018) and even rebuild trust (Shahrdar et al., 2019), it is unclear which effect holds in a cross-selling VR situation. Customer monetary value is also affected by trust (Kim & Peterson, 2017), and WOM or referrals can be positively influenced too (Ladeira et al., 2016). Similarly, emotions can affect the perception of service quality, be a significant predictor of satisfaction, and lead to WOM recommendations (White, 2010). Hence, if an immersive VR experience positively affects emotions, both satisfaction and WOM can be enhanced – and both are relevant for NPS.

The NPS, developed by Reichheld (2003), is based on a single question asking whether you would recommend a product/service to a friend on a scale from 1–10. Responses between 1 and 6 are called detractors, and responses 9 and 10 are called promotors. Answers 7 and 8 are categorised as passive. The NPS is calculated by subtracting the number of detractors in percentages terms from the number of promoters. Industry has widely adopted this score for measuring customer satisfaction as it is easy to apply in a business context and allows for benchmarking and comparisons within and between sectors.

The effect VR has on purchase intentions is device-dependant (Martínez-Navarro et al., 2019), and as mentioned above, cybersickness can also be an issue (Bruck & Watters, 2011; Davis et al., 2014; Israel et al., 2019; Shafer et al., 2018). No one feeling nauseous is likely to be in the best condition to make an important purchase. Adjusting the IPD of your HMD when exploring virtual worlds is crucial to clear vision, and failing to do so can lead to cybersickness, as empirical evidence shows (Kim & Park, 2019). Interestingly a larger-than-ideal IPD seems to prompt cybersickness more often than a lower-than-ideal IPD (Kim & Park, 2019). Since the evidence is unclear about how cybersickness affects customer value in VR-supported marketing and whether the wrong IPD can induce cybersickness, our research questions are as follows: *How does cybersickness affect customer-related constructs in VR? (RQ1)* and *How does IPD affect cybersickness in VR marketing? (RQ2).*

3. METHODOLOGY

Although this is a preliminary study, it tested for reactions using a questionnaire after exposing participants to a VR application. The test group has an IPD in their HMD that did not correspond to their actual IPD, which empirical evidence suggests might trigger cybersickness (Kim & Park, 2019). In our experiment, an offset of +6 mm was used.

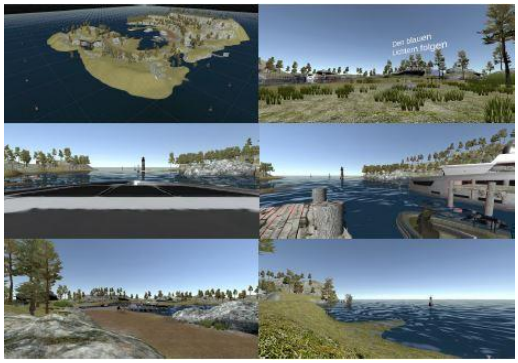

Figure 1. Motorboat rental – VR island

Figure 2. Foot (red) and boat (yellow) routes

Mayer and Davis trust scales were used (Mayer et al., 1995; Mayer & Davis, 1999) to ensure easy comparison with earlier research. In addition, the three dimensions of "integrity", "competence", and "benevolence" from Mayer and Davis were shortened by Dreiskämper et al. (2016) to account for the motorboat scenario.

Customer value measurement was in line with Tewes (2003), building on the theory presented earlier in this paper. In addition, purchasing behaviour (intention to rent a motorboat), cross-selling (diving equipment rental for the boat trip), up-selling (a higher price for a more powerful motorboat), and referential potential in form of the NPS were all measured. Apart from the NPS, all ratings were measured on a five-point Likert scale.

This study used a common scale to measure cybersickness and compare these results to earlier research. Although it has its critics (Stone Iii, 2017), one of the most popular (Balk et al., 2013; Rebenitsch, 2015; Rebenitsch & Owen, 2016) scales for measuring cybersickness is the simulator sickness questionnaire (SSQ) – subdivided into nausea (SSQ-N), disorientation (SSQ-D), and oculomotor (SSQ-O). In line with Kennedy et al. (1993), the questionnaire was only filled out by participants who had already experienced VR to prevent the possibility of symptoms being triggered by suggestion alone. An exception to this approach was made for customer value; before being immersed in VR, participants were asked to answer the customer value questions as a baseline and provide their socio-demographic data. After the VR experience, customer value questions were repeated, and the difference between the baseline (pre-VR) and customer value (post-VR) was calculated.

In line with existing theory and empirical evidence, we derived the hypotheses in Table 1 below.

Table 1. Overview of the hypotheses

#	Text	Result
1	The intensity of cybersickness affects customer value in VR marketing.	Accept
2	Cybersickness affects purchase intention.	Accept
3	Cybersickness negatively affects trust.	Accept
4	Cybersickness negatively affects cross-selling.	Reject
5	Cybersickness negatively affects-up-selling.	Reject
6	Cybersickness negatively affects NPS.	Accept
7	A poorly set HMD IPD adjustment increases cybersickness.	Reject
8	A poorly set HMD IPD adjustment increases cybersickness nausea (SSQ-N).	Reject
9	A poorly set HMD IPD adjustment increases cybersickness oculomotor (SSQ-O).	Reject
10	A poorly set HMD IPD adjustment increases cybersickness disorientation (SSQ-D).	Reject

The authors could not identify clear empirical evidence for the effects of cybersickness and its impact on customer value. Nevertheless, cybersickness shows numerous adverse effects on the VR experience in general. Therefore, Hypothesis 1 states that cybersickness negatively affects customer value (H1) as if one feels nauseous, this is also likely to affect the ability or desire to shop (H2). For this reason, we hypothesise that cybersickness negatively affects trust (H3), cross- (H4), up-selling (H5), and NPS (H6). Furthermore, based on the research by Kim and Park (2019), we hypothesise that a poorly set HMD IPD intensifies the symptoms of cybersickness (H7). Hypotheses 8–10 are derived from H7 but in a more detailed manner to better understand the effects of cybersickness in our chosen scenario and context. Therefore, we hypothesise that a poorly set HMD IPD will support SSQ-N (H8), SSQ-O (H9), and SSQ-D (H10). The experiment used the same virtual boat simulator as in our earlier project. Here, the application had a boat jetty (see Figure 1.), and to get there, participants followed blue markers (see Figure 2.). The walking element in VR to reach the boat was intentionally added to help participants familiarise themselves with the environment and ensure everyone had the same amount of time in VR. This was important for the poorly adjusted IPDs to take effect (The treatment group had 6 mm added to their correct and physically measured IPDs.). After reaching the boat jetty, participants were asked to board the boat and navigate along yellow buoys in the water, leading to a destination flag. The buoys marking the way also ensured that participants did not stay from the route either intentionally or otherwise. Figure 2 depicts the virtual world's red (walking) and yellow (boat) paths.

A pilot study was conducted to identify problems with the questionnaire (including the setup of the experiment and the comprehension of the instructions) and the general scenario. As a result, minor revisions to the instructions and the section of the questionnaire asking about prior knowledge were made. R was used to analyse the data and the following packages (readxl, car, robustbase, ggplot2, psych, apaTables, and plot.lmSim). Twenty participants took part in the main study, although two had to drop out at the preliminary walking stage as they were already experiencing symptoms associated with cybersickness before they had got into the boat. This reduced our final sample to 18.

4. RESULTS, DISCUSSION, IMPLICATIONS, AND LIMITATIONS

Data collection was conducted in the spring term of 2020 with nine people in the treatment group and nine in the control group. The average participant age was 32 (SD = 13.79), and six were female and twelve were male. Fourteen participants had no prior experience of VR applications, and of the remaining four, three had experienced cybersickness in the past.

Correlations were calculated, and SSQ-T (see above) scores correlated with the customer value delta. A strong correlation between the customer value and SSQ-N, SSQ-O, and SSQ-D was observed. Therefore, H1 stating that cybersickness affects customer value is accepted. A negative correlation between trust and SSQ-O: ($r(15) = -.49$, $p = .043$); SSQ-D: ($r(15) = -.59$, $p = .012$); and SSQ-T: ($r(15) = -.49$, $p = .048$) was also observed. Furthermore, a negative correlation was observed between SSQ-T, SSQ-N, SSQ-O, SSQ-D, and purchase intention. Therefore, not only does cybersickness affect customer value (H1) and purchase intention (H2), but trust is also negatively affected by cybersickness, and thus, H1, H2, and H3 are accepted.

Cross- (H4) and up-selling (H5) do not correlate with SSQ-T or the significant subscales, so H4 and H5 are rejected. NPS, however, strongly and significantly correlates with SSQ-T and its subscales leading to the acceptance of H6. Regarding the IPD and its influence, non-significant effects were reported since neither Welch-test for group comparison showed significant effects although all mean values of the SSQ scales were higher in the treatment than in the control group (SSQ-T: Mt = 53.61, SD = 56.94; SSQ-T: Mc = 26.18, SD = 14.84; SSQ-N: Mt = 39.22, S.D = 54.06; SSQ-N: Mc = 13.78, SD = 18.54; SSQ-O: Mt = 37.06, SD 39.65; SSQ-O: Mc = 23.58, SD = 13.90; SSQ-D Mt = 74.24, SD 68.19; SSQ-D: Mc = 34.03, SD = 17.21). Furthermore, we calculated a dummy variable where SSQ-T >20 was coded as 1 and smaller as 0, resulting in a binary variable. Here too, no significant group comparison differences were reported. Accordingly, hypotheses 7–10 are rejected.

The preliminary results of this study were discussed and analysed using correlation analysis, suggesting that cybersickness negatively correlates with purchasing intentions and NPS – thus lowering the intention to recommend a product or service to others. However, the same cannot be said for cross- and up-selling. Interestingly, trust seems to correlate positively with cross- but not up-selling, just as up-selling correlates with purchasing intention. Such an observation may be due to more complex correlations between the present

constructs than bivariate correlations. Indeed, cybersickness seems to correlate with customer value, making it a relevant construct for businesses seeking to implement VR applications. Furthermore, trust correlates negatively with cybersickness, suggesting that cybersickness influences trust. Earlier research and literature both indicate that this can be detrimental to business success. Consequently, trust is a relevant construct regarding immersive VR experiences in a business context.

VR has been shown to be a promising technology for businesses seeking to enhance emotions in customer interaction and immersive experiences. Furthermore, this study suggests that it is crucial to avoid cybersickness as a general rule and, more specifically, in a business setting. Failing to do so may negatively affect trust, NPS, customer value, and ultimately, purchase intention.

This study was conducted in the shadow of a worldwide pandemic, so there may have been self-selection bias in the sample. In addition, this initial study must be labelled as early-stage research, and the results may be different for a representative sample. Similarly, the results may differ in other scenarios or products.

Finally, as this study does not measure actual purchasing behaviour, the laboratory findings might vary if participants were in an alternative purchasing decision and context in the field. As participants were given a fixed route (blue markers and yellow buoys), they may have exhibited behaviour (e.g. walking more slowly or looking around) that would not have been observed in the absence of such guidance. Furthermore, this study analysed the data through correlation. However, the authors want to emphasise that although correlations may point towards causation, they cannot imply causation as this can only be achieved in an experiment where manipulation checks and confounding variables are rigorously controlled. Adding to the results of this preliminary study could be done by increasing the convenience sample size used here due to the worldwide pandemic situation.

In this study, referral and positive word of mouth were measured using the NPS and it is acknowledged that in the most recent publications, a further concept called “net emotional value” (Müller et al., 2021) was introduced. Instead of counting on a single question to measure satisfaction, emotions are presented and measured to create net emotional value as augmented (Batdi & Talan, 2019; Javornik, 2016) and virtual worlds (Reisoğlu et al., 2017; Schutte & Stilinović, 2017) can foster emotional responses. Since both AR and VR (Hamari & Keronen, 2017; Huang & Liao, 2015; Tussyadiah et al., 2018) can generate a feeling of presence, the authors suggest that net emotional value could be used to enrich to the findings of this study.

Our correlation analysis in the discussion section suggests that indirect effects may be present (e.g. trust) rather than bivariate correlations. Therefore, a further opportunity for research seeking to extend these preliminary results would be to employ more advanced statistical methods such as structural equation modelling (SEM), which can handle direct and indirect effects.

This study focuses on renting a motorboat, so it would be interesting to see if product type (e.g. search, experience, or trust goods) plays a role since the perceived risk (and the need for trust) may be different depending on the situation.

5. CONCLUDING REMARKS

The results in this study are promising, and companies seeking to optimise purchase intention, NPS, customer value, and trust will find that VR applications generate emotions showing positive effects on these business-relevant constructs. However, it is crucial to mitigate cybersickness as this can undo the very benefits which VR is trying to promote.

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