Master Thesis

Radboud Universiteit Nijmegen

Stepping into a Sustainable Future:

What is the effect of Virtual Reality as a communication channel on customer behaviour regarding plastic fast-moving consumer goods?

Name: Floris Barten

Student number: s1086268

Study program: Business Administration with a specialization in Innovation and Entrepreneurship

Date: 23 June 2023

Abstract

This research is on the topic of green marketing, Virtual Reality (VR) and consumer behaviour. It examines the effect of VR on influencing consumer behaviour regarding plastic fast-moving consumer goods. For this, an experiment was conducted by comparing the phone condition with the head-mounted-display (HMD) condition. It shows that using an HMD generates a higher level of emotional engagement, which increases purchase intention. The results of this study are relevant because it highlights the opportunities to use VR as a marketing channel to reduce plastic use.

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1. Introduction

Effective green marketing is crucial for companies and governments to influence the behaviour of their customers or citizens to make more environmentally conscious choices (Dangelico & Vocalelli, 2017). Green marketing is about influencing consumer buying behaviour to buy less polluting products (Polonsky, 2011). This also includes promotion by governments to use fewer plastics. This can be done through educational campaigns to make people aware of plastic pollution so that people will change their buying behaviour (Amenábar Cristi et al., 2020; Clayton et al., 2021; Macintosh et al., 2020). Despite the need, the government does not always succeed in getting the message clearly across and thus motivating their citizens to change their behaviour (Webb, 2012).

1.1 Practical need

That it is difficult today to get a message across effectively is not just a problem for governments (Webb, 2012). It is a broader problem. This is partly because of clutter (Jung & Heo, 2021; Katke, 2016). Clutter refers to the fact that there are a lot of advertisements on existing channels and this negatively affects the extent to which advertising reaches consumers effectively, i.e. the effectiveness of advertising decreases (Jung & Heo, 2021; Katke, 2016). The figures show that people get to see a lot of advertising. Digital marketing experts indicate that the average American sees and hears between 4,000 and 10,000 ads in a single day (Simpson, 2017). This is through various channels. That is why clutter is prevalent on channels such as radio, television and online (social) media (Jung & Heo, 2021; Katke, 2016). Within green marketing, there is still much to be gained.

Clutter affects multiple marketing domains so also green marketing (Ha & McCann, 2008). A solution to clutter could be increasing the originality of advertising, personalising ads and using other channels to get the message across (Jung & Heo, 2021; Katke, 2016). Therefore, it is important to look for new channels that are not yet saturated with ads and therefore less clutter. A suitable channel to use to get the message across could be Virtual Reality (VR) (Burke, 2018). Virtual Reality is a simulated digital environment created via a computer, allowing the user to feel as if they are actually present in that environment (Desai et al., 2014). In recent years, VR has become increasingly accessible to consumers. This is due to the rise of head-mounted displays (HMDs). These headsets make VR more accessible through more user-friendly software and a lower price (Brown & Green, 2016). This is reflected in

sales numbers. For where 4.42 million HMDs were sold in 2018, this is expected to reach 27.25 million units by 2028 (Statista, 2023). The increased popularity of HMDs offers new opportunities. The practical use of VR as a communication channel within green marketing is still in its infancy. An understanding of the effects of VR on consumers' sustainable buying behaviour is crucial for deploying VR within green marketing. However, existing research on the effects of VR on sustainable buying behaviour offers little guidance.

1.2 Theoretical need

As described in the practical need, there is still a lack of clarity around deploying VR in the customer experience (CX) process within green marketing. This also applies to the theoretical underpinnings on this topic. First the current research on advertisement effectiveness and clutter. This indicates that too much information causes overload (Ha & McCann, 2008). Researchers who adopt the informational processing perspective have primarily utilized the "overload theory" to account for how clutter can diminish the effectiveness of advertising. This theory is grounded in the notion that individuals have a finite capacity to process messages (Jacoby, 1984; Miller, 1956). Research needs to be done on whether this also applies to VR as a communication channel (Lee & Chung, 2008).

Secondly the current literature on VR and behavioural change. Much of this current literature takes place in three different contexts. The first context is learning. This is because many VR studies are about deploying VR in schools (Deng et al., 2020; Guan et al., 2021; Lee et al., 2022; Liu et al., 2020). The second context is in the tourism sector. Here, research is mainly done on how people can be persuaded through VR to proceed to buying a trip or booking a hotel (Flavián et al., 2021; Taufik et al., 2021; Zeng et al., 2020). The last context is online marketing, where most research is done on how to improve online shopping through VR (Martínez-Navarro et al., 2018; Park et al., 2018; Wedel et al., 2020). Research should be done on using VR to induce a behavioural change that does not directly lead to a particular purchase, but encourages people to think more carefully about their future purchases. In the case of green marketing, to buy a less polluting product.

Thirdly, the current literature on customer experience (CX). CX refers to the internal and subjective personal responses that a customer experience when they engage with a company (Meyer & Schwager, 2007). So, it is important to delve deeper into this process because this

is where the decision is made by a consumer to make a particular purchase (Jain et al., 2017a). Here is where you have to direct as a government or company to influence the behaviour of the consumer. Currently, CX is still mostly studied descriptively (Gentile et al., 2007; Jain et al., 2017b; Lemon & Verhoef, 2016). Therefore, it is important to conduct empirical research on CX (Lemon & Verhoef, 2016). Also to see what the effects of VR in this context are (H. Kim & So, 2022). This way, it is possible to look at the real-life implications of CX. In addition, this can look at how this relates to VR and what value this technology can add to CX and the way messages can be conveyed.

Lastly, green marketing. Within green marketing, there is increasing research into using technology to persuade people to make greener decisions (Alrowaily & Kavakli, 2017; Kourouthanassis et al., 2015). This research contributes to this as it capitalises on the use of VR to get people to change their behaviour. In addition, this research draws comparisons with phones and shows how these conditions relate to each other. This is currently a gap in the literature within the context of green marketing and consumer behaviour.

1.3 Research objective

To address these practical and theoretical needs, the current study seeks to identify antecedents and consequences of the VR customer experience process by focusing on a central concept in research on VR: spatial presence. Spatial presence is the feeling of being in a particular place or environment despite not being there (Han et al., 2022; Nicovich et al., 2005; Steuer, 1992; Witmer & Singer, 1998). In addition, this research will also focus on another component of the CX, namely emotional engagement. Emotional engagement pertains to the emotions that learners associate with their experiences, which can include feelings of interest, frustration, or boredom (Fredricks et al., 2004). This can be a consequence of spatial presence and could be responsible for the extent to which people adjust their buying behaviour after seeing a message (Aydin, 2018; Wagler & Hanus, 2018; Willems et al., 2019). Buying behaviour refers to the cognitive and behavioural processes that individuals go through when making decisions about purchasing and utilizing products (Sharma, 2014).

The driver of spatial presence in CX, which will also be addressed in this study, is the level of immersion (Barnes, 2016). This refers to a mental state in which a person is completely

isolated from the outside world and can therefore fully focus on what they are experiencing (Witmer & Singer, 1998). Empathy will also be included in the study because this is a stable personality trait that influences the degree of presence a person experiences (Nicovich et al., 2005; Samana et al., 2009). Empathy involves the capacity to understand and perceive the world through another individual's point of view, along with experiencing an emotional response to that perspective. This emotional response encompasses feelings of care and concern for others (Davis, 1980; Schutte & Stilinović, 2017). Finally, this study will look at the intention to change behaviour. This is the attempted outcome of spatial presence via emotional engagement (Moes & Vliet, 2017; Verhagen et al., 2014; Willems et al., 2019). Here, in particular, the intention to buy an environmentally friendly product will be examined. This is the intended purpose of green marketing (Polonsky, 2011). This will all be done via a lab experiment. Here, one group is shown a 360-degree video about how polluting plastic is via a head-mounted display (HMD) and the other group via a phone. An HMD is a VR headset that completely isolates the person from the outside world and generates a higher degree of immersion than a phone (Breves, 2020). Afterwards, a questionnaire will be used to see how the participants react to seeing the video and to what extent this influences their purchase intention regarding plastics.

1.4 Relevance

The relevance of this study with the question: ‘What is the effect of Virtual Reality as a communication channel on customer behaviour regarding plastic fast-moving consumer goods?’ is both practical and theoretical. The first contribution is theoretical. Namely, it aims to contribute to the knowledge regarding the use of VR as a communication channel to convey a message in the green marketing domain. In particular whether VR, in comparison to a phone, is a suitable means to influence buying behaviour. The second contribution deals with the empirical contribution to the customer experience context. This can test the existing descriptive knowledge in the CX domain in an empirical setting to find out whether the theory holds true in practice. Conducting an experiment will provide empirical knowledge that can complement the current descriptive literature. Third, from a practical perspective, this study expanded the knowledge that provides governments with the tools to steer citizens in reducing plastics via VR. If VR proves to be a suitable channel to convey this message, then governments can capitalise on this by developing ads for it.

1.5 Outline

To address the above points in an orderly manner, the following structure was chosen for this master thesis. It starts with the literature review. It is divided into the theoretical background and the hypothesis development. First the theoretical background. This highlights the different contexts of this study. These are green marketing, VR in learning and customer experience. The second part of the literature review is the hypothesis development. In this, (spatial) presence and emotional engagement are discussed first because they are central to CX. Second, the drivers of the CX namely immersion and empathy are discussed. And finally, the outcome of CX will be discussed, which is purchase intention. Next is the methodology which describes and justifies the design of the study. This is followed by the reference and then the appendices which contain, for example, the questionnaire.

2. Literature review

The literature review is separated into the theoretical background and the hypothesis review. In the theoretical background, the three main topics are discussed. The hypothesis review contains the conceptual model and the hypotheses which will be argued there.

2.1 Theoretical background

In the theoretical background first, green marketing will be discussed, then VR in learning and lastly consumer experience. The researcher has chosen to cite only VR in learning in the theoretical background. The introduction also mentions VR in tourism and VR in online marketing. However, these two streams are mainly about persuading people to buy a specific product or service or entertaining people (Han et al., 2022; Talwar et al., 2022). In this study, the focus is on influencing someone's purchasing behaviour to make greener purchases. For this reason, it was decided to highlight only VR in learning in this section because it is about teaching knowledge that can lead to a change in behaviour (Chirico et al., 2021).

2.1.1 Green marketing

Green marketing is not necessarily something new but still does not have a long history. While there was some attention given to environmental issues in the 1970s, it was not until the late 1980s that the concept of green marketing gained traction (Peattie & Crane, 2005; Prothero, 1990; Vandermerwe & Oliff, 1990). Early academic literature on the subject noted the surge in green consumerism during this period and predicted a significant shift towards environmentally friendly products (Peattie & Crane, 2005; Prothero, 1990; Vandermerwe & Oliff, 1990). As often seen with new marketing trends, green marketing quickly became the subject of extensive market research. Several reputable research organizations presented survey data that demonstrated increased environmental awareness, growing consumer interest in eco-friendly products, and a willingness to pay extra for green features (Peattie & Crane, 2005).

The term green marketing does have some related terms. Various scholars use ecological marketing, environmental marketing, and responsible marketing, to define green marketing (Polonsky, 2011). Regardless of the terminology, these definitions share a common focus on minimizing environmental harm during the exchange process. An effective definition of green marketing must integrate transformative change that benefits both individuals and society

while improving the natural environment (Polonsky, 2011). Transformative green marketing is distinct from the traditional marketing perspective that merely seeks to avoid causing societal harm, as it prioritizes enhancing human well-being and environmental sustainability (Polonsky, 2011). This separation is due to the following. There are two types of marketing, macro and micro. Macro-marketing is about the environment and micro-marketing is more about individuals (Polonsky, 2011). The traditional micro-economics approach to marketing is different from the macro approach because it cannot fully address environmental issues. Because microeconomics assumes that individuals aim to maximize their own welfare without necessarily considering the welfare of society or the natural world (Russell & Russell, 2010). For environmental concerns to be integrated into decision-making, they must be aligned with individual values. This macro focus on sustainability and the environment presents a challenge for transformational green marketing (van Dam & Apeldoorn, 1996). It is about ways that marketers and society motivate individuals and organizations with a narrow focus to incorporate broader macro issues and systems into their personal mindset. It could be contended that this disconnection is among the factors that compel governments to regulate activities in order to prevent the exploitation of market distortions (Harris & Carman, 1984). Furthermore, the absence of a macro perspective may explain why social marketers have to encourage consumers to modify their behaviour and minimize negative personal impacts (Rothschild, 2000), as short-term self-interest often takes precedence over long-term benefits (van Dam & Apeldoorn, 1996). In the realm of marketing, governments have the potential to be the most influential macro-force as they surpass the impact of individuals and corporations. While there are viewpoints suggesting that multinational corporations and certain industry bodies also transcend governments, governments still hold a significant position in this regard (Polonsky, 2011).

The government is also active in green marketing. They conduct campaigns to change buying behaviour (Knoblauch & Mederake, 2021). This can be done through educational campaigns to make people aware of plastic pollution so that people will change their buying behaviour (Amenábar Cristi et al., 2020; Clayton et al., 2021; Macintosh et al., 2020). Governments employ a variety of methods to influence both consumers and corporations, which involve the use of rewards and punishments. For instance, they may incentivize the purchase of fuel-efficient vehicles or mandate automakers to enhance automobile fuel efficiency. Conversely, some governments may implement penalties like Singapore and London's city tolls, which discourage private car use and promote public transportation (Polonsky, 2011).

2.1.2 VR in learning

A channel that the government could use to teach people about environmentally conscious purchasing behaviour could be VR because it is already proven its value within the learning environment. When VR is used in learning it is mostly called a virtual learning environment (VLE). The VLE offers learners an opportunity to acquire new skills, including spatial socialization, data visualization, sharing, and even language capacity. By exploring ideas in real-time and in an experimental setting, learners become actively engaged in the learning process. Moreover, VLE serves as a heuristic tool that allows learners to conduct experiments with no risk to themselves or others, which would be impossible in actual reality. Within VLE, users form and share virtual assets in authentic contexts, enabling them to expand their scope of learning (Huang et al., 2016; Shin, 2017). The reason why VR is used in the learning context is that a higher degree of immersion contributes positively to learning outcomes. This is because it makes people more engaged, less distracted and more serious about learning (Jensen & Konradsen, 2018; Loup et al., 2016; Reiners et al., 2014). The use of VR for learning purposes is not new. Research shows that, as far as is known, 1989 was the first time VR was used in education (Pantelidis, 2010). Since then, development has continued steadily, running parallel to the development of other computer-aided education and technological developments (Pantelidis, 2010; Yildirim et al., 2018).

VLE can also be used in the green marketing context by learning people about things that are damaging the environment (Markowitz & Bailenson, 2021). One example is that people in VR can learn about the chemical process of coral acidification and subsequent degradation. Overall, individuals who engaged more in the exploration of the underwater realm were more likely to acquire knowledge about ocean acidification, implying that interaction can aid in the comprehension of complex scientific concepts. With this study, they showed that the use of VR contributes positively to understanding complex natural phenomena and in addition, respondents also developed a connection with nature (Markowitz et al., 2018).

Another example where VLE has been used to educate people about climate change is the research on plastic water bottles. The study discovered that when plastic consumption was presented in numerical form (such as the number of plastic water bottles consumed by ten individuals annually), it reduced participants' emotional responses towards the issue. In addition, it reduced their overall attitudes towards the environment as well. This was not the case when the participants saw a visually tangible representation (such as a heap of plastic

water bottles) or a combination of visuals and numbers. Thus, how climate change information is presented in VR can impact people's emotional reactions towards the subject (Chirico et al., 2021).

2.1.3 Customer experience

Another area where presentation and emotion also play an important part is the customer experience. The CX is a vital aspect of the business-customer relationship, with experiences resulting from coming across, living through, or undergoing things (Schmitt, 1999). In this regard, CX refers to the internal and subjective personal responses that a consumer experiences when they engage with a company, as described by Meyer & Schwager (2007).

Studies on CX and its management have adopted two main approaches. Firstly, mapping customer contact with a company along a journey of experience touchpoints, and secondly, differentiating various types of internal and subjective responses (Hoyer et al., 2020). To define the CX, Lemon & Verhoef (2016) consider it as a journey taken by the customer with the company over time, starting from the pre-transaction stage that includes searching for the product or service, then continuing to the transaction and post-transaction stages. During each stage and sub-stage of this customer journey, customers interact with the company through different touchpoints (Lee et al., 2018; Shankar, 2014)

Historically, the points of contact between customers and firms have been identified as the product and its aesthetics, elements related to the brand identity such as naming conventions, logos, and other visual cues, packaging, various modes of communication, and any direct interactions with customer service representatives. With the advent of the digital age, the touchpoints and channels/environments for CX have been expanded. This includes social media, which has become a new mode of communication, as well as e-commerce, websites and mobile platforms that have emerged as new environments (Foroudi et al., 2018; Lee et al., 2018; Lemon & Verhoef, 2016; Shankar, 2014). In addition, customers are becoming more connected, knowledgeable, empowered, and engaged in seeking out and shaping their own experiences, often collaborating with companies in the process (Prahalad & Ramaswamy, 2004). Related to the CX is the brand experience (Brakus et al., 2009). However, this is omitted for this study because this study is about the message and not a specific brand.

To see how new technologies will impact the customer journey, Hoyer et al. (2020) have created a framework outlining what is going to change with the arrival of new technologies for the customer journey. This shows that through VR it is more accessible to facilitate imagination. This mainly concerns the pre-transaction phase (Azuma, 1997). This is because immersion (via VR) can give people more sensory information which makes it easier for people to imagine something. In addition, imagination leads to a higher degree of telepresence. This is because it is easier to imagine being in a different environment than it actually is when people have a higher degree of imagination (Cowan & Ketron, 2019). Imagination can help customers to learn more about products (Yim et al., 2017). This is important for companies to get their message across to the customer. The scope of this study stops after the actual transaction of a product.

Hoyer et al. (2020) have also created a framework with the potential of new technologies for CX dimensions. Here they distinguished between cognitive, sensory/emotional and social dimensions. This shows that on the cognitive dimension, VR can be used as a catalyst for actions. In the dimension of social, VR can provide customer immersion and thus create 'possible worlds'. This is comparable to the study of Lemon & Verhoef (2016, p. 71) where they describe CX as: "A multidimensional construct focusing on a customer's cognitive, emotional, behavioural, sensorial, and social responses to a firm's offerings during the customer's entire purchase journey.". Four of these five dimensions are overlapping with VR. Because VR has the characteristic that people score higher on it in terms of cognitive, sensory, emotional engagement and behavioural change than a traditional 2D screen such as a phone or a computer (Sas & O'Hare, 2003; Suh & Lee, 2005; Willems et al., 2019). This overlap between VR and customer experience makes VR an appropriate channel to influence the customer experience. Therefore, in the conceptual model (see Figure 1), the four customer experience terms that overlap with VR (sensory, cognitive, emotional and behavioural) are in italics. Above spatial presence is sensory/cognitive, above positive emotional engagement and negative emotional engagement is emotional and above purchase intention is behavioural.

2.2 Hypothesis development

In the hypothesis development, the hypotheses are justified. Figure 1 shows the conceptual model. The hypothesis development starts with the central concept which is customer experience. Then the drivers of CX will be discussed and lastly, the outcome of CX can be found.

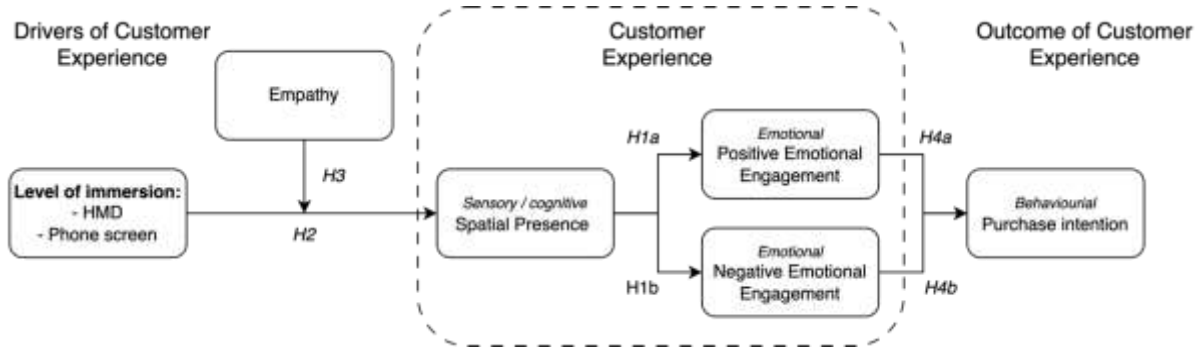


Figure 1: Conceptual model

2.2.1 Customer experience dimensions

As seen in the conceptual model in Figure 1, the CX consists of three concepts. These are spatial presence, positive emotional engagement and negative emotional engagement. Where spatial presence falls under sensory/cognitive, positive emotional engagement falls under emotional as well as negative emotional engagement as described at the end of section 2.1.3. They all will be discussed in this section in this order.

2.2.1.1 Spatial presence

Presence is the feeling of being in a particular place or environment, whether real or virtual (Benyon, 2012; Floridi, 2005). Presence is defined as "the subjective experience of being in one place or environment, even when one is physically situated in another" (Witmer & Singer, 1998, p. 123). It goes beyond just being aware of the environment a person is in, as it also includes how a person's mind experiences and perceives that environment. This includes not only sensory perceptions like seeing but also cognitive processing, like how a person's mind processes and makes sense of the information it receives through its senses (Sas & O'Hare, 2003; Wirth et al., 2007). So, a person's sensors give input to the mind so that the person is thinking that he or she is in another place. Essentially, presence includes the integration of physical and mental experiences to create a sense of presence in a particular place (Benyon, 2012; Gibson, 1979; Steuer, 1992).

A term that is related to presence is called telepresence. This refers to a situation in which the experience of being in a mediated environment, such as a VR or remote-control system, takes precedence over the experience of being in the physical environment. In other words, telepresence measures the extent to which a person feels present in the virtual or external

environment, as opposed to the immediate physical environment (Steuer, 1992). This means that presence refers to the subjective sense of being present in a particular environment or place, regardless of whether the environment is real or virtual. It is the feeling of "being there" and the sense of immersion that a person experiences when one engages with an environment. Telepresence, on the other hand, specifically refers to the use of technology to simulate the experience of being physically present in a remote environment. It involves the use of advanced communication and sensory technologies to create a highly immersive and interactive experience for the user, such as in a VR or augmented reality environment (Steuer, 1992). According to Steuer (1993), the concept of telepresence was initially used to distinguish between the experience of presence mediated by technology versus that experienced in the physical world, over time, the term has become less popular, and the distinction between presence and telepresence has become less clear-cut and presence is the most used term.

In addition to presence and telepresence, there is also spatial, sensory and social presence. According to the International Society for Presence Research (2000) is presence measured across multiple dimensions; spatial, sensory, and social. Because this study will focus on measuring how individuals respond to a 360-degree video via an HMD compared to the same video via a phone screen, the focus of this study will be spatial presence. This type of presence is described as the sense of being present in another navigable location (International Society for Presence Research. (ISPR), 2000; Wagler & Hanus, 2018). Despite the sensory characteristics that link VR to customer experience (see section 2.1.3), no sensory presence is included in this study. This is a form of presence in which the person has the feeling of being in a different place by means of technologically generated conditions because they think they perceive it sensorially. This can be done, for instance, by generating smell, feel and taste (International Society for Presence Research. (ISPR), 2000). This is not relevant for this study.

2.2.1.2 Emotional engagement

Another part of CX and an outcome of spatial presence is emotional engagement (Wagler & Hanus, 2018). Emotional engagement, which can be divided into positive and negative emotional engagement appears to be crucial in learning (Lee et al., 2022). Emotional engagement for students consists of several aspects such as boredom, frustration, interest and social connections at school (Fredricks et al., 2004). Positive and negative facets can be used

to further classify students' emotional engagement, it has been observed that positive emotional engagement is linked to favourable learning outcomes (Lee et al., 2022). Deng et al. (2020) discovered that learners who exhibited elevated levels of positive emotional engagement had a greater probability of accomplishing tasks and achieving superior performance. Previous studies have also indicated that VR learning tends to promote positive emotional engagement (Guan et al., 2021; Liu et al., 2020). For instance, Liu et al. (2020) demonstrated that the group exposed to science lessons through VR achieved notably better academic results and emotional engagement scores than the control group that received the same instruction using conventional teaching methods.

Having emotional engagement is not a goal in itself but it is the basis of many other things. In the VR literature, emotional engagement is often associated with impressing, loyalty and satisfaction. In marketing, it is often associated with selling a product or a service. But it can also be used to promote a brand and ensure that customers commit to it (Bowden, 2009; Flavián et al., 2021). More toward charity and everything around it, emotional engagement can be seen to be used to entice people to donate to a particular charity (Kandaurova & Lee, 2019). Research among adolescents in Hong Kong also shows that a green marketing message that evokes emotional engagement is generally more effective than a rational message. This is because the emotions evoked by the message motivate people to do something more than if it is just a rational message (Lee, 2008).

One channel that can be used to capitalise more on consumer emotion is the HMD. The HMD is already being used in other sectors, such as tourism and hospitality, partly for its emotive qualities (Wagler & Hanus, 2018). With the rise of VR and the accessibility of HMDs, more studies are being done on VR in the tourism and hospitality sector. For example, VR tours are recommended to tourists because it increases engagement (Bec et al., 2019). But there is also direct evidence that spatial presence affects emotional engagement. For example, research by Wagler & Hanus (2018) shows that individuals who were either physically present or immersed in a 360-degree video reported greater spatial presence scores compared to those who only experienced a two-dimensional setting. This increased sense of spatial presence was associated with higher levels of emotional engagement. (Spatial) presence leads to (emotional) engagement due to the following reason. Because, in full engagement, a person is cognitively fully absorbed in the situation/environment and can thus fully focus on the

moment. This state of being fully absorbed in the environment/situation is due to the feeling of presence (Herrington et al., 2003; Mollen & Wilson, 2010).

This results in the following hypothesis:

H1a. *Customer's perceived degree of spatial presence in the customer experience process has a positive effect on the customer's perceived degree of positive emotional engagement.*

H1b. *Customer's perceived degree of spatial presence in the customer experience process has a negative effect on the customer's perceived degree of negative emotional engagement.*

2.2.2 Drivers for Customer Experience

A driver of CX is spatial presence. But spatial presence is not something that arises out of nothing. Some so-called drivers can give people a (higher) sense of spatial presence. The first driver that will be discussed is the level of immersion.

2.2.2.1 Level of immersion

The terms immersion and presence are often used interchangeably by practitioners who are well-versed in VR, even though these terms refer to separate concepts (Bowman & McMahan, 2007). When it comes to VR systems, immersion refers to the degree of sensory accuracy provided by the system, while presence refers to the user's personal and subjective psychological experience of the VR environment (Bowman & McMahan, 2007; Slater, 2003). A VR environment is an artificially created environment that gives users the illusion of being physically there. This is a three-dimensional computer-generated environment that offers the sensation of real existence, even if it does not really exist. VR offers not only visually immersive experiences but also sound and tactile stimuli to further enhance the feeling of being in the virtual world (Desai et al., 2014). For the study, tactile stimuli are irrelevant and will therefore not be discussed further.

Back to the difference between presence and immersion. It can be concluded that immersion is what a device delivers and presence is what a person experiences (Bowman & McMahan, 2007; Slater, 2003). The level of immersion a VR environment can provide is directly related

to the level of presence it evokes (Witmer & Singer, 1998). The higher the degree of immersion, the higher the degree of presence someone is experiencing (Van Damme et al., 2019). This also applies to spatial presence. A recent study shows that a higher degree of immersion leads to a greater sense of spatial presence (Han et al., 2022).

There are several factors that influence the level of immersion, like the degree of isolation from the physical environment, the feeling of being included in the VR environment, natural ways of interacting and controlling, and the perception of self-movement. A VR environment that successfully isolates users from their physical surroundings, depriving them of real-world sensations, is more likely to enhance the level of immersion. HMDs are commonly used to achieve this isolation in a VR environment (Witmer & Singer, 1998).

These HMDs, which deliver an immersive experience, are becoming increasingly popular. Nowadays, VR has shifted from being mainly used for professional use to consumer use (Breves, 2020). This is mostly due to the development of HMDs. These VR headsets are portable, becoming more sophisticated and also more affordable. Another reason for the increasing popularity among consumers is the fact that the ease of use has increased of VR headsets and more content is being developed for it (Brown & Green, 2016).

But consumers are not limited to computer-generated VR content. Videos can offer an immersive experience as well. These videos are captured using cameras capable of recording a complete 360-degree perspective of the scene (Breves, 2020; Prospero, 2023). By utilizing such tools, a viewer can freely explore and enjoy 360 degrees of perspective while consuming media. Although immersive videos have limited interactivity and are not considered "true" VR, they represent a merging of television and VR technologies (Breves, 2020). Genuine VR applications have been found to enhance prosocial behaviour and perspective-taking. However, creating and implementing these immersive virtual environments can be more challenging due to the need for supplementary hardware, such as tracking devices (Breves, 2020; Herrera et al., 2018). For this study, both a phone and an HMD are used as channels to

measure how people respond to them. This was chosen because they both generate different levels of immersion (Breves, 2020)[1].

What makes VR unique is the way of interacting with the computer. This goes beyond just using the mouse, keyboard and a touch-sensitive screen. Through VR, it is possible to interact with full immersion. Full immersion is based on two main components. These are the depth and breadth of information. First the depth of information, this consists of the quality, resolution and effectiveness of the audio-visuals. A higher degree of these features gives the wearer the feeling of being in a different environment. Secondly the breadth of information, this consists of the number of sensors present at a time (Desai et al., 2014). Stimulating their senses makes the wearer feel like they are in a different environment. So, when an HMD scores higher on the depth and breadth of information, there is a higher level of immersion.

Besides the breadth and depth of the information is also interactivity important. This comes from speed, range and mapping. Where speed refers to the speed at which the user's input can be processed in the mediated environment, range refers to the number of options available to the operator to take action in the environment and mapping refers to how well the control system can correlate changes in operator input with changes in the mediated environment, logically and simply (Steuer, 1992). This means that when someone has the feeling that they can naturally interact in and with the VR environment, it gives a higher level of immersion.

The degree of the above characteristics makes some devices considered more immersive than others. For instance, a flat 2D screen (e.g. TV or phone) is considered less immersive than an HMD (Wiederhold et al., 2010). But there is also a difference between HMDs. For instance, an HMD that has a higher depth and breadth of information can be considered more immersive than one that has this to a lower degree (Breves, 2020).

In conclusion, there is a difference in the degree of immersion a device possesses. For instance, the HMD is seen as a device that can provide a more immersive experience than a phone (Breves, 2020). This is because of the depth and breadth of information a device can

[1] The researcher believes that a phone with a 360-degree video has features of VR but that this is not full VR. To label this as full VR would negate a true VR experience.

deliver (Desai et al., 2014). But also because of the interactivity capabilities of the device (Steuer, 1992). In addition, research also shows that a higher degree of immersion leads to a greater sense of spatial presence (Han et al., 2022).

This resulted in the following hypothesis:

H2. *When customers watch content using a more immersive channel, such as an HMD, compared to a less immersive channel like a phone, they experience a higher level of spatial presence.*

2.2.2.2 Empathy

To experience a degree of spatial presence as a person, just an immersive environment is not enough. Besides technological conditions, there is also a human condition that needs to be met. A person needs to feel involved. Involvement is defined as a psychological state that arises from directing a person's focus and energy towards a consistent set of stimuli or activities that are meaningfully related. For example, if the HMD does not sit properly and the wearer is disturbed by this then the involvement is disrupted (Witmer & Singer, 1998). But more human conditions appear to influence the degree of presence a person experiences. One of these factors is the personality trait empathy (Nicovich et al., 2005; Samana et al., 2009; Sas, 2004). A personality trait refers to the distinctive and enduring patterns of thoughts, feelings, and behaviours that set individuals apart from each other. These traits are characterized by their relative stability over time, and their ability to differentiate one person's personality from another (Roberts & Mroczek, 2008). Empathy is the ability to feel and understand the emotions of others, without necessarily experiencing those emotions ourselves. It involves an affective response that is influenced by both the person’s inherent abilities and current emotional state and is shaped by both automatic and controlled processes. Through empathy, people can perceive and imagine the emotions of others, while recognizing that these emotions do not belong to them (Cuff et al., 2016).

In the past, immersive media forms like VR are described as empathy machines. Not new was the fact that certain visuals evoke situational empathy in someone. But the level of situational empathy appears to be higher when these visuals are viewed via a highly immersive device than via a low immersive device. (Breves, 2020; Milk, 2015). Most research is focusing on immersive VR as a stimulus for situational empathy someone is experiencing. That is not the case for this study. Here, empathy is used as a personality trait which moderates the effect

between the two variables' level of immersion and the degree of spatial presence someone is experiencing.

The reason this study is focussing on empathy as a personality trait is that not everyone experiences presence to the same extent. Research shows that presence is closely related to empathy and that a strong empathic tendency will lead to higher levels of perceived presence. This is because empathetic people can more easily empathise with another person. This corresponds to presence, where a person can empathise with a situation and therefore feel part of it. Empathy and presence are thus supposedly part of the same toolset (Nicovich et al., 2005; Samana et al., 2009). Evidence of this can also be found in the research of Sas (2004). Regarding the differences among individuals in their ability to experience a sense of presence in VR, she suggests that those who are more empathic tend to experience a much stronger sense of presence. This is also the case for spatial presence specifically. Persons who scored higher on empathy give a higher score on spatial presence than persons who score lower on empathy (Sacau et al., 2005).

So far, all the above studies are about empathy and the direct relation with immersion or presence. But in this study, empathy is not a mediator but a moderator for the effect of the degree of immersion and the level of presence someone experiences. In the research of Han et al. (2022), they look at the effect of immersion on empathy and presence. In this, they see that when the level of immersion increases, so does the level of presence. But they also see that when the level of immersion increases this does not result in an increase in empathy. Other studies show that the level of empathy a person has positively affects the level of presence a person experiences (Nicovich et al., 2005; Samana et al., 2009; Sas, 2004). There is evidence in the literature that personality traits influence the degree of immersion on the degree of presence. Research shows that personality traits determine the extent to which presence occurs when someone is exposed to immersive experiences (Samana et al., 2009; Weibel et al., 2010). In one study, the Big Five personality traits were used which consist of: openness to experience, conscientiousness, extraversion, agreeableness and neurotic (Weibel et al., 2010). This raises the question of whether empathy can be used as a moderator as well.

This results in the following hypothesis:

H3. *The consumers' personality trait empathy moderates the effect of the level of immersion on spatial presence in the customer experience process, such that a consumer with a higher degree of empathy will experience an increased feeling of spatial presence.*

2.2.3 Outcomes of customer experience

Green marketing aims to influence people's behaviour so that they buy a less polluting product (Polonsky, 2011). The CX outcome used for this study is buying behaviour where the focus is on purchase intention.

2.2.3.1 Buying behaviour (purchase intention)

An outcome of the customer experience is purchase intention. This is a type of decision-making that investigates the reasons why a consumer chooses a particular product or brand (Shah et al., 2012). Purchase intention according to Morinez et al. (2007) can be defined as a situation in which a consumer expects to buy a certain product in a certain condition (as cited in Parengkuan, 2017, p. 3). The customer purchase decision process is very complex. Among other things, it is related to the behaviour, perceptions and attitudes of consumers (Mirabi et al., 2015).

The intention to purchase something can be affected by factors such as price, perception of quality, and perception of value. During the purchasing process, consumers may also be influenced by internal impulses and external environmental factors (Grewal et al., 1998; Zeithaml, 1988). A person's behaviour is driven by physiological motivations that lead them to retail stores to meet their needs (Kim & Jin, 2001).

When shopping online, consumers do not have the opportunity to physically touch or experience the product in person. As a result, they tend to rely on other cues, such as heuristic cues on the retailer's website, to form an opinion about the quality of the product and the retailer's ability to deliver it (Moes & Vliet, 2017; Venkatesh, 1999). According to Venkatesh (1999), using a VR photo to depict a shop is more realistic and creates a greater sense of familiarity compared to a regular photo or a 360-degree photo. As a result, consumers who view the shop through VR are more likely to perceive the shop as capable and trustworthy,

which increases their likelihood of making a purchase. In other words, the immersive experience of VR can enhance the perceived quality of the shop and increase the consumer's purchase intention.

That there is a direct effect of seeing something in VR and purchase intention is shown by the following study. It demonstrates that when a person sees a product through VR, compared to a 360-degree spin photo (via a 2D screen) or a normal photo (via a 2D screen), this directly leads to an increase in purchase intention (Moes & Vliet, 2017). But there is also research that shows an indirect link between presence and purchase intention. Research indicates that perceiving telepresence does not automatically lead to a higher purchase intention. Instead, it is the cognitive and emotional engagement that occurs during the experience of telepresence that explains the increase in purchase intention. In other words, when people feel emotionally connected and engaged during an experience of telepresence, they are more likely to have a greater desire to make a purchase. This is because when people are emotionally engaged with a particular message or product, it sticks in their minds and this captivates their interest (Willems et al., 2019). This is because sensations (in this case spatial presence) are processed via perceptions, emotions (in this case emotional engagement) and cognitions and result in a certain behaviour (in this case a higher purchase intention) (Krishna, 2012).

This results in the following hypothesis:

H4a. *When a customer is experiencing a higher degree of positive emotional engagement in the customer experience process, the outcome of this process, the customer's purchase intention, will be higher.*

H4b. *When a customer is experiencing a higher degree of negative emotional engagement in the customer experience process, the outcome of this process, the customer's purchase intention, will be lower.*

3. Methodology

This section provides a detailed description of the research design, participants, procedures, measurements, limitations, and ethical considerations of the study. This section aims to provide the reader with a clear understanding of the methods used and to ensure the reliability and validity of the results obtained.

3.1 Design

This lab experiment utilized a one-factor, between-subjects experimental design. It thus involved two conditions to which the participants were randomly assigned. In one condition, the participants were shown a 360-degree video through an iPhone 12. The iPhone 12 can play a 360-degree video where the viewer could move the phone to explore the surroundings. The phone featured a 60hz 6.1-inch OLED display with a resolution of 2531 x 1170 pixels (Apple, n.d.). The group that watched via the phone was referred to as the control group. In the other condition, participants were exposed to the 360-degree video through an Oculus Go. This stand-alone HMD had a 60hz LCD display capable of presenting a resolution of 1280 x 1440 per eye. The visible Field of View (FoV) measured 89 degrees horizontal and 90 degrees vertical. The visible FoV represented the field of view visible to the wearer of the HMD (Brown, n.d.). The group using the HMD was the experimental group. The participants were not informed of the existence of the other group before conducting the experiment.

For the experiment a video is used which was found on YouTube. The 5-minute 360-degree video contains scenes of landscapes, seas and the harmful impact of plastic pollution on the environment. This video can be viewed either through an HMD using the YouTube VR application or via a phone using the YouTube application. The narration in the video emphasizes the environmental harm caused by (single-use) plastic and urges viewers to reduce their consumption. Seeking permission, the researcher contacted the video creators who expressed their delight in granting permission for its use in the study. They shared the source material, allowing the researcher to make necessary modifications. To ensure optimal participant engagement, the researcher aimed to utilize a video duration of between 3 and 4 minutes. A minimum of 3 minutes allowed participants to acclimate to the HMD or phone, while a maximum of 4 minutes maintained their attention. Accordingly, the video was shortened as the initial 5-minute duration was deemed too long for the study. A revised voice-

over was edited to match the length of the new video. Appendix B contains a screenshot of the video and its corresponding YouTube link.

In addition to a video, two scenarios had to be devised for the experiment. The first scenario is after the consent form and must be read by the participant before watching the video. This scenario is as follows: 'It is evening and you are sitting alone at home on the sofa. You are looking for some entertainment and come across the following video.' The next scenario is before the participants start the questions on purchase intention. This is: 'You are sitting at home on the sofa and you watched the video about the consequences of using plastic 5 minutes ago. Then you suddenly realise you have yet to buy toothbrushes. You search the internet and then see two toothbrushes; a plastic and a non-plastic variant.'.

Before the actual experiment could start, a pre-test was conducted. This is to assess the effectiveness of the manipulation. Specifically, the pre-test aimed to determine whether the HMD provided a more immersive experience compared to using the phone. This evaluation involved the creation of an immersive questionnaire that incorporated alternative explanations for observed effects (Collins, 2003; Hu, 2014). After the pre-test demonstrated the effectiveness of the manipulation, a pilot test was conducted as the next step. The pilot test involved two participants (both conditions) to ensure the smooth execution of the experiment and allow for necessary adjustments if required (Collins, 2003).

3.2 Procedure

The experiment has taken place in the Elinor Ostrom (EOS) building at Radboud University in Nijmegen, which houses the faculty of management sciences (Radboud University, n.d.). Individuals passing through the corridor of the EOS building were approached and invited to participate in a VR experiment. Those who agreed were escorted to the room where the experiment was conducted. Before the experiment, participants signed a consent form, indicating their agreement to participate. They were informed that they would be shown a 360-degree video using either an HMD or a phone. Detailed instructions were provided to participants on how to use the HMD or phone, ensuring a consistent understanding among all participants and minimizing potential disruptions to the research findings. Participants were only made aware of the existence of the channel (HMD or phone) they were assigned to. At the start of the survey, respondents were asked to enter a number, which was randomly

generated using an application (Pretty Random) on the researcher's phone. These numbers ranged from 1 to 70. Based on the entered number, participants were directed to the appropriate consent form. Numbers 1 to 35 were assigned to the phone's consent form, while numbers 36 to 70 were directed to the HMD's consent form, ensuring a completely random allocation of conditions. Before watching the video, a scenario was introduced to enhance realism for the participants and to provide a consistent starting point for all participants. Next, the participants were asked to watch the video. After that, the participants fill in the survey. For the questions about purchase intention, another scenario is introduced. The scenario involved participants imagining themselves sitting on a couch at home, having just viewed the video. Subsequently, participants were directed to search for a new toothbrush on the internet. They encountered a website offering two options: a traditional toothbrush and a non-plastic alternative. Detailed information regarding features such as price, quantity, and the presence of plastics was provided for evaluation. After they have finished the experiment and the questionnaire, they could leave.

3.3 Participants

Participants were asked one by one in the corridor of the Elinor Ostrom building if they wanted to participate in an experiment on customer behaviour. A total of at least 60 usable participants were needed to participate in the experiment, with at least 30 usable participants for each channel (HMD and phone). This is because, according to the central limit theorem, when a sample size of 30 is reached, the distribution was considered normal, which is good for the reliability of the research (Kwak & Kim, 2017). This was established. Due to randomly approaching people in the corridor, participants were of various ages. This indicated the use of non-probability sampling, specifically convenience sampling (Malhotra, 2020). This was because the researcher is a student and the sampling location took place in a location with a high concentration of students (campus). Therefore, the participants were close to the researcher (Etikan, 2016). This approach was chosen for its feasibility and limited resources. The only requirement to participate was the ability to speak English, as the survey could not be completed otherwise. A total of 60 participants took part in the study. The average age of the participants was 22 years, 65 per cent of them were male and 62 per cent had used a VR headset in the past.

3.4 Measurement

For this study, multiple things were measured among the participants, these were; spatial presence, emotional engagement, immersion, purchase intention, empathy and some control variables.

3.4.1 Spatial presence

The first concept that was measured is the degree of spatial presence the participant is experiencing. For this, the questionnaire of Hartmann et al. (2016) was used. This questionnaire is called the Spatial Presence Experience Scale (SPES) questionnaire. This questionnaire exists out of eight questions and has a two-dimensional construct that comprises a user's self-location and perceived possible actions in a media environment. It uses a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The SPES questionnaire is derived from the MEC Spatial Presence Questionnaire (MEC SPQ) (Wirth et al., 2007). The factors and the place of the questions in the questionnaire can be found in Table 1.

Factors	**Number of items**	**Question numbers**
Self-location	4	1, 2, 3 & 4
Possible actions	4	5, 6, 7 & 8

Table 1: The factors of the Spatial Presence Experience Scale (SPES) questionnaire (Hartmann et al., 2016; Wirth et al., 2007)

3.4.2 Positive and negative emotional engagement

Secondly, the concepts of positive and negative emotional engagement were measured. For this, the revised version of the Math and Science engagement scale of Wang et al. (2016) was used. This scale is changed by Lee et al. (2022) so it is suitable for VR experiences instead of math and science lectures. The questionnaire has three questions to measure positive emotional engagement and five questions to measure negative emotional engagement. It uses a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The factors and question numbers can be found in Table 2.

Concepts	Number of items	Question numbers
Positive emotional engagement	3	9, 10 & 11
Negative emotional engagement	5	12, 13, 14, 15 & 16

Table 2: The concepts of the Math and Science Engagement Scale questionnaire (s Lee et al., 2022; Wang et al., 2016)

3.4.3 Level of immersion

Thirdly, the concept of immersion was measured. This was used as a manipulation check. To measure this, the revised version of the immersion scale of Fornerino et al. (2008) was used. The original scale is used to measure immersion when watching a movie but the scale is changed by Leveau & Camus (2023) so it is suitable for VR. The questionnaire has six questions to measure the level of immersion a device delivers to someone. It uses a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). This questionnaire was also used for the pre-test to check the manipulation. The place of the questions in the questionnaire can be found in Table 3.

Concept	Number of items	Question numbers
Immersion	6	17, 18, 19, 20, 21 & 22

Table 3: The concept of immersion (Fornerino et al., 2008; Leveau & Camus, 2023)

3.4.4 Purchase intention

Fourthly, purchase intention was measured. For this, the questionnaire of Li et al. (2002) was used which consists of three questions. Table 4 shows the place of the questions in the questionnaire. The questions were adapted because they have been modified slightly. The original questions were about purchase intention for a particular product. For this survey, this was changed to 'non-plastic toothbrushes'. Above the questionnaire, two pictures of toothbrushes (plastic vs. non-plastic) could be found with their prices and some other characteristics. For the questions, a 5-point Likert scale was used, ranging from 1 (strongly disagree) to 5 (strongly agree).

Concept	Number of items	Question numbers
Purchase intention	3	23, 24 & 25

Table 4: The concept of the purchase intention (Li et al., 2002)

3.4.5 Control variables

Fifthly, the control variables. The participant was asked about two socio-demographic items. These were age and gender (Talwar et al., 2022). But the participant was also asked whether they regularly choose a non-plastic alternative product in the past (Talwar et al., 2022). This is because when it does, it could affect the results of the survey. Participants were also asked about their experience with VR (Talwar et al., 2022) and their willingness to use human-machine interactive technologies (Van et al., 2020). The control variables with the question numbers can be found in Table 5.

Control variable	**Number of items**	**Question number**
Preference for non-plastic products (Talwar et al., 2022)	1	26
Willingness to use human-machine interactive technologies (Van et al., 2020)	1	27
VR usage before (Talwar et al., 2022)	1	28
Pro-environmental behaviour (Talwar et al., 2022)	1	29
Age (Talwar et al., 2022)	1	45
Gender (Van et al., 2020)	1	46

Table 5: The control variables (Talwar et al., 2022; Van et al., 2020)

3.4.6 Empathy

The last concept that was measured is the degree of empathy the participant has. This is a stable personality trait. To measure this, the Interpersonal Reactivity Index (IRI) questionnaire developed by Davis (1980) was used. But because the researcher found it too long for this study, the Braun et al., (2015) version was used. Braun et al., (2015) reduced Davis' (1980) version from 28 questions to 15 questions. They have kept the same number of factors. These factors are fantasy, perspective-taking, empathic concern and personal distress (see Table 6).

Factors	**Number of items**	**Question numbers**
Fantasy	4	30, 31, 32 & 33
Perspective-taking	4	34, 35, 36 & 37
Empathic concern	3	38, 39 & 40

Personal distress	4	41, 42, 43 & 44

Table 6: The factors of the Interpersonal Reactivity Index (Braun et al., 2015; Davis, 1980)

The questionnaire can be found in Appendix A. All questionnaires as mentioned above, as well as the control variables, were merged for the study. All concepts, factors and their related sources can be found in Table 7.

The researcher is aware that the total questionnaire consists of 46 questions. However, most of these questions are easy and quick to complete using a Likert scale of 5 or 7 points. The researcher filled in the questionnaire himself and it took 5 minutes to complete. The pilot test also showed that, according to the participants, there was no problem with the length of the experiment. In the actual experiment, no problems were noticed regarding the time it took to fill in.

Concept	**Factors**	**Number of items**	**Adapted/adopted from**
Spatial presence	Self-location	4	Hartmann et al. (2016); Wirth et al. (2007)
	Possible actions	4	Hartmann et al. (2016); Wirth et al. (2007)
Positive emotional engagement	-	3	Lee et al. (2022): Wang et al. (2016)27/02/2024 11:09:00
Negative emotional engagement	-	5	Lee et al. (2022): Wang et al. (2016)
Immersion	Immersion	6	Fornerino et al. (2008); Leveau & Camus (2023)
Purchase intention	Purchase intention	3	Li et al. (2002)
Age	-	1	Talwar et al. (2022)
Gender	-	1	Talwar et al. (2022)
Preference for non-plastic products	-	1	Talwar et al. (2022)
VR usage before	-	1	Talwar et al. (2022)

Pro-environmental behaviour	-	1	Talwar et al. (2022)
Willingness to use human-machine interactive technologies	-	1	Van et al, (2020)
Empathy	Fantasy	4	Braun et al. (2015); Davis, (1980)
	Perspective-taking	4	Braun et al. (2015); Davis, (1980)
	Empathic concern	3	Braun et al. (2015); Davis, (1980)
	Personal distress	4	Braun et al. (2015); Davis, (1980)

Table 7: All concepts and factors for the study

3.5 Data analysis

The data from the questionnaires is cleaned where necessary and then processed using SmartPLS and SPSS. From this, several reports were produced which are needed to determine the effects of the different variables on each other. The results of the experiment can be found in Chapter 4.

3.6 Ethics

This study strictly adhered to the following 10 ethical rules (Bryman & Bell, 2007). Firstly, the well-being of research participants was not compromised in any way, as their safety and comfort were of utmost importance. Secondly, respect for the dignity of research participants was prioritized and maintained throughout the research process. These ethical rules were ensured by indicating to participants that they could stop whenever they wanted during the experiment. Thirdly, full consent was obtained from the participants before any research was conducted. This was guaranteed via a consent form that the participants needed to sign before the experiment. Fourthly, the protection of the privacy of research participants was ensured. Fifthly, the anonymity of individuals participating in the research was ensured. Privacy and anonymity were maintained as names were not asked for, and the researcher handled the data confidentially.

Sixthly, any deception or exaggeration about the aims and objectives of the research was avoided. Seventh, there were no affiliations in any form. Eighthly, any type of misleading information or representation of primary data findings in a biased way was avoided. Ninthly, any type of communication about the research was done with honesty and transparency. This was assured by the fact that the researcher had no interest in exaggerating data. The researcher was independent and not tied to any institution or group that had an interest in a particular outcome. Finally, it was vital to maintain high ethical standards throughout the research process to ensure the credibility and validity of the research findings.

3.7 Pre-test

Two constructs were measured during the pre-test. These are the level of immersion and the level of perceived information. To test whether the manipulation has the desired effect, the pre-test examines the level of immersion. For this, the same questionnaire is used as in the main experiment. For this, the revised version of the immersion scale of Fornerino et al. (2008) was used. The original scale is used to measure immersion when watching a movie but the scale is changed by Leveau & Camus (2023) so it is suitable for a VR environment.

To exclude other explanations for the result, the amount of perceived information is also taken into account. The survey of Kim & Lennon (2000) on perceived information consists of five questions and uses a Likert scale of 7 (1 = very unlikely, 7 = very likely). This was included in the pre-test to exclude that one condition provides more or less information to the participant. This is because a higher level of perceived information leads to a higher level of purchase intention (Kim & Lennon, 2000). The results of the t-test for the pre-test can be found in Appendix C.

3.8 Manipulation check experiment

A manipulation check was done before the experiment. The results of the t-test for the manipulation check can be found in Appendix D.

4. Results

The study used a combination of data analysis techniques using SPSS and SmartPLS. To gain insight into descriptive statistics and test the normality assumptions, SPSS 29 was used. SmartPLS 4 (Ringe et al., 2022), a software package specifically designed for Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis, was utilized. It was employed to examine the measurement model and structural model, encompassing reliability, validity, hypotheses, and assumptions. PLS-SEM integrates the analysis of total variance and partial least squares to assess the relationships between variables and constructs (Hair et al., 2012) as well as a principal component analysis and ordinary least squares regressions (Mateos-Aparicio, 2011). This method is particularly advantageous when dealing with small sample sizes (Hair et al., 2011). Moreover, it enables the simultaneous estimation of all relationships between variables and constructs (Hair, 2010). Partial Least Squares Structural Equation Modelling (PLS-SEM) was chosen over Covariance-Based Structural Equation Modelling (CB-SEM). Because PLS-SEM is more suitable for the extension of an existing structural theory, a formative construct is part of the structural model and the sample size is relatively low (Hair et al., 2011). For the bootstrapping procedure, 10,000 subsamples were employed, this generates robust t-statistics and standard errors (Hair et al., 2022). In the model, the dummy variable ‘Condition_Phone’ was used as the baseline.

Before the results of the experiment are highlighted, the results of the pre-test and the manipulation check are discussed. As for the pre-test, it can be seen that the difference in the level of immersion experienced by respondents with the phone (M = 2.77; SD = 1.24) and with the HMD (M = 5.47; SD .61) was significant (t (8) = -4.38; p = .002). The second component measured in the pre-test is perceived information. Here it can be seen that the difference in respondents' perceived information on the phone (M = 5; SD = 1.12) and the HMD (M = 5.49; SD .95) was not significant (t (8) = 7.28; p = .488). Then the manipulation check. This was the level of immersion during the experiment. Here it can be seen that the difference in the level of immersion between the phone (M = 2.4278; SD = 1.2842) and the HMD (M = 5.1778; SD 1.23249) was significant (t (58) = -9.014; p <.001).

4.1 Data preparation

4.1.1 Missing data and extremes

60 respondents participated in the experiment. As all questions were mandatory, there was no missing data. To prevent some data from being unusable, restrictions were used as much as possible. For the age question, for instance, it was only possible to fill in two numbers. In the survey, two questions (EM12PD, EM13PD) were negative, but these were reverse coded in Qualtrics so no further manual work was required. Upon analysing the descriptive statistics, no remarkable outliers were observed within the dataset.

4.1.2 Normality assumption

Descriptive statistics were employed by using SPSS to identify any deviations from the normality assumption. If the skewness falls within the range of -2 to 2 and the kurtosis falls within the range of -7 to 7, no deviations from normality are observed (Byrne, 2013; Hair et al., 2010). Within the data (see Appendix E, Table E1) no problems were found regarding the normality assumption.

4.2 Evaluation of the measurement model

Next, the measurement model is evaluated. This consists of the following four steps; internal reliability, construct reliability, convergent validity and discriminant validity. First the internal reliability. This is shown as the composite reliability and this needs to be higher than .60 for the exploratory stage and .70 for the more advanced stages of the research (Hair et al., 2011). As can be seen in Appendix E (Table E2) the composite reliability for all the multi-level constructs was between .820 and .947. Moreover, the reliability of the constructs was assessed using Cronbach's Alpha values, which were computed for each construct. A threshold of >.700 is typically considered acceptable for Cronbach's Alpha (Field, 2017, p. 1268). The lowest Cronbach’s Alpha was .767 (Negative Emotional Engagement).

Appendix E (Table E3) shows that 4 items (EM13PD, EM14PD, EE7N and EE8N) have lower outer loading than the stated .50 (Hair et al., 2010, p. 131). Of these items, EM13PD, EM14PD and EE8N have been removed (see Appendix E, Tables E4, E5 and E6). The researcher has chosen to keep EE7N because it had a value of .494 after removing EE8N. This value is slightly below the set minimum of .50 (Hair et al., 2010, p. 131) but otherwise, it would make the construct consist of only three items instead of the current four. Next, the

convergent validity is examined. Here, the average variance extracted (AVE) must be at least .50 (Fornell & Larcker, 1981). After removing the three items, the minimum AVE is .593 (see Appendix E, Table E7). Lastly, the discriminant validity via the Heterotrait-Monotrait ratio (HTMT) was examined. Here a threshold of 1 is used (Henseler et al., 2015). The HTMTs are ranging between .000 and .908 for the concepts of positive and negative emotional engagement (see Appendix E, Table E8). Table 8 shows the factor loading with t-values for the items and the composite reliability and average variance extracted from the constructs for the final model.

Components and manifest variables after deleting	Loading (t-value)
Empathy	**CR: 0.944, AVE: 0.539**
I really get involved with the feelings of the characters in a novel.	0.787 (10.590)*
After seeing a play or movie, I have felt as if I were one of the characters.	0.872 (13.342)*
When I watch a good movie, I can very easily put myself in the place of a leading character.	0.810 (10.685)*
When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me.	0.818 (10.610)*
I try to look at everybody's side of a disagreement before I make a decision.	0.673 (6.675)*
I sometimes try to understand my friends better by imagining how things look from their perspective.	0.821 (11.472)*
When I'm upset at someone, I usually try to "put myself in their shoes" for a while.	0.848 (12.716)*
Before criticizing somebody, I try to imagine how I would feel if I were in their place.	0.775 (8.835)*
I often have tender, concerned feelings for people less fortunate than me.	0.816 (9.955)*
When I see someone being taken advantage of, I feel kind of protective toward them.	0.727 (8.367)*
I am often quite touched by things that I see happen.	0.830 (11.961)*
When I see someone get hurt, I tend to remain calm.	0.590 (4.749)*
When I see someone who badly needs help in an emergency, I go to pieces.	0.546 (4.321)*
Spatial presence	**CR: 0.947, AVE: 0.693**
I felt like I was actually there in the environment of the video.	0.878 (39.761)*
It was as if my true location had shifted into the environment in the video.	0.898 (46.390)*
I felt as if I was physically present in the environment of the video.	0.891 (35.511)*
It seemed as if I actually took part in the action of the video.	0.831 (19.605)*
I had the impression that I could be active in the environment of the video.	0.809 (15.685)*
The objects in the video gave me the feeling that I could do things with them.	0.785 (12.559)*
I felt like I could move around among the objects in the video.	0.824 (17.578)*
It seemed to me that I could do whatever I wanted in the environment of the video.	0.730 (10.560)*
Positive emotional engagement	**CR: 0.868, AVE: 0.688**
I looked forward to this VR activity.	0.725 (6.755)*
I enjoy learning new things about this VR activity.	0.899 (30.348)*
I want to understand what is being taught in this VR activity.	0.854 (14.844)*
Negative emotional engagement	**CR: 0.820, AVE: 0.526**
I think this VR activity was boring.	0.906 (41.220)*
I did not want to be in this VR activity.	0.880 (24.279)*
I did not care about this VR activity.	0.888 (22.828)*
I often felt down when I am in this VR activity.	0.494 (3.303)*
Purchase intention	**CR: 0.922, AVE: 0.798**
There is a strong likelihood that I will buy the non-plastic toothbrushes.	0.915 (38.568)*
I will purchase these non-plastic toothbrushes.	0.891 (31.773)*
I would like to recommend the non-plastic toothbrushes to my friends.	0.874 (26.971)*
Notes: CR: Composite reliability; AVE: Average variance extracted; * p < 0,01	

Table 8: Final components and manifest variables

4.3 Evaluation of the structural model

To analyse the structural model, five steps are applied; Goodness-of-Fit analysis, evaluation of collinearity among predictor constructs, determination of the coefficient of determination, examination of effect size, analysis, and assessment of the size and significance of path coefficients (Hair et al., 2010; Henseler et al., 2016).

4.3.1 Goodness-of-Fit (GoF)

The measurement of the model fit was performed using the Goodness-of-Fit (GoF) Index, in which $GoF = \sqrt{communality \times R^2}$ (Tenenhaus et al., 2005; Wetzels et al., 2009). A GoF of .1 means a small model fit, .25 is a medium model fit and >.36 and means a large model fit (Wetzels et al., 2009). For this study, a GoF value of rounded .58 (see Appendix E, Table E9) is obtained, which indicated a good model fit (Wetzels et al., 2009).

4.3.2 Collinearity among predictor constructs

To evaluate the level of collinearity among predictor constructs, the researcher employed VIF values. The VIF values serve as a measure to assess the extent of collinearity where a <5 is considered acceptable (Hair et al., 2011). For this study, all the VIF values were below the established threshold of 5 since they range between 1 and 2.856 (see Appendix E, Table E10).

4.3.3 Coefficient determination

The primary criteria used to evaluate the structural model include the R^2 measures and the significance and magnitude of the path coefficients. The R^2 represents the amount of explained variance of each endogenous latent variable (Hair et al., 2011). The interpretation of a high R^2 level varies depending on the specific research discipline. For instance, in consumer behaviour, R^2 results of .20 are generally considered high, while in success driver studies, R^2 values of .75 would be regarded as high. In the context of marketing research studies, a rule of thumb suggests that R^2 values of .75, .50, or .25 for endogenous latent variables in the structural model can be described as substantial, moderate, or weak, respectively (Hair et al., 2011). In this study, the various R^2's range between .407 and .622 (see Figure 2). Because this research is at the intersection of consumer behaviour and marketing and tends more towards consumer behaviour, the R^2 values can be described as moderate to high.

4.3.4 Effect size

The effect size denotes the alteration in the R^2 value when a particular exogenous construct is excluded from the model and is expressed as an f^2 (Hair et al., 2010). The classification of weak, moderate, and strong effects may vary depending on the research context, but as a general guideline, effect sizes of .02, .15, and .35 can be considered indicative of weak, moderate, and strong effects, respectively (Cohen, 1988; Hair et al., 2012). The f^2 values in this study are ranging between .003 and 1.274 (see Appendix E, Table E11).

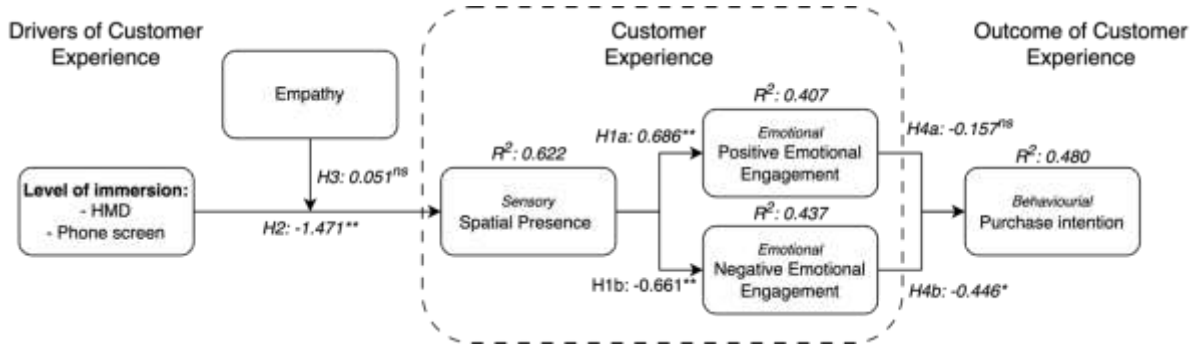
4.3.5 Size and significance

Lastly, the path coefficients, also called the beta coefficient. These provide information about the hypotheses and effects of the structural model. The structural model directly from SmartPLS 4 can be found in Appendix E (Figure E1). To start with the first hypothesis. In the model (see Figure 2) can be found that H1a is statistically significant because the concept spatial presence has a positive significant effect on the concept positive emotional engagement (β = .686; p < .01; R^2 = .407). H1b on the other hand is negative significant since spatial presence has a negative significant effect on the concept negative emotional engagement (β = -.661; p < .01; R^2 = .437). H2 is also statistically significant because the condition phone has a negative significant effect on the concept spatial presence (β = -1.471; p < .01; R^2 = .622). This means that the condition HMD has a significant positive effect on spatial presence (β = 1.471; p < .01; R^2 = .622). Not all hypotheses are significant since there is no moderating effect (H3) measured from the concept empathy on the relation between the channel and the concept spatial presence (β = .051; p > .05; R^2 = .622). This is also the case for H4a. Because there is no significant effect of the concept positive emotional engagement on the concept purchase intention (β = -.157; p > .05; R^2 = .480). Lastly, H4b. This is statically significant because the concept negative emotional engagement has a negative significant effect on the concept purchase intention (β = -.446; p < .05; R^2 = .480)

For the study, certain control variables were also included in the survey. The analysis of these variables (see Appendix E, Table E12) shows that there is only one (positive) significant effect. This is the effect of plastic preference on purchase intention (β = .335; p < .05; $R2$ = .480).

In addition, several direct effects are also observed (see Appendix E, Table E18) that were not included in the conceptual model. The direct effect of the condition HMD on negative emotional engagement is negatively significant (β = -.973; p < .001). This is in direct contrast to the effect of the condition HMD on positive emotional engagement which is positively significant (β = .938; p < .001). A positively significant effect of the condition HMD on purchase intention was also measured (β = .286; p < .05). Finally, a positive significant effect was measured of spatial presence on purchase intention (β = .194; p < .05).

Also, the indirect effects were analysed (see Appendix E, Table E19). This shows that the effect of spatial presence via negative emotional engagement on purchase intention is positively significant (β = .295; p < .05). A significant negative effect also applies to the effect of the condition HMD via spatial presence on negative emotional engagement (β = -.973; p < .001). A positive significant effect was observed for the effect of the condition HMD via spatial presence on positive emotional engagement (β = .938; p < .001). Finally, a positive significant effect was observed of the effect of the condition HMD via spatial presence and negative emotional engagement on purchase intention (β = .434; p < .05).



Notes: *: meets or exceeds p < .05 (two-tailed); ** meets or exceeds p < .01 (two-tailed); ns: non-significant

Figure 2: Structural model (condition phone for the level of immersion)

5 Discussion

This study focuses on the impact of Virtual Reality (VR) as a communication channel on customer behaviour on plastic fast-moving consumer goods with the central question: ‘What is the effect of Virtual Reality as a communication channel on customer behaviour regarding plastic fast-moving consumer goods?’. It can be claimed that an effect exists. Specifically, employing a Head-Mounted Display (HMD) instead of a conventional phone engenders a heightened sense of spatial presence, consequently resulting in a diminished level of negative emotional engagement. Ultimately, this reduced negative emotional engagement leads to increased purchase intent. This is also shown by the indirect effects analyses.

5.1 Discussion and conclusion

This study looks at the drivers and outcomes of the customer experience. In particular, how VR can affect the consumers' buying behaviour regarding plastic. Firstly, it is noteworthy to observe the presence of an effect within the customer experience, encompassing both spatial presence and emotional engagement. Specifically, the findings indicate a positive effect of spatial presence on positive emotional engagement, as well as a negative effect of spatial presence on negative emotional engagement. This implies that a heightened level of spatial presence corresponds to an increased level of positive emotional engagement and a reduced level of negative emotional engagement, aligning with the hypothesized expectations. This is in line with other studies conducted in the learning and in tourism context (Liu et al., 2020; Wagler & Hanus, 2018).

Furthermore, a relation is visible between the utilization of different channels, namely phone and head-mounted display (HMD), and the extent of spatial presence experienced by individuals. The analysis reveals that the HMD generates a greater sense of spatial presence compared to the phone. This disparity can be attributed to the immersive qualities inherent in the HMD technology, distinguishing it from the phone (Breves, 2020). The evidence of enhanced immersion through the HMD, relative to the phone, is also supported by the results obtained from the manipulation check and pre-test (see Appendix C and D). This is in line with earlier studies (Breves, 2020).

In this study, a moderator variable was employed, namely empathy, intended to moderate the impact of the channel on spatial presence. However, contrary to expectations, the

experimental results did not demonstrate a significant moderating effect. This could have several causes. First, this hypothesis was not supported by a specific source but it was a concatenation of multiple sources (Han et al., 2022; Nicovich et al., 2005; Samana et al., 2009; Sas, 2004; Weibel et al., 2010). For this reason, it may be that this effect did not occur at all. Secondly, it could also be that there is no evidence for this hypothesis within the current sample (the one used for this study). It could theoretically be that another sample does support this hypothesis. This could be because another sample has a higher level of empathy, for instance, which would make the effects more visible.

Lastly, the investigation encompassed an examination of the influence of emotional engagement on purchase intentions. The findings indicate a negative and significant relationship between negative emotional engagement and the intention to purchase non-plastic alternatives. Conversely, no significant relationship was observed between positive emotional engagement and the purchase intention of non-plastic alternatives. These results suggest that consumers who experience negative emotional engagement are less inclined to opt for non-plastic alternatives. However, the presence of heightened positive emotional engagement does not correspond to a higher intention to purchase non-plastic alternatives, contradicting the anticipated expectations (Willems et al., 2019). Again, within this sample size, the effect may not have been observed. However, it is unusual that a higher level of positive emotional engagement does not lead to a higher level of purchase intention while a lower level of negative emotional engagement does lead to a higher purchase intention. This could be because negative emotions have more impact than positive emotions (Baumeister et al., 2001). This has also been tested in learning; punishing (negative emotion) has more effect than rewarding (positive emotion) (Baumeister et al., 2001). The first reason for this would lie with human instinct. In the old days, when people had to hunt for their food, it was the case that when a positive opportunity presented itself it made little difference whether you went for it. You might have had more to eat but there were few consequences. When danger arose, you had to react to it, otherwise, you could die. This could be one reason that negative emotion has more impact than positive emotion (Baumeister et al., 2001). Another reason could be that negative stimuli have a greater influence on neural responses than positive stimuli. This ensures that negative things draw people's attention more than positive things (Ito et al., 1998; Pratto & John, 1991).

5.3 Theoretical implications

The first theoretical implication is about the difference in the amount of perceiving information via an HMD and a phone. This can be measured in the amount of perceived information (Kim & Lennon, 2000). In the pre-test, participants were asked to what extent they perceived information. This showed that there was no significant difference between the phone and the HMD. This means that in the future, perceived information does not have to be taken into account when doing research on a comparison between a phone and an HMD.

Secondly, this study contributed to the research on presence, immersion and personality traits. Multiple studies indicated that personality traits may play a moderating role in the relationship between immersion and (spatial) presence (Samana et al., 2009; Weibel et al., 2010). However, this had not yet been investigated for the personality trait empathy. This study shows that empathy is not a moderator for the relationship between immersion and presence. This is important because it shows that empathy does not need to be taken into account as a personality trait when investigating immersion and presence.

Lastly, this research contributes to the current literature on VR and behavioural change in the form of encouraging more environmentally friendly consumer behaviour. This study shows that negative emotional engagement has a stronger effect on purchase intentions than positive emotional engagement. These insights can be used when researching new ads. Here, they can then be directed towards achieving negative emotional engagement rather than the slightly weaker positive emotional engagement.

5.4 Managerial implications

The results of this study are useful for both governments and marketers. First of all, governments. At the moment, they struggle to communicate their green message to citizens (Webb, 2012). This is partly due to clutter (Jung & Heo, 2021; Katke, 2016). To get the message across effectively, they need to look at other channels where there is less clutter. This research shows that VR is a suitable technology to use for this purpose. This would be a great opportunity as HMDs are becoming increasingly accessible and thus rising in popularity (Brown & Green, 2016). Getting the message across can be done by advertising via HMDs as it is now done via phones or laptops. So, this means via websites or social media for example. When HMDs become more popular and will be used by more people, marketers will start

advertising on these devices too. In addition, the pre-test shows that there is no difference in the amount of information people experience between a phone and an HMD. So, this should not be a reason to ignore the HMD.

Another group for which the results of this research are useful are marketers. This group is also hindered by clutter and will therefore be looking for new channels to get their message across effectively. This too can be done through an HMD. As mentioned, ad possibilities will in all likelihood increase when there are more users. Currently, there are already companies advertising in online VR worlds (Kim, 2021). They create their own space here with their branding. This way, the customer is immersed in the world of that brand. But not only in online worlds. For a few years now, users of YouTube VR (the YouTube application for an HMD) have been shown VR ads (Ranaweera, 2019). In addition, this study shows that people with reduced negative emotional engagement have higher levels of purchase intention. This, together with the fact that negative emotions make more impact than positive emotions (Baumeister et al., 2001), may motivate marketers to make more use of people's emotions when it comes to green marketing.

Within the field of green marketing, it is important to motivate people to make greener choices (Polonsky, 2011). This can be done by appealing to consumers' emotions, as this works better than a rational message (Lee, 2008). This can be done by responding to the feelings your target audience has. For example, if your target audience is afraid of the consequences of climate change, you respond to that in your advertising. This research shows that an HMD is a suitable means of eliciting emotional engagement from consumers to stimulate consumers to make greener choices.

5.5 Limitations and future research

Despite this research providing new insights into customer experience and VR, there are also limitations. For instance, the data shows that 52 per cent of participants had a preference for non-plastic alternatives in the past (see Appendix E, Table E13). This is compared to 33 per cent (15 per cent voted neutral) who had no preference for these products in the past. In addition, the data also shows that 62 per cent of the participants had used a VR headset before (see Appendix E, Table E14). This is the vast majority and this may mean that this group got used to the HMD quicker and thus could focus better on the video and message. Third, the

outcome of the study showed that 73 per cent of the participants were open to human-machine interactive technologies (like VR). As opposed to 15 per cent who indicated that they were not open to this (see Appendix E, Table E15). In addition, there is also an uneven distribution of the different genders among the participants (male: 65 per cent, female: 33 per cent and non-binary/third gender: 2 per cent) as can be seen in Appendix E (Table E16). This may influence the results because research shows that men show less environmentally conscious behaviour than women (Davidson & Freudenburg, 1996; Lee & Holden, 1999). Finally, it is worth noting that there is no society average when it comes to age. Because the experiment was held on the campus of Radboud University in Nijmegen, the Netherlands, and people were asked in the corridor for the experiment, the mean age is 22.3 years with a minimum of 18 and a maximum of 29 years (see Appendix E, Table E17).

Researchers in this profession could conduct future similar research examining a larger and more diverse sample. By taking a sample that represents a cross-section of society in the new research, there is a higher degree of generalisability. This could strengthen this existing research.

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Appendix A: The complete questionnaire with guidance

Page 1

Enter below the number given by the researcher.

Enter a number (1-35 phone – 36-70 HMD)

Page 2 (phone)

Purpose:

The aim of this study is to investigate responses to Virtual Reality (VR) experiences.

Equipment:

- An iPhone 12 to watch a 360-degree video about plastic use.

Procedure:

First, you are asked to watch a video about the use of plastic and its consequences. This is a 360-degree video. This allows you to look around. Finally, after watching the video about plastics, you are asked to complete additional survey questions.

Please confirm the following:

- I understand that Virtual Reality (VR) experiences are highly immersive and can feel extremely realistic at times. Further, I confirm that I do not have any physical, mental or health-related reasons or problems that should preclude my participation in the Virtual Reality (VR) experience (e.g. dizziness, nausea, epilepsy, seizures), and I also confirm that I assume all of the physical, psychological, and financial risks associated with the use of Virtual Reality (VR) equipment.
- I confirm that I do not have any mental, physical, or health-related problems, or reasons that should stop me from participating in this VR experiment.
- I confirm that I assume all of the psychological risks that are associated with the use of virtual reality (or related) technology, including potential discomfort or motion sickness.

If you agree to participate in the study, you will be asked to do the following:

- Watch a 360-degree video
- Fill in the questionnaire

The total time required to complete the study should be approximately 10 minutes, including watching the video and filling in the survey.

Health risks

The video you will be shown might include shocking content. We do not expect that this content will cause any harm or discomfort. However, if you experience feelings of discomfort, or distress as a result of your participation in this experiment, please let the researcher know. The researcher can then provide appropriate assistance if necessary. In some cases, participants report a so-called 'Virtual Reality (VR) Simulator Sickness' caused by the Virtual Reality (VR) experience, which can cause dizziness, headaches, anxiety or other effects on the user's sense of balance, or other mental or physical negative effects when experiencing Virtual Reality (VR). I voluntarily assume all associated risks and take full responsibility for these and any other consequences that may arise from my participation. I agree to report any discomfort or disorientation immediately so that the researcher can remove the equipment and take appropriate measures to assist.

Confidentiality:

Your participation in the study (watching a 360-degree video, and survey) is entirely voluntary. If you do not want to complete the experiment or feel uncomfortable answering any of the survey questions, you can stop at any point, at any time. When there are any questions, feel free to contact the researcher, and the researcher will answer your questions. Your data will be treated confidentially and will be used solely for this research project. After the research project is finished, your data will be terminated.

Additionally, the research results will be used to write a thesis that will be uploaded to a digital repository owned by Radboud University. However, your privacy is assumed to be most important, no personal identification can be done through these results.

Contact and questions:

If you have any questions, or you wish to contact the researcher for any other reasons with regard to this study, you can contact the researcher through the following email:

Floris.barten@ru.nl

Statement of Consent:

I have read and understood all of the above information. I have asked all my questions and expressed all of my concerns, and issues with regard to the experiment, and survey. All of my questions, concerns, and issues have been dealt with to my satisfaction. I consent to participate in this study.

CONSENT: I do consent to the text above

- Yes
- No

Page 2 (HMD)

Purpose:

The aim of this study is to investigate responses to Virtual Reality (VR) experiences.

Equipment:

- An Oculus Go to watch a 360-degree video about plastic use.

Procedure:

First, you are asked to watch a video about the use of plastic and its consequences. This is a 360-degree video. This allows you to look around. Finally, after watching the video about plastics, you are asked to complete additional survey questions.

Please confirm the following:

- I understand that Virtual Reality (VR) experiences are highly immersive and can feel extremely realistic at times. Further, I confirm that I do not have any physical, mental or health-related reasons or problems that should preclude my participation in the Virtual Reality (VR) experience (e.g. dizziness, nausea, epilepsy, seizures), and I also confirm that I assume all of the physical, psychological, and financial risks associated with the use of Virtual Reality (VR) equipment.
- I confirm that I do not have any mental, physical, or health-related problems, or reasons that should stop me from participating in this VR experiment.

- I confirm that I assume all of the psychological risks that are associated with the use of virtual reality (or related) technology, including potential discomfort or motion sickness.

If you agree to participate in the study, you will be asked to do the following:

- Watch a 360-degree video
- Fill in the questionnaire

The total time required to complete the study should be approximately 10 minutes, including watching the video and filling in the survey.

Health risks

The video you will be shown might include shocking content. We do not expect that this content will cause any harm or discomfort. However, if you experience feelings of discomfort, or distress as a result of your participation in this experiment, please let the researcher know. The researcher can then provide appropriate assistance if necessary. In some cases, participants report a so-called 'Virtual Reality (VR) Simulator Sickness' caused by the Virtual Reality (VR) experience, which can cause dizziness, headaches, anxiety or other effects on the user's sense of balance, or other mental or physical negative effects when experiencing Virtual Reality (VR). I voluntarily assume all associated risks and take full responsibility for these and any other consequences that may arise from my participation. I agree to report any discomfort or disorientation immediately so that the researcher can remove the equipment and take appropriate measures to assist.

Confidentiality:

Your participation in the study (watching a 360-degree video, and survey) is entirely voluntary. If you do not want to complete the experiment or feel uncomfortable answering any of the survey questions, you can stop at any point, at any time. When there are any questions, feel free to contact the researcher, and the researcher will answer your questions. Your data will be treated confidentially and will be used solely for this research project. After the research project is finished, your data will be terminated.

Additionally, the research results will be used to write a thesis that will be uploaded to a digital repository owned by Radboud University. However, your privacy is assumed to be most important, no personal identification can be done through these results.

Contact and questions:

If you have any questions, or you wish to contact the researcher for any other reasons with regard to this study, you can contact the researcher through the following email: Floris.barten@ru.nl

Statement of Consent:

I have read and understood all of the above information. I have asked all my questions and expressed all of my concerns, and issues with regard to the experiment, and survey. All of my questions, concerns, and issues have been dealt with to my satisfaction. I consent to participate in this study.

CONSENT: I do consent to the text above.

- Yes
- No [participants who press 'No' are going directly to page 7]

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Thank you for participating in this experiment. First, you will watch a video after which a questionnaire will follow. Before you start the video, imagine the following: it is evening and you are sitting alone at home on the sofa. You are looking for some entertainment and come across the following video. You can now start watching the video.

VIDEOCHECK: I watched the video

- Yes

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The following questions are about the video you just watched.

	Strongly disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Strongly agree

1. I felt like I was actually there in the environment of the video.	○	○	○	○	○
2. It was as if my true location had shifted into the environment in the video.	○	○	○	○	○
3. I felt as if I was physically present in the environment of the video.	○	○	○	○	○
4. It seemed as if I actually took part in the action of the presentation.	○	○	○	○	○
5. I had the impression that I could be active in the environment of the presentation.	○	○	○	○	○
6. The objects in the presentation gave me the feeling that I could do things with them.	○	○	○	○	○
7. I felt like I could move around among the objects in the presentation.	○	○	○	○	○
8. It seemed to me that I could do whatever I wanted in the environment of the presentation.	○	○	○	○	○
9. I looked forward to this VR activity.	○	○	○	○	○
10. I enjoy learning new things about this VR activity.	○	○	○	○	○
11. I want to understand what is being taught in this VR activity.	○	○	○	○	○
12. I think this VR activity was boring.	○	○	○	○	○

13. I did not want to be in this VR activity.	○	○	○	○	○		
14. I did not care about this VR activity.	○	○	○	○	○		
15. I often felt down when I am in this VR activity.	○	○	○	○	○		
16. I get worried when I learn new things about this VR activity.	○	○	○	○	○		

	Strongly disagree	Disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Agree	Strongly agree
17. The device (with which I watched the video) created a new world that suddenly disappeared at the end of the experience.	○	○	○	○	○	○	○
18. During the experience, my body was in the real world, but my mind was in the virtual world.	○	○	○	○	○	○	○
19. This experience made me forget the realities of the outside world.	○	○	○	○	○	○	○
20. During the experience, what had happened before the experience or what would happen after the experience no longer mattered.	○	○	○	○	○	○	○
21. This experience made me forget my immediate environment.	○	○	○	○	○	○	○
22. At times, I lost awareness of my surroundings.	○	○	○	○	○	○	○

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Before filling in the following questions imagine the following scenario:
You are sitting at home on the sofa and you watched the video about the consequences of using plastic 5 minutes ago. Then you suddenly realise you have yet to buy toothbrushes. You search the internet and then see two toothbrushes; a plastic and a non-plastic variant. With this in mind, you may complete the following 3 questions.

Non-plastic toothbrush and packaging	**Plastic toothbrush and packaging**
	
- 9 euro	- 4 euro
- 4 toothbrushes	- 6 toothbrushes
- 2,25 euros each	- 0,67 euros each

	Strongly disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Strongly agree
23. There is a strong likelihood that I will buy the non-plastic toothbrushes.	○	○	○	○	○
24. I will purchase this non-plastic toothbrushes.	○	○	○	○	○
25. I would like to recommend the non-plastic toothbrushes to my friends.	○	○	○	○	○

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The following questions are about yourself and does nothing have to do with the video you just saw about plastic.

	Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
26. Did you prefer non-plastic alternatives in the past?	○	○	○	○	○
27. Are you willing to use human-machine interactive technologies (like VR)	○	○	○	○	○

	Never	1 to 3 times	4 to 6 times	More than 6 times
28. Did you use VR in the past?	○	○	○	○

	Does not describe me	Describes me slightly well	Describes me moderately well	Describes me very well	Describes me extremely well
29. I show pro-environmental behaviour.	○	○	○	○	○
30. I really get involved with the feelings of the characters in a novel.	○	○	○	○	○
31. After seeing a play or movie, I have felt as though I were one of the characters.	○	○	○	○	○
32. When I watch a good movie, I can very easily put myself in the place	○	○	○	○	○

of a leading character.					
33. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me.	○	○	○	○	○
34. I try to look at everybody's side of a disagreement before I make a decision.	○	○	○	○	○
35. I sometimes find it difficult to see things from the other person's point of view.	○	○	○	○	○
36. In case of disagreement, I try to take everyone's point of view into account before making a decision.	○	○	○	○	○
37. Before criticizing somebody, I try to imagine how I would feel if I were in their place.	○	○	○	○	○
38. I often have tender, concerned feelings for people less fortunate than me.	○	○	○	○	○
39. When I see someone being taken advantage of, I feel kind of protective toward them.	○	○	○	○	○
40. I am often quite touched by things that I see happen.	○	○	○	○	○

41. When I see someone get hurt, I tend to remain calm. (-)	○	○	○	○	○
42. I am usually pretty effective in dealing with emergencies. (-)	○	○	○	○	○
43. I tend to lose control during emergencies.	○	○	○	○	○
44. When I see someone who badly needs help in an emergency, I go to pieces.	○	○	○	○	○

45. What is your age?

Enter a number

	Male	Female	Non-binary/third gender	Prefer not to say
46. What is your gender?	○	○	○	○

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We thank you for your time spent taking this survey.

Your response has been recorded.

Appendix B: Screenshot of the videos (with links)

Screenshot of the original video (link: https://www.youtube.com/watch?v=URVGXu7ujL4)

Screenshot of the shortened video (link: https://youtu.be/zbfNXFA0yHc)

Appendix C: Results pre-test

The difference in the level of immersion experienced by respondents with the phone (*M* = 2.77; *SD* = 1.24) and with the HMD (*M* = 5.47; *SD* .61) was significant (*t* (8) = -4.38; *p* = .002) (see Tables C1).

Group Statistics

	Condition	N	Mean	Std. Deviation	Std. Error Mean
Immersion	1 Phone	5	2.7667	1.23940	.55428
	2 HMD	5	5.4667	.60553	.27080

Table C1a: Group statistics immersion (pre-test)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Immersion	Equal variances assumed	2.097	.186	-4.377	8	.001	.002	-2.70000	.61689	-4.12256	-1.27744
	Equal variances not assumed			-4.377	5.807	.003	.005	-2.70000	.61689	-4.22175	-1.17825

Table C1b: Independent sample test immersion (pre-test)

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
Immersion	Cohen's d	.97539	-2.768	-4.550	-.911
	Hedges' correction	1.08052	-2.499	-4.107	-.822
	Glass's delta	.60553	-4.459	-7.655	-1.245

a. The denominator used in estimating the effect sizes.

Cohen's d uses the pooled standard deviation.

Hedges' correction uses the pooled standard deviation, plus a correction factor.

Glass's delta uses the sample standard deviation of the control group.

Table C1c: Independent sample effect sizes immersion (pre-test)

The difference in respondents' perceived information at the telephone (M = 5; SD = 1.12) and at the HMD (M = 5.49; SD .95) was not significant (t (8) = 7.28; p = .488) (see Tables C2).

Group Statistics

	Condition	N	Mean	Std. Deviation	Std. Error Mean
Immersion	1 Phone	5	5.0000	1.12250	.50200
	2 HMD	5	5.4800	.95499	.42708

Table C2a: Group statistics perceived information (pre-test)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Immersion	Equal variances assumed	.338	.577	-.728	8	.244	.487	-.48000	.65909	-1.99986	1.03986
	Equal variances not assumed			-.728	7.800	.244	.488	-.48000	.65909	-2.00668	1.04668

Table C2b: Independent sample test perceived information (pre-test)

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval Lower	95% Confidence Interval Upper
Immersion	Cohen's d	1.04211	-.461	-1.706	.812
	Hedges' correction	1.15444	-.416	-1.540	.733
	Glass's delta	.95499	-.503	-1.759	.810

a. The denominator used in estimating the effect sizes.

Cohen's d uses the pooled standard deviation.

Hedges' correction uses the pooled standard deviation, plus a correction factor.

Glass's delta uses the sample standard deviation of the control group.

Table C2c: Independent sample effect sizes perceived information (pre-test)

Appendix D: Results manipulation check experiment

The difference in the level of immersion experienced by respondents with the phone (*M* = 2.4278; *SD* = 1.2842) and with the HMD (*M* = 5.1778; *SD* 1.23249) was significant (*t* (58) = -9.014; *p* = < .001) (see Tables D1).

Group Statistics

	Condition	N	Mean	Std. Deviation	Std. Error Mean
Immersion	1 Phone	30	2.4278	1.12842	.20602
	2 HMD	30	5.1778	1.23249	.22502

Table D1a: Group statistics immersion (manipulation check experiment)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Immersion	Equal variances assumed	.322	.572	-9.014	58	<.001	<.001	-2.75000	.30509	-3.36070	-2.13930
	Equal variances not assumed			-9.014	57.554	<.001	<.001	-2.75000	.30509	-3.36080	-2.13920

Table D1b: Independent sample test immersion (manipulation check experiment)

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval Lower	95% Confidence Interval Upper
Immersion	Cohen's d	1.18160	-2.327	-2.981	-1.662
	Hedges' correction	1.19716	-2.297	-2.942	-1.640
	Glass's delta	1.23249	-2.231	-2.986	-1.459

a. The denominator used in estimating the effect sizes.

Cohen's d uses the pooled standard deviation.

Hedges' correction uses the pooled standard deviation, plus a correction factor.

Glass's delta uses the sample standard deviation of the control group.

Table D1c: Independent sample effect sizes immersion (manipulation check experiment)

Appendix E: Results experiment

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
SP1SL	60	1	5	3.20	1.459	-.225	.309	-1.430	.608
SP2SL	60	1	5	2.93	1.460	.052	.309	-1.452	.608
SP3SL	60	1	5	2.90	1.386	.106	.309	-1.363	.608
SP4SL	60	1	5	2.72	1.316	.086	.309	-1.369	.608
SP5PA	60	1	5	2.73	1.376	.219	.309	-1.303	.608
SP6PA	60	1	5	2.58	1.357	.302	.309	-1.276	.608
SP7PA	60	1	5	3.28	1.415	-.450	.309	-1.231	.608
SP8PA	60	1	5	2.63	1.221	.228	.309	-1.142	.608
EE1P	60	2	5	4.12	.783	-.429	.309	-.588	.608
EE2P	60	2	5	3.80	.953	-.433	.309	-.659	.608
EE3P	60	1	5	3.75	.985	-.791	.309	.113	.608
EE4N	60	1	5	2.27	1.219	.625	.309	-.840	.608
EE5N	60	1	5	1.72	.976	1.285	.309	1.119	.608
EE6N	60	1	4	1.88	1.010	.956	.309	-.160	.608
EE7N	60	1	4	2.03	1.008	.651	.309	-.640	.608
EE8N	60	1	4	1.95	1.016	.906	.309	-.214	.608
IM1	60	1	7	3.92	1.977	-.030	.309	-1.403	.608
IM2	60	1	7	4.13	2.021	-.226	.309	-1.488	.608
IM3	60	1	7	3.53	2.046	.307	.309	-1.425	.608
IM4	60	1	7	3.55	1.917	.361	.309	-1.097	.608
IM5	60	1	7	3.73	2.074	.016	.309	-1.537	.608
IM6	60	1	7	3.95	2.004	-.178	.309	-1.467	.608
PI1	60	1	5	2.97	1.164	-.133	.309	-1.259	.608
PI2	60	1	5	2.58	1.124	.155	.309	-1.157	.608
PI3	60	1	5	3.08	1.253	-.323	.309	-1.016	.608
EM1FAN	60	1	5	3.10	1.145	-.552	.309	-.714	.608
EM2FAN	60	1	5	2.85	1.162	-.234	.309	-.836	.608
EM3FAN	60	1	5	3.18	1.242	-.306	.309	-.957	.608
EM4FAN	60	1	5	3.30	1.212	-.489	.309	-.579	.608
EM5PT	60	1	5	3.20	1.232	-.115	.309	-1.042	.608
EM6PT	60	1	5	3.55	1.096	-.851	.309	.113	.608
EM7PT	60	1	5	3.02	1.200	-.094	.309	-.975	.608
EM8PT	60	1	5	3.17	1.167	-.270	.309	-.721	.608
EM9EC	60	1	5	2.93	1.103	.057	.309	-.883	.608
EM10EC	60	1	5	3.32	1.097	-.350	.309	-.734	.608
EM11EC	60	1	5	3.22	1.091	-.611	.309	-.344	.608
EM12PD	60	1	5	3.10	1.115	.252	.309	-.957	.608
EM13PD	60	1	5	2.87	1.186	.645	.309	-.539	.608
EM14PD	60	1	4	2.05	1.032	.663	.309	-.683	.608
EM15PD	60	1	5	2.57	1.198	-.010	.309	-1.333	.608
CON_PLASTIC_PREF	60	1	5	3.13	1.171	-.333	.309	-.949	.608
CON_TECH	60	1	5	3.87	1.142	-1.002	.309	.289	.608
CON_VR	60	1	4	1.87	.873	.900	.309	.315	.608
CON_ENVIRON	60	1	5	2.75	1.114	.062	.309	-.746	.608
CON_GENDER	60	1	3	1.37	.520	.939	.309	-.318	.608
Valid N (listwise)	60								

Table E1: Descriptive statistics

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Empathy	0.936	0.958	0.944	0.539
Negative emotional engagement	0.769	0.901	0.820	0.526
Positive emotional engagement	0.768	0.784	0.868	0.688
Purchase intention	0.874	0.877	0.922	0.799
Spatial presence	0.936	0.945	0.947	0.693

Table E2: Composite reliability and validity (before deleting)

	Empathy	Negative emotional engagement	Positive emotional engagement	Purchase intention	Spatial presence
EM1FAN	0.787				
EM2FAN	0.872				
EM3FAN	0.810				
EM4FAN	0.818				
EM5PT	0.673				
EM6PT	0.821				
EM7PT	0.848				
EM8PT	0.775				
EM9EC	0.816				
EM10EC	0.727				
EM11EC	0.830				
EM12PD	0.590				
EM13PD	0.444				
EM14PD	0.452				
EM15PD	0.546				
EE4N		0.906			
EE5N		0.880			
EE6N		0.888			
EE7N		0.481			
EE8N		0.134			
EE1P			0.725		
EE2P			0.899		
EE3P			0.854		
PI1				0.915	
PI2				0.891	
PI3				0.874	
SP1SL					0.878
SP2SL					0.898
SP3SL					0.891
SP4SL					0.831
SP5PA					0.809
SP6PA					0.785
SP7PA					0.824
SP8PA					0.730

Table E3: Initial outer loadings

- Deleted EE8N in the construct negative emotional engagement because of the outer loading of .134, which is less than the minimum of .50 (Hair et al., 2010, p. 131). In Table E4a the new outer loadings for negative emotional engagement can be found.

	Outer loading
EE4N	0.902
EE5N	0.882
EE6N	0.889
EE7N	0.494

Table E4a: Outer loadings negative emotional engagement after deleting EE8N

- As can be seen, EE7N is still less than the minimum of .50 (Hair et al., 2010, p. 131). Besides that, the researchers have chosen to keep the item. The reasons for this are the minimal shortage of .006 and otherwise, there are only 3 items left instead of the current 4. In Table E4b the new statistics for the construct negative emotional engagement can be found.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Negative emotional engagement	0.821	0.916	0.880	0.656

Table E4b: Composite reliability and validity negative emotional engagement after deleting EE8N

- Deleted EM13PD in the construct empathy because of the outer loading of .444, which is less than the minimum of .50 (Hair et al., 2010, p. 131) In Table E5a the new outer loadings for empathy can be found.

	Outer loading
EM1FAN	0.792
EM2FAN	0.876
EM3FAN	0.811
EM4FAN	0.824
EM5PT	0.674
EM6PT	0.827
EM7PT	0.847
EM8PT	0.773
EM9EC	0.814
EM10EC	0.732
EM11EC	0.826
EM12PD	0.577
EM14PD	0.435
EM15PD	0.545

Table E5a: Outer loadings empathy after deleting EM13PD

- In Table E5b the new statistics for the construct empathy after deleting EM13PD can be found.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Empathy	0.937	0.957	0.946	0.563

Table E5b: Composite reliability and validity empathy after deleting EM13PD

- Deleted EM14PD in construct empathy because of the outer loading of .435 which is less than the minimum of .50 (Hair et al., 2010, p. 131). In Table E6a the new outer loadings for empathy can be found.

	Outer loading
EM1FAN	0.801
EM2FAN	0.879
EM3FAN	0.812
EM4FAN	0.830
EM5PT	0.674
EM6PT	0.831
EM7PT	0.840
EM8PT	0.770
EM9EC	0.813
EM10EC	0.736
EM11EC	0.824
EM12PD	0.566
EM15PD	0.544

Table E6a: Outer loadings empathy after deleting EM14PD

- In Table E6b the new statistics for the construct empathy after deleting EM14PD can be found.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Empathy	0.941	0.957	0.949	0.593

Table E6b: Composite reliability and validity empathy after deleting EM14PD

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Empathy	0.941	0.957	0.949	0.593
Negative emotional engagement	0.821	0.916	0.880	0.656
Positive emotional engagement	0.768	0.784	0.868	0.688
Purchase intention	0.874	0.878	0.922	0.798
Spatial presence	0.936	0.945	0.947	0.693

Table E7: Composite reliability and validity (after deleting)

	CON_AGE	CON_ENVIRON	CON_GENDER	CON_PLASTIC_PREF	CON_TECH	CON_VR	Condition_HMD	Empathy	Negative emotional engagement	Positive emotional engagement	Purchase intention	Spatial presence	Empathy x Condition_HMD
CON_AGE													
CON_ENVIRON	0.016												
CON_GENDER	0.199	0.483											
CON_PLASTIC_PREF	0.017	0.714	0.364										
CON_TECH	0.220	0.147	0.088	0.153									
CON_VR	0.041	0.122	0.040	0.134	0.458								
Condition_HMD	0.229	0.287	0.065	0.201	0.206	0.039							
Empathy	0.109	0.700	0.397	0.479	0.381	0.271	0.333						
Negative emotional engagement	0.290	0.286	0.189	0.264	0.569	0.212	0.639	0.449					
Positive emotional engagement	0.297	0.162	0.088	0.182	0.539	0.247	0.679	0.535	0.908				
Purchase intention	0.049	0.567	0.137	0.589	0.109	0.089	0.265	0.278	0.413	0.193			
Spatial presence	0.152	0.319	0.177	0.328	0.277	0.123	0.791	0.380	0.685	0.745	0.482		
Empathy x Condition_HMD	0.104	0.547	0.374	0.448	0.000	0.074	0.264	0.675	0.227	0.253	0.367	0.275	

Table E8: Discriminant validity (HTMT)

Mean construct commonality	Empathy
	(0.787 * 0.787) + (0.872 * 0.872) + (0.810 * 0.810) + (0.818 * 0.818) + (0.673 * 0.673) + (0.821 * 0.821) + (0.848 * 0.848) + (0.775 * 0.775) + (0.816 * 0.816) + (0.727 * 0.727) + (0.830 * 0.830) + (0.590 * 0.590) + (0.546 * 0.546) = 7.681177 7.681177 / 13 = 0.5908597692
	Spatial Presence
	(0.878 * 0.878) + (0.898 * 0.898) + (0.891 * 0.891) + (0.831 * 0.831) + (0.809 * 0.809) + (0.785 * 0.785) + (0.824 * 0.824) + (0.730 * 0.730) = 5.544312 5.544312 / 8 = 0.693039
	Positive emotional engagement
	(0.725 * 0.725) + (0.899 * 0.899) + (0.854 * 0.854) = 2.063142 2.063142 / 3 = 0.687714
	Negative emotional engagement
	(0.906 * 0.906) + (0.880 * 0.880) + (0.888 * 0.888) + (0.494 * 0.494) = 2.627816 2.627816 / 4 = 0.656954
	Purchase intention
	(0.915 * 0.915) + (0.891 * 0.891) + (0.874 * 0.874) = 2.394982 2.394982 / 3 = 0.7983273333
	Mean construct commonality
	0.5908597692 + 0.693039 + 0.687714 + 0.7983273333 = 2.7699401025 2.7699401025 / 4 = 0.6924850256
Mean R^2	0.437 + 0.407 + 0.480 + 0.622 = 1.946 1.946 / 4 = 0.4865
Mean construct commonality * Mean R^2	0.6924850256 * 0.4865 = 0.336893965
GoF-Index	√0.336893965 = 0.5804256757

Table E9: Calculation of the Goodness-of-Fit-Index

	VIF
CON_AGE -> Purchase Intention	1.162
CON_ENVIRON -> Purchase Intention	2.377
CON_GENDER -> Purchase Intention	1.437
CON_PLASTIC_PREF -> Purchase Intention	2.083
CON_TECH -> Purchase Intention	1.816
CON_VR -> Purchase Intention	1.297
Condition_HMD -> Spatial Presence	1.123
Empathy -> Spatial Presence	2.856
Negative Emotional Engagement -> Purchase Intention	2.788
Positive Emotional Engagement -> Purchase Intention	2.398
Spatial Presence -> Negative Emotional Engagement	1.000
Spatial Presence -> Positive Emotional Engagement	1.000
Empathy x Condition_HMD -> Spatial Presence	1.766

Table E10: VIF index

	f-square (f^2)
CON_AGE -> Purchase Intention	0.003
CON_ENVIRON -> Purchase Intention	0.090
CON_GENDER -> Purchase Intention	0.066
CON_PLASTIC_PREF -> Purchase Intention	0.104
CON_TECH -> Purchase Intention	0.013
CON_VR -> Purchase Intention	0.036
Condition_HMD -> Spatial Presence	1.274
Empathy -> Spatial Presence	0.010
Negative Emotional Engagement -> Purchase Intention	0.137
Positive Emotional Engagement -> Purchase Intention	0.020
Spatial Presence -> Negative Emotional Engagement	0.776
Spatial Presence -> Positive Emotional Engagement	0.686
Empathy x Condition_HMD -> Spatial Presence	0.001

Table E11: f-square (f^2) index

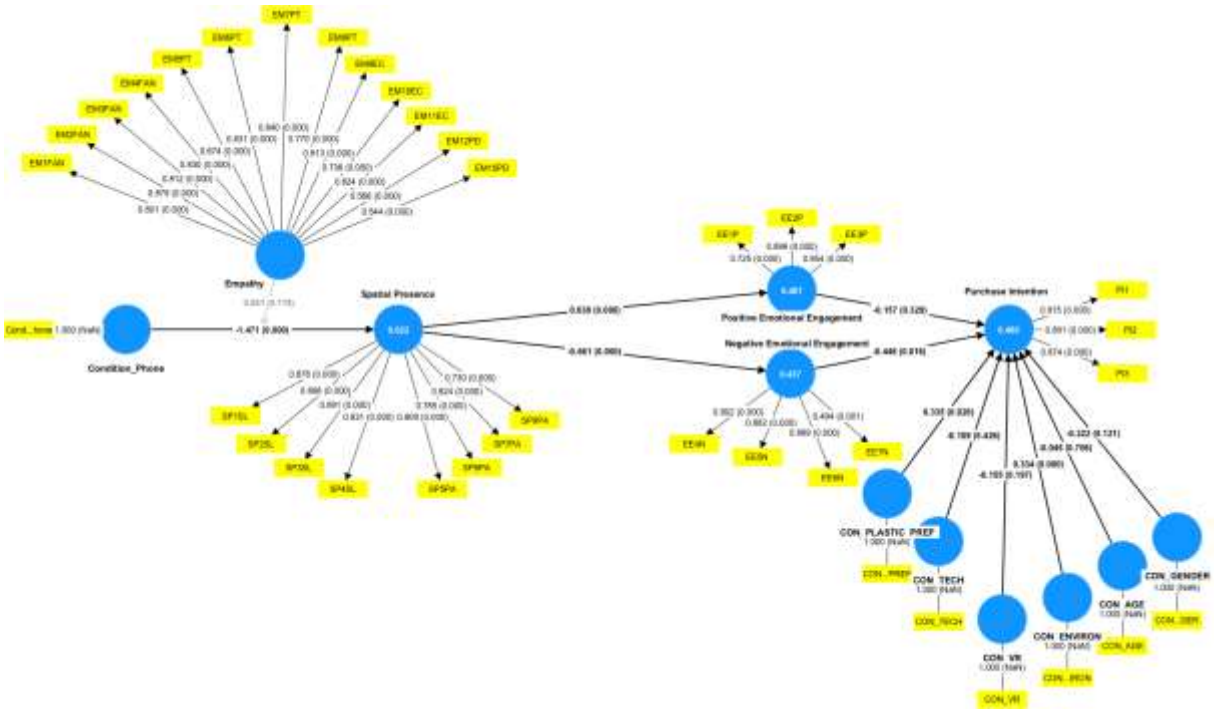

Figure E1: Structural model from SmartPLS 4 with path coefficients and p-values and outer weights/loadings and p-values

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
CON_AGE -> Purchase Intention	-0.045	-0.045	0.119	0.378	0.706
CON_ENVIRON -> Purchase Intention	0.334	0.350	0.177	1.882	0.060
CON_GENDER -> Purchase Intention	-0.222	-0.225	0.143	1.551	0.121
CON_PLASTIC_PREF -> Purchase Intention	0.335	0.317	0.150	2.232	0.026
CON_TECH -> Purchase Intention	-0.109	-0.111	0.137	0.796	0.426
CON_VR -> Purchase Intention	-0.155	-0.153	0.120	1.289	0.197

Table E12: Path coefficients with Mean, STDEV, T values and p values (control variables)

CON_PLASTIC_PREF - Did you prefer non-plastic alternatives in the past?	Count
Definitely not	6
Probably not	14
Might or might not	11
Probably yes	24
Definitely yes	5

Table E13: Data CON_PLASTIC_PREF

CON_VR - Did you use VR in the past?	Count
Never	23
1-3 times	26
4-6 times	7
More than 6 times	4

Table E14: Data CON_VR

CON_TECH - Are you willing to use human-machine interactive technologies (like VR)?	Count
Definitely not	3
Probably not	6
Might or might not	7
Probably yes	24
Definitely yes	20

Table E15: Data CON_TECH

CON_GENDER - What is your gender?	Count
Male	39
Female	20
Non-binary/third gender	1
Prefer not to say	0

Table E16: Data CON_GENDER

CON_AGE – What is your age?	Count
18	3
19	5
20	3
21	10
22	6
23	12
24	18
25	1
26	1
29	1

Table E17: Data CON_PLASTIC_PREF

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Condition_HMD -> Negative emotional engagement	-0.973	-0.987	0.128	7.613	0.000
Condition_ HMD -> Positive emotional engagement	0.938	0.951	0.143	6.577	0.000
Condition_ HMD -> Purchase intention	0.286	0.303	0.139	2.052	0.040
Empathy -> Negative emotional engagement	-0.103	-0.118	0.079	1.297	0.195
Empathy -> Positive emotional engagement	0.099	0.117	0.082	1.216	0.224
Empathy -> Purchase intention	0.030	0.036	0.030	1.005	0.315
Spatial presence -> Purchase intention	0.194	0.206	0.092	2.112	0.035
Empathy x Condition_ HMD -> Negative emotional engagement	0.034	0.031	0.122	0.276	0.782
Empathy x Condition_ HMD -> Positive emotional engagement	-0.033	-0.032	0.119	0.275	0.783
Empathy x Condition_ HMD -> Purchase intention	-0.010	-0.009	0.041	0.242	0.808

Table E18: Extra direct effects

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Spatial presence -> Positive emotional engagement -> Purchase intention	0.938	0.951	0.143	6.577	0.000
Spatial presence -> Negative emotional engagement -> Purchase intention	-0.100	-0.101	0.105	0.957	0.339
Empathy -> Spatial presence -> Negative emotional engagement -> Purchase intention	0.295	0.307	0.129	2.278	0.023
Empathy -> Spatial presence -> Negative emotional engagement	0.046	0.052	0.042	1.086	0.277
Condition_ HMD -> Spatial presence -> Positive emotional engagement -> Purchase intention	-0.103	-0.118	0.079	1.297	0.195
Empathy -> Spatial presence -> Positive emotional engagement -> Purchase intention	-0.015	-0.013	0.061	0.249	0.804
Empathy x Condition_ HMD -> Spatial presence -> Negative emotional engagement	-0.148	-0.149	0.156	0.947	0.344

Empathy -> Spatial presence -> Positive emotional engagement	-0.016	-0.016	0.025	0.633	0.527
Empathy x Condition_ HMD -> Spatial presence -> Positive emotional engagement	0.034	0.031	0.122	0.276	0.782
Empathy x Condition_ HMD -> Spatial presence -> Negative emotional engagement -> Purchase intention	0.005	0.004	0.027	0.189	0.850
Empathy x Condition_ HMD -> Spatial presence -> Positive emotional engagement -> Purchase intention	0.434	0.452	0.198	2.190	0.029
Condition_ HMD -> Spatial presence -> Negative emotional engagement -> Purchase intention	0.099	0.117	0.082	1.216	0.224
Condition_ HMD -> Spatial presence -> Positive emotional engagement	-0.033	-0.032	0.119	0.275	0.783
Condition_ HMD -> Spatial presence -> Negative emotional engagement	-0.973	-0.987	0.128	7.613	0.000

Table E19: Indirect effects