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Investigating the interplay of personality, gaming experience, and presence in VR.

MASTER THESIS

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Abstract

A factor that is determined to be important in the success of virtual reality (VR) training is presence. Presence refers to the subjective feeling of being physically present in a virtual environment, rather than just observing it from the outside. Many factors influence this feeling of presence. Two factors that might correlate with presence in the context of a VR public speaking training are researched in this study. The predictors of presence in VR are an individual's personality traits, and an individual's gaming experience.

This study investigates whether individuals with different levels of honesty-humility, openness to experience, conscientiousness, extraversion, agreeableness, emotionalism, and prior gaming experience, experience varying levels of presence during VR public speaking training.

This study concludes that in this research, individual differences in personality traits, as measured by the HEXACO Personality Inventory Test, do not directly influence presence, as measured by the I-Group Presence Questionnaire, in virtual reality training designed to enhance presentation skills.

Secondly, this study concludes that in this research, individual differences in gaming experience influence the feeling of presence in VR. Gaming experience is significantly negatively correlated with the feeling of presence in VR.

In summary, these findings contribute to a more nuanced understanding of what influences the sense of presence in VR environments. They suggest a shift in focus away from personality traits towards more dynamic user factors such as prior gaming experience, which can guide the development of more engaging and effective VR applications.

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Introduction

Virtual Reality (VR) is a contemporary technology that creates a simulated environment that users can interact with as if they were physically present. This is achieved through specialized equipment, such as headsets and gloves, that track the user's movements and provide feedback in real-time. VR has a wide range of applications, including gaming, education, training, and therapy (Lanier, 2018). These virtual settings can be utilized to tackle scenarios that are challenging to replicate or manage in the physical world (Anton et al., 2009). One such example of an application of a scenario that is challenging to replicate is using VR to train public speaking, due to difficulties in replicating audience size and settings in real life. Several studies have highlighted the potential of VR to enhance educational experiences such as training public speaking (Poeschl, 2017; Bowman, 2007).

One factor determined to be important in the success of VR applications is presence (Schubert & Bosse, 2022). Presence refers to the degree to which an individual feels fully engaged and absorbed in a virtual environment, measured as the sense of being surrounded by and interacting within a computer-generated reality. According to Schubert and Bosse, the feeling of presence can make the VR experience more engaging and memorable and can also lead to positive psychological effects, such as reduced anxiety. The subjective encounter of "being present" for the learner, is a phenomenon influenced by the degree of immersion (Cummings & Bailenson, 2016). It goes beyond the mere utilization of technology and involves creating an environment where learners sense a heightened connection to the virtual world (Mayer & Fiorella, 2022). Many factors influence the feeling of presence, and many of these effects remain unclear. One such factor that remains unclear is whether individual differences in personality influence the feeling of presence in a VR public speaking training environment.

Personality, shaped by patterns of thoughts, emotions, and behaviors, plays a significant role in how we perceive and engage with the world around us. Many psychologists believe that the number of personality traits can be condensed into a certain amount of overarching factors, wherein all other individual traits fit. In this study, one of these personality tests called the HEXACO-PI is utilized to determine personality traits of participants. Understanding how personality traits intersect with the experience of presence in VR might hold significant potential for enhancing the understanding of individual differences in a VR experience, learning to optimize the VR learning design, addressing potential barriers

to VR adoption, and promoting user acceptance and satisfaction.

Another factor that remains unclear is whether an individual's gaming experience influences the feeling of presence in a VR public speaking training environment. Prior research has confirmed the interaction effect between gaming experience and cybersickness (Weech et al., 2020). Additionally, Weech et al. confirmed a negative association between cybersickness and presence. However, little is still known about the influence of a person's gaming experience and the feeling of being present in a virtual world.

This research will contribute to the existing body of knowledge by systematically investigating the role of personality and gaming experience as variables in the context of VR presence in a VR public speaking training environment. By employing research methods and drawing upon relevant theories of learning and technology adoption, this study aims to contribute valuable insights that can inform educators, instructional designers, and policymakers in harnessing the potential of VR technologies for educational purposes. The goal of this study is to determine to what extent individual differences in personality traits and differences in gaming experience influence presence in virtual reality training.

Theoretical Framework

Virtual Reality

Virtual reality (VR) is a contemporary technological advancement that allows for worlds to be recreated that are not always readily available in the real world. Virtual reality is a simulated experience that employs pose tracking and 3D near-eye displays to give the user a feel of presence in a virtual world. The feeling of being fully present, the subjective experience of "being there", in a virtual environment can make VR experiences more captivating and memorable, and it can also bring about beneficial psychological effects, such as decreased anxiety and heightened empathy (Poeschl, 2017). This sense of presence is often measured by evaluating the extent to which an individual feels surrounded by and is interacting with a computer-generated or simulated world (Bailenson et al., 2018).

Several key components contribute to the immersive nature of VR, such as visual fidelity and head and hand tracking, providing a sense of presence. Visual fidelity encompasses high-resolution displays and advanced rendering techniques to create realistic and detailed virtual environments (Ragan et al., 2015). Head tracking allows users to move their viewpoint in the virtual world, while hand tracking enables interaction with objects and actions (Oing & Prescott, 2018). VR engages multiple senses, including vision, hearing, and touch. This multisensory engagement further enhances the immersive experience and allows for a more realistic simulation.

Presence

To fully leverage the benefits that VR offers, the sense of presence must be as strong as possible. Presence is described as the "subjective experience of being in one place when we are physically in another" (Souza et al., 2022). According to Souza et al., presence is closely linked to the effectiveness of virtual environments, specifically in how well the virtual environment generates a subjective illusion of presence in the user, usually described as the 'level of immersion' of a virtual environment. Although there are similarities between the terms 'presence' and 'immersion', these key concepts differ in important ways. According to Arnold et al. (2009), immersion is defined as 'what the technology objectively provides'. The more a system can deliver sensory displays and tracking that feel similar to their real-world counterparts, the more it can be considered 'immersive'. Immersion can be evaluated objectively using technical specifications, such as field of view, framerate, and haptic

feedback. Presence on the other hand is a subjective 'feeling of being there'. According to Slater et al. (2009), presence is a human response to immersion, where different individuals may experience varying levels of presence from the same immersive system, or the same level of presence from different immersive systems. Presence is a highly personal 'response' to a system with a certain level of immersion.

This presence, or "feeling of being there" in the scenario depicted by the VR hardware and software, is widely recognized as a critical component in any VR application. A stronger sense of presence can enhance training effectiveness, improve engagement, support more effective therapy, and provide more enjoyable entertainment. Sjölie (2013) emphasizes the importance of considering the sense of presence in virtual environment systems from the design phase through to their use.

The concept of presence has been a key element in virtual reality research and development since the field's inception. The sense of presence is often described as "the feeling of being there" (Slater, 1997). Another definition of presence besides "the feeling of being there" is "the ability to do there" (Flach & Holden, 1998). The capability to "do there" can be directly related to the use of body functions that are deeply ingrained in the human brain to interact in a virtual environment as if it is a real-life environment. An example of this, is the human urge to explore something to the right and the subsequent turning of the head and eyes towards that direction (Sjölie, 2013).

In recent times, numerous research endeavours have focused on presence, particularly delving into methodologies for its measurement and the characteristics of virtual environments that enhance the user's sense of presence. The techniques for assessing presence can be categorized into subjective and objective methods, with subjective methods being the more commonly employed ones. (Souza et al., 2022). Based on an analysis of over 230 studies, Souza et al. concluded that over 85% of all presence measurements where purely subjective measurements. This often involves post-questionnaires, such as the Slater-Usoh-Steed Questionnaire (SUS) (Usoh et al, 2000) and the Presence Questionnaire (PQ) (I-Group, n.d). The I-Group Presence Questionnaire (IPQ) is a standardized tool used to measure the sense of presence experienced by users in virtual environments and was developed to assess different aspects of presence. The IPQ includes questions that evaluate the user's subjective feelings of being in the virtual environment, the degree to which the virtual environment feels real, and the extent to which the user is involved or engaged with the virtual environment. The IPQ consists of four dimensions, categorized as: Spatial Presence, Involvement, Experienced Realism, and General Presence. Spatial Presence measures the feeling of being

physically located in a virtual environment. Involvement measures the degree of engagement and absorption in the virtual environment. Experienced Realism measures the extent to which the virtual environment is perceived as realistic. Lastly, General Presence measures the overall sense of presence or being in the virtual environment. Each dimension is assessed through multiple items, where respondents rate their experience on a Likert scale (e.g., from "strongly disagree" to "strongly agree"). The IPQ is widely used in VR research to evaluate and compare different VR systems, environments and applications (I-Group, 2024). While defining and measuring presence in a VR public speaking training environment is challenging due to the lack of a universal definition, there is a consensus that it encompasses at least these components. The term 'presence in VR' according to the IPQ refers to the subjective feeling of being in a virtual environment, rather than just observing it from the outside. In this study, presence in VR is explained by measuring the four components of the IPQ (General Presence, Spatial Presence, Involvement, and Experienced Realism) to measure how much a user feels present in the VR environment, rather than in the real world.

Apart from scale questionnaires, various subjective observation techniques, including subjective reports and cross-modality matching, are also utilized. According to Souza et al (2022), these subjective measuring techniques offer different strengths and weaknesses. For example, a subjective report measures through direct open questions to bring forth reactions and feelings on presence in VR, offering a direct user perception, but the variability in responses makes it hard to interpret. Overall, the most used method in subjective measurements for presence in VR is questionnaires. It is easy to use and read, is generally not expensive, and unlike other subjective measurements, it does not interfere with the participant's experience in VR as it is a post-experience survey about the feeling of presence, resulting in a more consistent and reliable data collection (Souza et al, 2022).

Some objective methods incorporate non-invasive physiological data, such as heart rate, skin conductance, eye movement, and surface electromyography, recorded during virtual environment use (Souza et al., 2022). Additionally, there are techniques that employ neurological measures obtained through Functional Magnetic Resonance, Transcranial Doppler, and Electroencephalography. According to Souza et al., these objective measurements can be divided into physiological and behavorial measures These objective measures state that they take into account that stimuli within an immersive virtual environment can trigger behavioral and/or physiological responses that are closely linked to the the sense of presence, without participant bias. The challenge with these measures lies in the difficulty of confirming that the physiological responses of participants are directly tied to

the level of feeling of presence, as numerous unknown variables could affect them. Although only 2.5% of all studies Souza et al. reviewed where purely based on objective measures, according to Clemente et al (2014), an observation of 20 participants did find notable differences in brain activity closely connected to the sense of presence when comparing navigation and video conditions in virtual environments. Due to this broad array of approaches, there remains ongoing discussion about the most effective means of measuring presence.

Presence and the level of presence an individual experiences in a virtual environment can depend on several factors. According to Junet et al. (2005), presence can be described as a construct that is shaped by both technological and human factors, forming a complex interplay in its understanding. One such human factor that might influence the feeling of presence in a virtual reality is a person's personality and gaming experiences.

Personality

Personality is a complex and multifaceted concept that encompasses the enduring patterns of thoughts, feelings, and behaviors that characterize an individual (Funder, 2012). It is shaped by a combination of genetic factors, environmental influences, and personal experiences. Personality traits are the relatively stable and enduring tendencies to behave in consistent ways across situations.

The Five-Factor Model of personality (FFM) is one of the most widely accepted and researched theories for understanding and measuring personality (Gosling et al., 2003). Many psychologists believe that the number of personality traits can be condensed into five overarching factors, wherein all other individual traits fall under these five categories, using the so-called 'Big Five Personality Test' (McCrae & Costa, 2003). In this model, a factor serves as a broader classification encompassing numerous smaller personality traits. The FFM proposes that personality can be described by five broad dimensions: openness, conscientiousness, extraversion, agreeableness, and neuroticism. These dimensions are not mutually exclusive, but rather they represent independent aspects of personality.

The Big Five Personality Test has deep historical roots. According to Kabigting (2021), its robustness results from diverse research methods and advanced quantitative analyses by many researchers throughout history. Furthermore, extensive cross-cultural research has reinforced its perceived universality. The model's ability to integrate findings from related fields such as neuroscience and genetics also contributes to its strength and ongoing development, enhancing our understanding of human personality and behavior

(Kabigting, 2021).

A newer, widely recognized personality test is the HEXACO Personality Inventory (HEXACO-PI) test, as proposed by psychologists Lee and Ashton, which is an extension of the Big Five Personality Test, adding the sixth factor of *Honesty-humility* to the roster of personality dimensions (Ashton & Lee, 2009). The authors of the HEXACO-PI propose that the HEXACO model – a six dimensional framework for personality structure – serves as a viable alternative to the widely known Big Five or FFM. This new model aligns with cross-cultural findings that consistently identify a common six-dimensional structure comprising the factors Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, and Openness to Experience (Ashton & Lee, 2007).

The HEXACO-PI divides a total of twenty-four dimensions of personality over six factors in total. The model emerged from cross-cultural research, particularly in Asia and Europe, and aims to provide a more comprehensive understanding of personality traits. It was partly developed to address potential limitations of the FFM, particularly in capturing variations in honesty, integrity, and ethical behavior. The HEXACO-PI (or HEXACO-60) test offers a more nuanced perspective by including an additional factor focused on honesty and humility. Therefore creating six factors: Honesty-humility, Emotionality (similar to Neuroticism), eXtraversion, Agreeableness, Conscientiousness, and Openness to experience, with the capital letters spelling the word 'Hexaco'.

According to the HEXACO-PI, the first dimension of personality is *honesty-humility.* This factor reflects a dimension of personality related to ethical behavior, sincerity, fairness, and modesty. It captures individual differences in how individuals approach interpersonal interactions, particularly in terms of their sincerity, integrity, and modesty. Secondly, the dimension of *emotionality* reflects an individual's tendency to experience negative emotions, such as anxiety, depression, and irritability. Consequently, the dimension of *extraversion* explains an individual's tendency to be outgoing, sociable, and assertive. Furthermore, the dimension of *agreeableness* reflects on an individual's tendency to be cooperative, trusting and helpful. The dimension of *conscientiousness* reflects an individual's organization, self-discipline, and ability to delay gratification. Lastly, the dimension *openness to experience* is a dimension that reflects an individual's willingness to try new things, embrace new ideas, and be open to new experiences. (Ashton & Lee, 2009).

These six factors all cover four more dimensions, leading up to twenty-four dimensions that are measured in total. These dimensions are for *honesty-humility:* sincerity, fairness, greed-avoidance, modesty; for *emotionality:* fearfulness, anxiety, dependence,

sentimentality; for *extraversion:* social self-esteem, social boldness, sociability, liveliness; for *agreeableness:* forgiveness, gentleness, flexibility, patience; for *conscientiousness:* organization, diligence, perfectionism, prudence; and for *openness to experience:* aesthetic appreciation, inquisitiveness, creativity, and unconventionality (Ashton & Lee, 2009).

Similar to the FFM, the HEXACO model continues to hold significant value in understanding personality traits and their influence on various aspects of human behavior (Ashton & Lee, 2009). Its extensive research base and widespread adoption make it a valuable tool for psychologists, educators, and others seeking to understand individual differences and their implications (Gosling et al., 2003).

The results of Jurnet, Beciu and Maldonado's study (2005) suggest that in general spatial intelligence, introversion, and anxiety positively influence the sense of presence experienced by the VR user. Although spatial intelligence does not have a clear fit in the HEXACO groups of personality traits, introversion and anxiety do fit in. These aspects of personality strongly align with the personality domains *, extraversion,* and *emotionality.* This study does not mention that any aspects of the domains *conscientiousness, openness to experience,* and *agreeableness* as a construct necessarily affect the feeling of presence in a general VR environment. It is not clear whether this assumption is true for VR public speaking training environments.

Although the number of participants was rather small, and the study had a boundary condition of only using anxiety-inducing VR experiences, a study conducted by Song et al. (2022) demonstrated an important role of presence across the Temperament and Character Inventory (TCI) personality dimensions. (Song et al, 2022). In this study, it is suggested that participants who exhibit high levels of cooperation are more likely to experience a heightened sense of physical presence in a virtual environment, which strongly correlates to the *agreeableness* domain of the HEXACO-60 personality constructs. Whether this remains true for a more general VR environment, rather than just an anxiety inducing VR environment, remains to be seen.

The effect of *honesty-humility* on presence has not been found to be reviewed, nor discussed.

Besides immersion levels of designed software and personality traits of individuals, more individual differences between participants may affect the feeling of presence in a virtual environment. One such aspect is how much experience a participant has with mechanics that are typical for VR environments.

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Gaming Experience

VR environments often incorporate elements and design principles that align closely with those found in traditional gaming. According to Smith and Du'Mont (2014), modern 3D computer games are one of the most encountered virtual environments. These games offer realistic virtual worlds with user-friendly interactions, making them the most frequent experience with 3D virtual environments for many people. According to Smith and Du'Mont, this has important implications for evaluating performance, and in this case evaluate an experience, in a virtual environment. Without distinguishing between experienced and inexperienced users in experimental studies, there is a risk of drawing overly generalized conclusions.

It is concluded that gaming experience has a certain effect on individuals' overall experience in VR, such as experiencing cybersickness, which has a negative effect on the feeling of presence in VR (Weech et al., 2020). In prior research conducted by Weech et al. (2020), responses to questionnaires measured the link between cybersickness and presence, and how this relationship was influenced by presenting either an 'enriched' or 'minimal' verbal narrative context. In the initial experiment, it was found that the enriched narrative was connected to increased feelings of presence. However, the impact of narrative on reducing cybersickness varied based on participants' gaming experience. This is possibly due to experienced gamers having a better familiarity with the controls and the mechanics of a virtual world, thus having less difficulty adapting to a virtual environment, and becoming less nauseous, and more present.

Kourtesis et al. (2023) found that greater gaming experience was directly linked to a reduced likelihood of experiencing cybersickness, thus possibly improving the feeling of presence, in VR. Bessa et al. (2020 studied several VR environments and the effects of gaming experience on the feeling of presence in these environments, and concluded that several positive relations between presence in VR and participants' gaming experience were present in their study. However, little other information was found about the possible effect of people's gaming experience on the actual feeling of being present in a virtual world or training.

Research Aim

This study aims to fill a literature gap by systematically exploring the impact of personality and gaming experience on virtual reality (VR) presence in an educational application designed to train public speaking, with the potential to offer valuable insights for educators, instructional designers, and policymakers in enhancing VR educational applications.

Understanding individual differences in the perception of presence is scientifically relevant because studying these differences and effects can contribute to our understanding of the psychological mechanisms in VR. Furthermore, investigating the relationship between personality traits and presence in VR can provide empirical evidence for existing psychological theories.

Understanding how personality and gaming experience influence presence in VR can inform the designers of personalized training programs for public speaking. Tailoring VR experiences to individuals' personality traits and gaming experience can enhance and possibly optimize training effectiveness and engagement.

Hence, the central research question for this study is: *"To what extent do individual differences in personality traits, as measured by the HEXACO Personality Inventory Test, and gaming experience, influence presence in virtual reality training designed to enhance presentation skills?"*

Based on findings in earlier studies, the following hypotheses are formulated:

H1: Individual differences in personality traits influence presence in VR public speaking training.

The results of Jurnet, Beciu and Maldonado's study (2005) suggest that an individual's spatial intelligence, introversion, and anxiety positively influence the sense of presence experienced by a VR user. It is therefore expected to find a correlation between certain personality traits and presence in VR. Secondly, in the study of Song et al. (2022), it is suggested that participants who exhibit high levels of cooperation are more likely to experience a heightened sense of physical presence in a virtual environment, which strongly correlates to the *agreeableness* domain of the HEXACO-60 personality constructs. Consequently, taking into consideration the personality domains of the HEXACO Personality Inventory of honesty-humility, emotionality, extraversion, agreeableness, conscientiousness, and openness to experience, the following sub-hypotheses are formulated.

H1.1: Honesty-humility does not correlate with presence in VR public speaking training.

The effect of an individual's level of honesty-humility on the feeling of presence in VR has not been found to be researched in prior research. The effects, whether they are positive, negative, or not present at all, are yet unknown.

H1.2: Emotionality correlates positively with presence in VR public speaking training.

The aspect of personality covering anxiety is a part of the personality domain of emotionality. According to Jurnet, Beciu and Maldonado (2005), the level of anxiety in an individual positively influences the feeling of presence in VR. Therefore, it is considered possible that a high level of emotionality can prove to have a positive effect on the feeling of presence in VR.

H1.3: Extraversion correlates negatively with presence in VR public speaking training.

According to the previous study of Jurnet, Beciu and Maldonado (2005), introversion is a strong predictor of having a positive effect on the feeling of presence in VR. As introversion is the opposite of extraversion, it is expected to find a negative correlation between an individual's extraversion level and the feeling of presence in VR.

H1.4: Agreeableness correlates positively with presence in VR public speaking training.

In the study of Song et al. (2022), it is suggested that participants who exhibit high levels of cooperation are more likely to experience a heightened sense of physical presence in a virtual environment, which strongly correlates to the *agreeableness* domain of the HEXACO-60 personality constructs. It is therefore hypothesized that agreeableness correlates positively with presence in VR public speaking training.

H1.5: Conscientiousness does not correlate with presence in VR public speaking training.

The effect of an individual's level of conscientiousness on the feeling of presence in VR has not been found to be researched in prior research. The effects, whether they are positive, negative, or not present at all, are yet unknown.

H1.6: Openness to experience does not correlate with presence in VR public speaking training.

The effect of an individual's level of openness to experience on the feeling of presence in VR has not been found to be researched in prior research. The effects, whether they are positive, negative, or not present at all, are yet unknown.

Honesty-humility, conscientiousness, and openness to experience, as constructs of domains of personality as measured by the HEXACO-PI have not been found by the researcher to have impact on the feeling of presence in VR in prior studies. A summary of all expected findings of correlations between the personality trait domains of the HEXACO Personality Inventory and presence in VR are summarised in Figure 1.
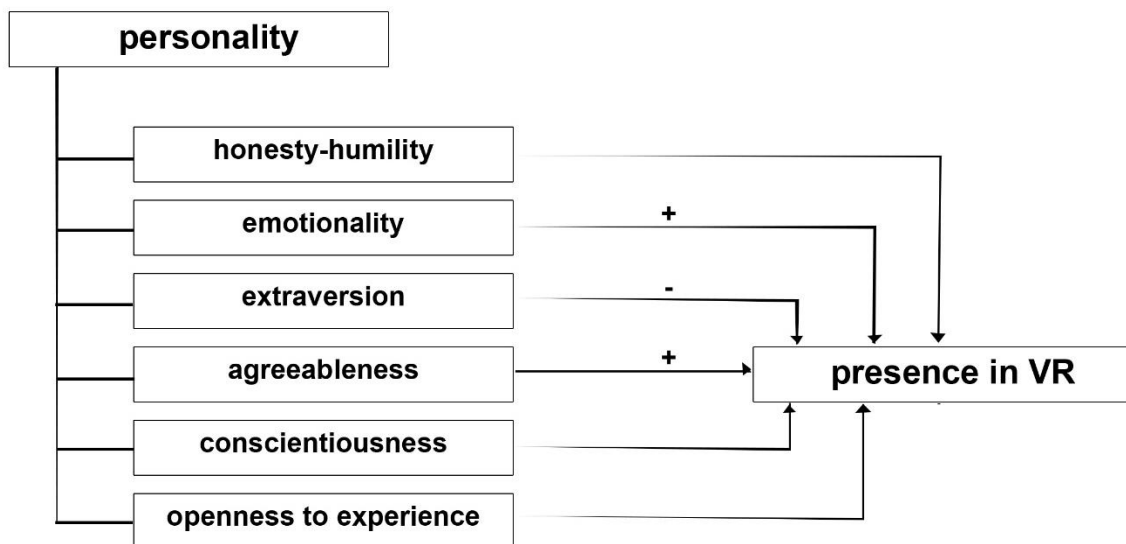
Figure 1. Expected findings of correlations between personality traits and presence in VR.

H1.7: Gaming experience correlates positively with presence in VR public speaking training.

Weech et al. (2020) concluded that cybersickness influences the feeling of presence in VR, and that cybersickness might be influenced by the level of gaming experience an individual has. Kourtesis et al. (2023) found that greater gaming experience was directly linked to a reduced likelihood of experiencing cybersickness, thus possibly improving the

feeling of presence, in VR. No prior research was found about the direct effects of individuals' gaming experience on the feeling of presence in VR. However, considering experienced gamers are

Figure 2. Expected finding of the correlation between gaming experience and presence in VR.

expected to feel less effect of cybersickness, it is expected to find a positive correlation between gaming experience and presence in VR.

VR Public Speaking Training

One example of a mentioned training that utilizes the benefits of VR is VR public speaking training. Proficient public speaking abilities facilitate powerful and efficient communication, a crucial skill in numerous fields and interactions (Chollet et al., 2015). Some jobs where effective communication skills are critical are for example educators, PR professionals, corporate trainers, lawyers, and politicians. Acquiring the capacity to speak confidently in public demands training and regular practice. It involves more than just presenting content, also including the nonverbal cues exhibited by speakers, such as gestures, tone of voice, vocal range, and facial expressions (Aylett et al., 2013).

Public speaking is frequently recognized as the most widespread social phobia globally. This scommunication-related disorder is consistently ranked among the top five most common phobias and seems to affect individuals irrespective of age, gender, or socio-economic factors (North et al., 1998). According to North, historically, conventional treatments have involved methods like systematic desensitization, cognitive restructuring, and skill development. However, recent progress, facilitated by computer display technology has led to the development of VR technology specifically designed to address the fear of public speaking.

Recent advancements have given rise to the creation of VR technology specifically tailored to tackle the anxiety associated with public speaking, or the inexperience people have with public speaking. Contemporary technological advancements now offer methods for public speaking training, providing users with opportunities to practice in a secure and captivating environment. One application that utilizes VR to enhance public speaking training is Ovation, an application that allows users to train public speaking. In this application, users

can address their public speaking skills by exposing themselves to virtual simulations of real-life scenarios (Ovation, 2024). In this particular case, a stage in front of a hundred people, all listening to what a user is presenting. Learners can experience standing in front of a virtual audience, complete with virtual people reacting in real-time. Presence may amplify the effectiveness of VR public speaking training by making the virtual experience as close to reality as possible. This realism helps to recreate the anxiety and pressure associated with public speaking, offering a feeling of presence, and possibly a more authentic learning experience, than when training public speaking in a more traditional method, such as a trainer providing instructions or practicing without an audience.

The interplay between personality traits, gaming experience, and presence in VR highlights how individual differences in personality traits can influence presence in VR, and how gaming experience can influence presence in VR, both effectively influencing the effectiveness of learning in a VR public speaking training (Jurnet, Beciu, Maldonado, 2005; Kourtesis et al, 2023; Souza et al, 2022). Traits that appear to affect the feeling of presence, such as emotionality, agreeableness, and extraversion, can lead to more effective VR training sessions, or conversely, hinder presence, thus reducing the overall effectiveness of the VR training. It is hypothesized that participants with more gaming experience will have less trouble adapting to a virtual environment.

A summary of expected findings in this study can be found in Figure 3.
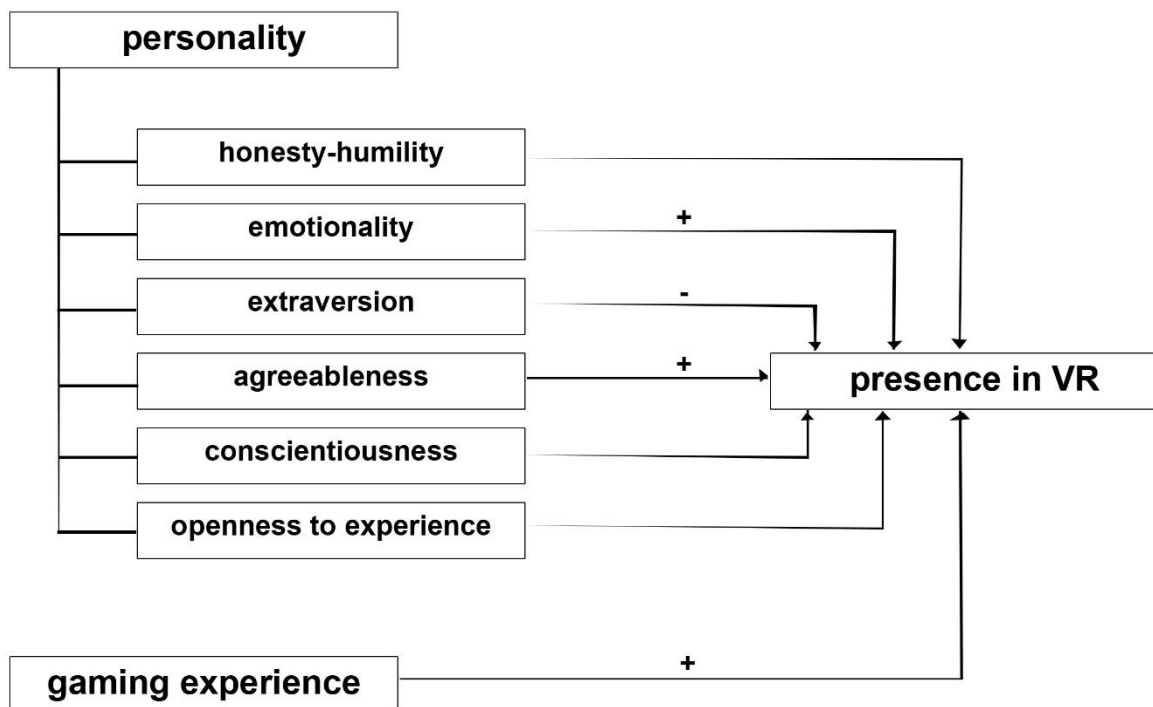
Figure 3. Expected findings in this study.

Method

Research Design

This study investigates whether individuals with different levels of honesty, openness to experience, conscientiousness, extraversion, agreeableness, and emotionalism experience varying levels of presence during VR public speaking training. To study these relationships, this study uses a quantitative research design. The primary focus is on exploring potential differences in the levels of presence experienced by individuals with varying degrees of honesty, openness, conscientiousness, extraversion, agreeableness, and emotionalism. Through established quantitative methods, the research aims to provide a systematic examination of these relationships, offering valuable insights into how specific personality traits may influence the efficacy of VR public speaking training. The strength of the expected relationship is weak.

Participants

The sample for this study was obtained through a combination of voluntary response sampling, convenience sampling, and snowball sampling. Initial participants were not specifically asked to refer any other participants, but when asking the researcher about the possibility to refer other participants who were willing, able, and met the criteria, they were allowed to do so.

Out of the 50 participants, 47 were Dutch. 2 participants were German, and 1 participant was Chinese. 25 participants were male and 25 were female. Participants' ages ranged between 18 and 80 years old (M= 38.42, SD= 13.97). Educational levels and occupations varied heavily between participants. 21 out of 50 participants had never experienced any form of VR before. 14 out of 50 participants had experienced VR once or twice before. 15 out of 50 participants had decent experience in VR. Each respondent participated in the study individually and provided their signed informed consent prior to taking part in the research.

Instrumentation

HEXACO Personality Inventory test

Before entering the virtual reality, participants were asked to fill in the HEXACO Personality Inventory Test (HEXACO-60). The HEXACO-60 test requires participants to answer sixty questions designed to assess participants' preferences and tendencies in relation to the six personality traits. Each item of the HEXACO-60 is phrased in the form of a

statement, and respondents are asked to rate how strongly they agree or disagree with the statement on a five-point scale.

Measuring Gaming Experience

Participants' gaming experience will be quantitatively measured by categorizing their weekly gaming hours into five dinstict levels, as part of the questionnaire. The question "How many hours do you play videogames per week?" is used to assess the extent of gaming engagement, with respondents selecting one of five options: "Never", which indicates no gaming activity, providing a baseline for participants with no exposure to gaming; "Less than an hour", which represents minimal engagement, suggesting sporadic or very limited interaction with games; "Between one and four hours", signifying moderate engagement, indicating a casual gaming habit that is not a primary leisure activity; "Between four and ten hours", indicating substantial engagement, reflecting a regular gaming practice that occupies a significant portion of leisure time; and finally "More than ten hours", the highest category indicating extensive gaming involvement, suggesting a major commitment to gaming, possibly as a primary hobby or interest.

VR hardware and software

In this study the Meta Quest 3 hardware was used. This included the use of a head-mounted display system. Hand controllers were available, but were not used, due to the ability of the Quest 3 hardware to allow system navigation by hand tracking.

Furthermore, the application 'Ovation VR' was used to have the participants experience a public speaking simulation. In this simulation, the participant is placed on a virtual stage in a hotel conference room, facing an audience of 96 people. The application tracks a participants presentation and grades them on topics such as 'gaze', 'voice', and 'hand movement'. The participants were allowed to take a look around first, get used to controlling the menu using hand tracking, and getting accustomed to the feeling of being in a virtual reality. When ready, the participants were asked to press start and start their short presentation to the audience. The participants were asked to present for at least three minutes, which they could track by keeping an eye on the display in the back of the hotel conference room which displayed the presentation time. All topics were allowed, and the audience was set up to not interfere, be rude, or ask any questions to the participant. After the presentation was done, all participants were allowed to review their presentation scores by scrolling through their personal statistics the application created.

I-Group Presence Questionnaire

In this study, the Presence Questionnaire was used, as presented by the I-Group, because the Presence Questionnaire tackles the different components of presence as mentioned earlier in this framework. Immediately after the participant has finished and reviewed the presentation, the participant was asked to remove the head-mounted display and fill in the I-Group Presence Questionnaire (PQ). The PQ test requires participants to answer fourteen questions designed to assess participants' perceived level of presence in the virtual environment they just experienced. Each item of PQ is phrased in the form of a statement, and respondents are asked to rate how strongly they agree or disagree with the statement on a seven-point scale.

The PQ measures four subcategories: General Presence (GP), Spatial Presence (SP), Involvement (INV), and Realism (REAL). The GP category evaluates the overall sense of being present in the virtual environment. The SP category assesses the sensation of physical presence, illustrated by an item such as: "I had the feeling I was just looking at pictures". The INV category examines the participants' attention and involvement in the VR environment, with a sample item being: "How aware were you of the real environment (e.g., outside sounds, room temperature) while you were in the virtual space?" The REAL category measures how real the VR environment felt to the participant, exemplified by the item: "How real did the virtual world seem to you?" All used questions and statements from the PQ can be found in Appendix A.

Pilot study

A pilot study was done with one participant. This study was done to test whether the instruments were all clear, ready, and to find any remaining flaws or hiccups within the use of the instruments. After the pilot study, a shortlist was created for the researcher to be able to deliver fast and clear instructions for the participants when entering the virtual environment. During the pilot test, the live streaming service of the hardware provider proved unreliable, making it difficult for the researcher to see what exactly the participant sees in real time. Hence, a step-by-step instruction to guide the participant in the use of the menu was created, so that the researcher could guide the participant efficiently, without directly seeing what the participant is seeing. A fault in the audio caption was also detected and resolved. Otherwise, no other modifications were necessary to start the data collection.

Procedure

Before joining the study, all participants were informed about the study's purpose, benefits, procedures, risks, and their rights, as seen in Appendix B. And signed consent was obtained. Furthermore, approval was sought from the Ethics Committee of the University Twente prior to this study.

Each participant was studied individually, experiencing the same conditions in the same VR environment, one at a time. The experiments took place at participants' homes, under the supervision of the researcher. Before the participants entered the VR environment, the researcher prepared the real-life environment and surroundings to be as equal to other participants' rooms as possible to make sure participants have a similar setting. Detailed instructions and actions by the researcher are provided in Appendix C.

After giving consent, participants filled in the HEXACO-60 questionnaire, as found in Appendix D. After finishing the HEXACO-60 questionnaire, participants were equipped with the Meta Quest 3 head-mounted display, and asked if they feel comfortable enough to start the training in VR. 50 out of 50 participants felt no nausea or dizziness during the VR experience. Guided by instructions from the researcher, all participants were able to complete a presentation of at least three minutes. Following the given presentation in VR, all participants completed the PQ, and were then given the opportunity to provide feedback, ask questions, and in some cases explore the opportunities of VR a bit further. All individual studies, including filling in the questionnaires, took between 45 and 90 minutes. Furthermore, all collected data was anonymized by the researcher. After the study, the researcher scored the questionnaires based on the provided scoring keys, as shown in Appendix E and Appendix F.

Data analysis

The HEXACO-60 and I-Group Presence Questionnaire were both analysed to determine their reliability, finding Cronbach's α. Secondly, factor analysis was employed to uncover underlying dimensions within the dataset of personality item responses. After doing so, the Pearson correlation coefficient was used to determine if there were any correlations between the six personality variables and the four presence variables. This method also identified correlations with the dimensions of presence and age, presence and gender, and presence and prior gaming experience. A linear regression was applied to assess the

significance of these six personality traits and gaming experience on the feeling of being present.

Results

Reliability Analysis

The validity of both the presence and the personality traits measurements were analyzed using the data from the I-Group Presence Questionnaires and the HEXACO Personality Inventory Test. This involved correlating the total presence scores and personality trait scores obtained by the researcher. Consequently, a factor analysis is computed to test the validity of both questionnaires.

In this study, Cronbach's α coefficients were computed to assess the reliability of the PQ subcategories. Specifically, the subcategory reliabilities were .80 for spatial presence, .88 for involvement, and .77 for experienced realism. Due to it being a single-item subcategory, the reliability of the general presence subcategory could not be determined. All α values here are acceptable standards for reliability, as they are above .60.

The questions used for the HEXACO-60 were also tested for reliability using Cronbach's α. The α value for honesty-humility is .88; for emotionality α is .87; for extraversion α is .63; for agreeableness α is .89; for conscientiousness α is .85; and for openness to experience α is .88. All items prove to be reliable.

Factor Analysis

In this study, factor analysis was employed to uncover underlying dimensions within the dataset of personality item responses. An oblique factor analysis was executed, because personality dimensions often correlate with each other. For example, extraversion might be somewhat related to openness to experience. Allowing factors to be correlated provides a more realistic and nuanced understanding of the underlying structure. The rotation method employed was oblimin.

The analysis identified six distinct factors, labeled as PA1 to PA6, each characterized by specific patterns of item loadings. For instance, PA1 showed high loadings for items related to assertiveness, while PA2 captured variance in items reflecting emotional stability and resilience. A Kaiser-Mayer-Olkin value of 0.5 is recognized as acceptable for factor analysis.

The variance explained by each factor varied slightly, with PA1 accounting for the highest proportion followed closely by PA2. Factor correlations revealed moderate associations between some factors, suggesting potential overlaps or shared underlying constructs. However, measures of factor score adequacy demonstrated strong correlations between observed variables and their estimated factors, indicating robustness in factor extraction.

Overall, the factor analysis provided a structured framework to understand the interrelationships among the personality items. These findings contribute to an understanding of personality traits within the study population, emphasizing both the complexity and coherence of the underlying constructs. An overview of the factor analysis results can be found in Table 1.

Table 1

Factor Analysis results of the HEXACO-60 Personality Inventory Questionnaire

Item	Factor					
	PA1	PA2	PA3	PA4	PA5	PA6
Item9 (Agreeableness)	0.80					
Item57 (Agreeableness)	0.72					
Item21 (Agreeableness)	0.69					
Item45 (Agreeableness)	0.69					
Item15 (Agreeableness)	0.66					
Item39 (Agreeableness)	0.60			-0.26		
Item27 (Agreeableness)	0.49					0.32
Item51 (Agreeableness)	0.48	0.25		-0.36	-0.25	
Item33 (Agreeableness)	0.47					0.32
Item38 (Conscientiousness)		0.67		-0.35		
Item50 (Conscientiousness)	-0.39	0.67		-0.30		
Item12 (Honesty-Humility)		0.65				
Item8 (Conscientiousness)	-0.36	0.61				
Item32 (Conscientiousness)		0.57		0.32		
Item60 (Honesty-Humility)	0.36	0.54				
Item14 (Conscientiousness)		0.48				
Item24 (Honesty-Humility)		0.48				
Item54 (Honesty-Humility)		0.43		0.37		-0.26

Item6 (Honesty-Humility)		0.38				
Item42 (Honesty-Humility)		0.31				
Item55 (Openness to Exp.)			0.83			
Item7 (Openness to Exp.)		-0.30	0.62			
Item25 (Openness to Exp.)			0.61		0.41	
Item43 (Openness to Exp.)			0.61			
Item1 (Openness to Exp.)			0.60	0.33		
Item37 (Openness to Exp.)			0.59			0.31
Item31 (Openness to Exp.)			0.51			
Item19 (Openness to Exp.)			0.50	-0.27		0.34
Item18 (Honesty-Humility)			0.33	0.28		-0.28
Item13 (Openness to Exp.)			0.30		-0.26	0.28
Item3 (Agreeableness)			0.28			
Item28 (Extraversion)				0.74		
Item10 (Extraversion)				0.68		
Item52 (Extraversion)				0.59		
Item4 (Extraversion)				0.56		
Item58 (Extraversion)	-0.41		0.26	0.51	-0.26	
Item26 (Conscientiousness)		0.36	-0.27	0.38		-0.31
Item34 (Extraversion)				0.36	-0.30	
Item22 (Extraversion)	0.33			0.34		0.27
Item36 (Honesty-Humility)				0.31		
Item56 (Conscientiousness)					0.77	
Item29 (Emotionality)					0.71	
Item5 (Emotionality)					0.55	0.31
Item44 (Conscientiousness)				0.41	0.49	
Item49 (Openness to Exp.)					-0.49	0.30
Item20 (Conscientiousness)				0.33	0.49	
Item23 (Emotionality)					0.43	
Item35 (Emotionality)		0.29			0.41	0.31
Item11 (Emotionality)					0.32	0.27
Item2 (Conscientiousness)					0.24	
Item40 (Extraversion)					-0.26	0.67
Item17 (Emotionality)						0.64
Item16 (Extraversion)						0.57
Item41 (Emotionality)					0.35	0.56

Item				
Item59 (Emotionality)			0.42	0.52
Item53 (Emotionality)			0.30	0.47
Item48 (Honesty-Humility)				0.46
Item46 (Extraversion)	-0.28	0.37		0.41
Item47 (Emotionality)			0.33	0.37
Item30 (Honesty-Humility)				0.25

Consequently, a similar factor analysis was conducted using the I-Group Presence Questionnaire. In conclusion, the factor analysis of the Presence Questionnaire reveals a coherent structure with four distinct dimensions of presence, marked in Table 2 by PA1 to PA4. These factors explain the variability in the questionnaire items related to general presence, spatial presence, involvement, and experienced realism. The Presence Questionnaire can be utilized to measure these constructs in this study. The factor analysis suggests that the Presence Questionnaire has several reliable subscales, particularly those with multiple items showing strong loadings (like PA1 and PA2). However, some factors (like PA3) may have lower reliability due to their reliance on a small number of items.

Table 2

Factor Analysis results of the I-Group Presence Questionnaire

	Factor			
Item	PA1	PA2	PA3	PA4
Item12 (Realism)	0.74			
Item8 (Involvement)	0.64			
Item7 (Involvement)	-0.52	0.27		-0.29
Item6 (Spatial Presence)	0.37			
Item3 ((Spatial Presence)	-0.29			
Item1 (General Presence)		0.91		
Item13 (Realism)		0.51		
Item4 (Spatial Presence)		0.20		
Item9 (Involvement)			1.14	
Item10 (Involvement)		0.21		-0.68
Item5 (Spatial Presence)				0.54
Item11 (Realism)				0.45
Item14 (Realism)	0.31	0.32		0.43

Item2 (Spatial Presence)   0.17

A summary of all found variables is displayed in Table 3.

Table 3

Summary of measured variables.

Variable *	N	Min	Max	Median	Mean	SD
General Presence *(1-7)*	50	2	7	6	5.36	1.31
Spatial Presence *(5-35)*	50	16	35	27	26.9	4.67
Realism *(4-28)*	50	7	28	16	15.64	4.05
Involvement *(4-28)*	50	6	28	22	20.08	5.55
Honesty-Humility *(20-100)*	50	46	98	78	77.08	11.73
Emotionality *(20-100)*	50	24	90	59	58.8	15.43
Extraversion *(20-100)*	50	38	92	75	74.2	11.54
Agreeableness *(20-100)*	50	28	88	63	63.08	14.17
Conscientiousness *(20-100)*	50	38	94	72	71.76	12.12
Openness to experience *(20-100)*	50	20	92	60	58.92	17.07

*The values in brackets behind the variables represent the theoretical minimums and maximums

Explaining Presence in VR by Personality Traits

To confirm or reject the main hypothesis 'individual differences in personality traits influence presence in VR public speaking training', multiple linear regression was applied to determine if personality traits as explained by the HEXACO Personality Inventory can predict the sense of presence a person has in a VR environment. For all four subcategories of presence a linear regression model was created and summarized.

Explaining General Presence in VR by the six personality traits

Table 4

Coefficients of the effect of personality traits on General Presence in VR.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	4.11	2.45	1.68	.10
Honesty-Humility	<.01	.02	.37	.71
Emotionality	<-.01	.01	-.27	.79
Extraversion	.01	.02	.53	.60
Agreeableness	<.01	.02	.26	.80
Conscientiousness	.01	.02	.30	.77
Openness to experience	-.01	.01	-.82	.42

The summary of the first multiple linear regression that was created to determine the effect of personality traits on the general presence of participants shows that none of the individual personality traits are statistically significant. The multiple R^2 value is .05, indicating that about 4.64% of the variance in the feeling of presence is explained by the six different personality traits. All personality traits do influence the feeling of general presence slightly, but none of the coefficients are statistically significant at the .05 p-value level, as all p-values are greater than .05. It null-hypothesis in this case can not be rejected, therefore it can not be concluded that personality traits have a significant effect on the feeling of general presence.

Explaining Spatial Presence in VR by the six personality traits

Table 5

Coefficients of the effect of personality traits on Spatial Presence in VR.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	16.50	8.62	1.92	.06
Honesty-Humility	-.03	.08	-.36	.72
Emotionality	.03	.05	.57	.58
Extraversion	.03	.07	.38	.71
Agreeableness	.06	.05	1.14	.26
Conscientiousness	.09	.08	1.07	.29
Openness to experience	-.01	.05	-.30	.77

The summary of the second multiple linear regression that was created to determine the effect of personality traits on the spatial presence of participants shows that none of the individual personality traits are statistically significant. The multiple R2 value is .08, indicating that about 7.64% of the variance in the feeling of spatial presence is explained by the six different personality traits. All personality traits do influence the feeling of spatial presence slightly, but none of the coefficients are statistically significant at the .05 p-value level, as all p-values are greater than .05. The null hypothesis in this case cannot be rejected, therefore it cannot be concluded that personality traits have a significant effect on the feeling of spatial presence.

Explaining Involvement in VR by the six personality traits

Table 6

Coefficients of the effect of personality traits on Involvement in VR.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	9.46	9.81	.97	.34
Honesty-Humility	.03	.09	.36	.72
Emotionality	-.11	.06	-1.97	.06
Extraversion	.08	.08	.08	.29
Agreeableness	.01	.06	.21	.84
Conscientiousness	.08	.09	.86	.40
Openness to experience	.03	.06	.62	.54

The summary of the third multiple linear regression that was created to determine the effect of personality traits on the feeling of involvement of participants shows that none of the individual personality traits are statistically significant. The multiple R^2 value is .16, indicating that about 15.51% of the variance in the feeling of involvement is explained by the six different personality traits. All personality traits do influence the feeling of involvement slightly, and although the effects of emotionality on involvement in VR is close with a p-value of .06, none of the coefficients are statistically significant at the .05 p-value level, as all p-values are greater than .05. The null-hypothesis in this case cannot be rejected, therefore it cannot be concluded that personality traits have a significant effect on the feeling of involvement in VR.

Explaining Realism in VR by the six personality traits

Table 7

Coefficients of the effect of personality traits on Realism in VR.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	11.81	7.43	1.59	.12
Honesty-Humility	-.01	.07	-.19	.85
Emotionality	-.01	.04	-.25	.81
Extraversion	.04	.06	.70	.49
Agreeableness	.08	.04	1.76	.09
Conscientiousness	-.02	.07	-.28	.78
Openness to experience	-.02	.04	-.42	.68

The summary of the fourth multiple linear regression that was created to determine the effect of personality traits on the perception of realism of participants shows that none of the individual personality traits are statistically significant. The multiple R^2 value is .092, indicating that about 9.19% of the variance in the feeling of realism is explained by the six different personality traits. All personality traits do influence the feeling of realism slightly, but none of the coefficients are statistically significant at the .05 p-value level, as all p-values are greater than .05. The null hypothesis in this case cannot be rejected, therefore it cannot be concluded that personality traits have a significant effect on the feeling of realism in VR.

Overall, it is concluded that, in this study, personality traits, as measured by the HEXACO Personality Inventory Test, do not influence the feeling of being present, as measured by the I-Group Presence Questionnaire, in a VR public speaking training environment.

Effect of Personality Traits on Presence in VR

Contrary to the formulated hypotheses (H1.1 to H1.6), none of the HEXACO personality traits – Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, and Openness to Experience – were found to have a significant effect on the feeling of presence in VR public speaking training. This indicated that individual differences in these personality dimensions did not significantly influence how participants experienced presence in the VR environment designed for presentation skills enhancement.

Explaining Presence in VR by Gaming Experience

Table 8

Coefficients of the effect of Gaming Experience on Total Presence in VR.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	51.18	5.29	9.68	1.44e-12
Gaming Experience	-3.25	1.11	-2.92	<.01

From this regression output, measuring the effect of gaming experience on the feeling of presence in VR, it is concluded that the intercept is highly statistically significant, with an associated p-value of 1.44e-12. The coefficient for gaming experience has a p-value of <.01, indicating that having prior gaming experience has a statistically significant effect on the feeling of presence. The effect is negative. With a slope of -3.25, a SE of 1.11, and a p-value of .005, gaming experience has a statistically significant negative effect on the feeling of presence in VR. The more experienced of a gamer a participant is, the less likely it is that the participant will feel present in the VR training environment.

Secondly, from a following regression output, measuring the effect of gaming experience on all four domains of presence in VR, it is concluded that the intercept is highly statistically significant on all domains, with all p-values below .05, as shown in tables 9, 10, 11, and 12.

Table 9

Coefficients of the effect of Gaming Experience on General Presence in VR.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	5.74	.23	25.23	<.01
Gaming Experience	-.31	.12	-2.59	.01

Table 10

Coefficients of the effect of Gaming Experience on Spatial Presence in VR.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	28.54	.78	36.38	<.01
Gaming Experience	-1.37	.42	-3.27	<.01

Table 11

Coefficients of the effect of Gaming Experience on Involvement in VR.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	21.04	1.01	20.85	<.01
Gaming Experience	-.80	.54	-4.48	.01

Table 12

Coefficients of the effect of Gaming Experience on Experienced Realism in VR.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	16.33	.74	22.13	<.01
Gaming Experience	-.57	.39	-1.45	.02

However, the collected data concerning gaming experience shows more results, as seen in Table 13.
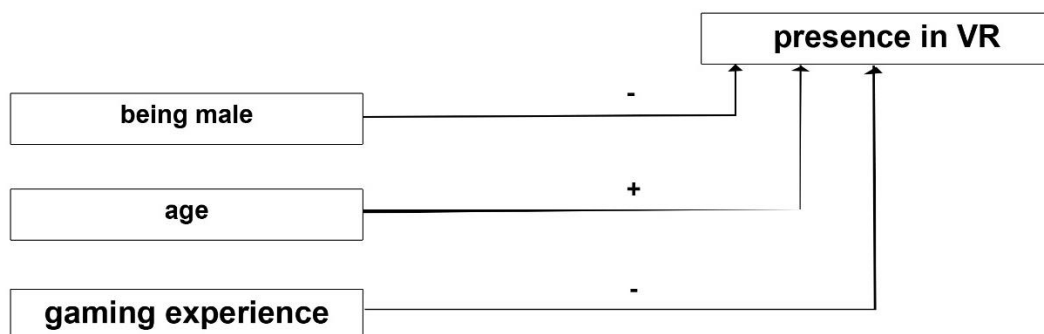
Table 13

Coefficients of the effect of Gaming Experience, Age, and Male/Female on Total Presence in VR.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	51.18	5.29	9.68	1.44e-12
Gaming Experience	-3.25	1.11	-2.92	<.01
Age	.40	.11	3.63	<.01
Male/Female	6.99	3.09	2.26	.03

The coefficient for age is .40 with a standard error of .11, indicating that the higher the participants' age, the higher the feeling of presence is. The p-value here is .0007, indicating that age has a statistically significant positive effect on the dependent variable of presence in VR.

The coefficient estimate for Male/Female is 6.99 with a SE of 3.09 and a p-value of .03. Though less strong compared to age and gaming experience, the effect of gender also has a significant effect on the feeling of presence in VR, with female participants feeling significantly more present than male participants. In a model, this would present itself as shown in Figure 4.

Figure 1. Gender and Age as predictors of presence in VR.

However, the data shows that the amount of gaming experience a participant has, is correlated to the participants' age and gender, as shown in Table 14.

Table 14

Coefficients of the effect of Age and Male/Female on Gaming Experience.

Coefficients	Estimate	SE	T-value	P-value
(Intercept)	2.11	0.56	3.76	<.01
Age	-0.04	0.01	-2.94	<.01
Male/Female	1.09	0.36	3.05	<.01

A linear regression between variables gender and gaming experience shows a scatterplot of these two variables, seen in Figure 5. A linear regression between variables age and gaming experience shows a scatterplot of these two variables, seen in Figure 6.

Concluding, these regression analyses suggest that gaming experience is a statistically significant predictor of presence in a VR public speaking training environment, whereas age and gender are statistically significant predictors of gaming experience, and consequently presence in VR.

The model itself explains about 44.29% of the variance in presence, indicating a moderate level of explanatory power.
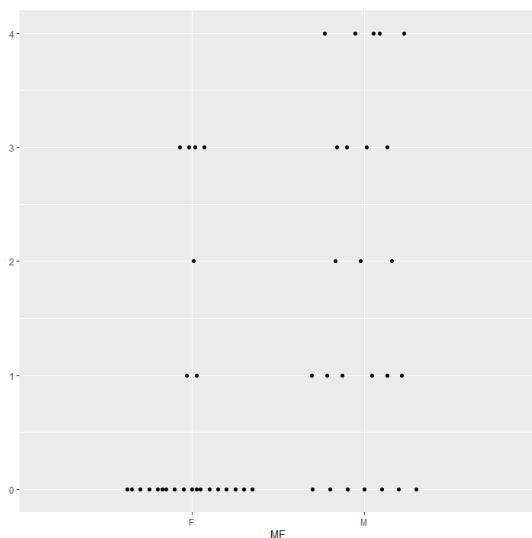
Figure 5 - Correlation between Gender and Gaming Experience
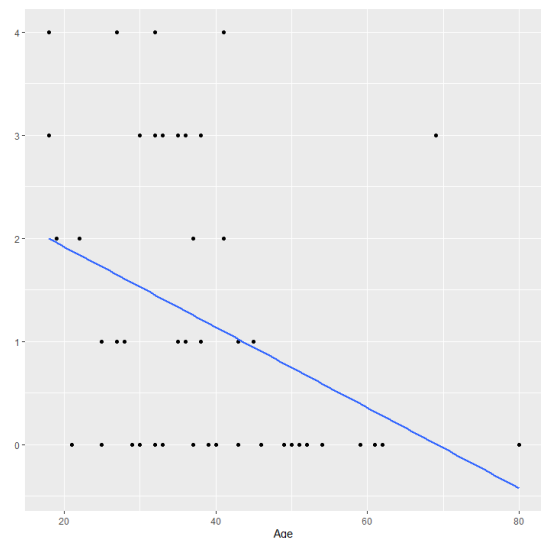
Figure 6 - Correlation between Age and Gaming Experience

Explaining these variables as predictors of gaming experience in this context results in a model shown in Figure 7.
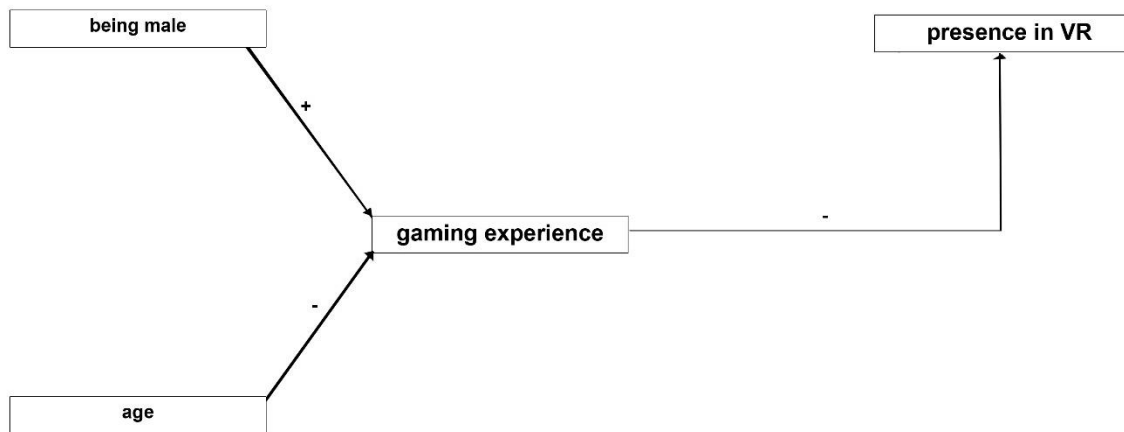
2. Gender and Age as predictors of gaming experience.

Effect of Gaming Experience of Presence in VR

In contrast to the hypothesis (H1.7), gaming experience was found to have a statistically significant negative correlation with the feeling of presence in VR public speaking training. More specifically, participants with greater gaming experience report lower levels of presence in the VR environment.

Discussion

This study explores how personality traits and gaming experience are correlated to the sense of presence in VR public speaking training. The results show that personality traits, as measured by the HEXACO Personality Inventory, do not directly correlate to presence. However, gaming experience is significantly negatively correlated with presence. These findings suggest that gaming experience, rather than personality traits, plays a more critical role in determining presence in VR.

Based on prior research, it was expected to find a correlation between several personality traits and presence in VR. However, none of the personality traits proved to be impacting the feeling of presence. The findings in this study revealed no significant correlation between any of the HEXACO personality traits and the sense of presence in VR public speaking training, which contrasts sharply with the initial hypotheses. H1.1 hypothesized that honesty-humility did not correlate with presence. While the analysis supported this, the lack of correlation might suggest that this trait is less relevant in VR contexts than anticipated. A lack of support in the literature for any research on this topic, suggest more research could be needed to provide a clearer insight in this relation.

H1.2, which predicted a positive correlation between emotionality and presence, was based on previous research linking anxiety with heightened presence (Jurnet, Beciu, & Maldonado, 2005). However, the absence of this relationship in the current study might suggest that the impact of emotionality is more complex or context-dependant than earlier studies implied, potentially due to differences in VR environments or tasks given. For example, a VR public speaking training will possibly trigger lots of different aspects of emotionality than a VR nature relaxation experience. Therefore, differences in factors like the type of VR content, the complexity of the task, or how immersive the environment is, might influence the emotionality-presence relationship.

H1.3 posited a negative correlation between extraversion and presence, drawing from the assumption that introversion would enhance presence. Contrary to this hypothesis, the null findings suggest that extraversion may not diminish presence as predicted. A possible explanation for this finding, is that the immersive nature of VR could mitigate the social discomfort introverted individuals usually face, thus sort of 'leveling the playing field' for all participants, whether introverted or extraverted. An introverted user might typically feel anxious or overwhelmed in a real-world presentation. However, in the VR event, they can

control their interactions more easily and might feel more comfortable. An extraverted participant, who is generally more comfortable in social situations, might not experience a decrease in presence, because they still find the VR environment engaging and interactive, similar to a real-world situation. Whether this is correct needs to be investigated further.

H1.4, which expected a positive correlation between agreeableness and presence, was grounded in the idea that cooperative individuals might feel more engaged in VR environments (Song et al, 2022). However, the lack of support for this hypothesis indicates that agreeableness might not translate well to the same dimension as cooperation does. Secondly, the lack of support might also indicate that agreeableness might not lead to a stronger sense of presence in a solo VR experience like public speaking, as opposed to, for example, a multiplayer VR experience in which cooperation is a must.

The non-influence of conscientiousness (H1.5) and openness to experience (H1.6) on presence was expected, yet the complete absence of correlations across all personality traits was unexpected. The discrepancies between the hypotheses H1.1 to H1.6 and the findings in this study can possibly be attributed to several factors. Presence in VR is influenced by multiple factors beyond personality traits and gaming experience alone. Environmental cues like sounds in the background of the real life situation during a VR presentation, technological factors like the level of immersion of VR environments, and individual cognitive processes play crucial roles in shaping how users perceive and engage with virtual environments. The lack of significant findings for personality traits might indicate that other variables have a stronger impact on presence in this specific VR context.

In contrast to the final hypothesis H1.7, gaming experience was found to have a statistically significant negative correlation with the feeling of presence in VR public speaking training. More specifically, participants with greater gaming experience reported lower levels of presence in the VR environment. This unexpected finding suggests that while experienced gamers may have higher tolerance or familiarity with virtual environments, they may also perceive them as less immersive or engaging, possibly due to the heightened expectations or differing engagement thresholds. Experienced gamers might have specific expectations regarding graphics, interactivity, and narrative. When these expectations are met or exceeded, their sense of presence can be heightened. However, if the VR experience does not meet these expectations, it might lead to a decreased sense of presence.

Scientific and Practical Implications

The findings of this study have several important scientific and practical implications for the fields of VR research and personality psychology. The lack of influence of the HEXACO personality traits on the feeling of presence in VR challenges assumptions that individual differences in personality significantly affect VR experiences. This suggests that VR developers and researchers might focus more on environmental and technological factors rather than personality traits when aiming to enhance the sense of presence.

Secondly, the negative correlation between gaming experience and presence in VR has significant implications for the design and deployment of VR applications. Experienced gamers' reduced sense of presence could be due to their familiarity with virtual environments, leading to higher expectations. This insight could inform the developers of more sophisticated or novel VR content to meet the expectations of this user group, ensuring that even experienced gamers can achieve a high level of presence. This could for example also involve introducing unique challenges or novel interactive elements to sustain their interest and feeling of presence.

Thirdly, the findings of this study underscore the importance of integrating insights from gaming studies into VR research. The distinct effects of gaming experience on VR presence highlight the need for cross-disciplinary approaches that consider the nuanced experiences of different user groups.

Limitations

While this study aims to provide valuable insights into the relationship between personality traits, gaming experience, and the sense of presence in VR public speaking training, several limitations must be acknowledged. These limitations pertain to the sample size and sampling methods, time and resource constraints, measurement instruments, and technology and software variability. Recognizing these limitations is crucial for interpreting the results, and for guiding future research in this area.

Convenience sampling and sample size

The use of a convenience sample and snowball sampling as mentioned in this study may introduce bias, as the participants might not be representative of the general population. This can limit the generalizability of the findings in this study. Moreover, the sampling size of 50 participants, while adequate for detecting moderate correlations, may not be sufficient to

detect smaller effect sizes. This can impact the statistical power of the study and the robustness of the conclusions.

Time and resource constraints

The 8-week data collection period may be insufficient to recruit a diverse and representative sample, especially considering the reliance on convenience and snowball sampling. Constraints on the researcher's time and travel possibilities may affect the thoroughness of the data collection, potentially leading to incomplete or biased data.

Measurement instruments

As described in the recommendation section of this study, this study uses the HEXACO-60 and the I-Group Presence Questionnaire, which both rely on self-reported data. This can be subject to biases such as social desirability and inaccurate self-assessment. While the HEXACO-60 and the I-Group Presence Questionnaire are established instruments, the study's results depend on the reliability and validity of these measures. Any shortcoming in these instruments could affect the accuracy of the findings in this study.

Technology and software variability

This study uses a specific VR headset (Meta Quest 3) and software (Ovation VR). Differences in hardware and software quality, interfaces, and immersion levels could affect the sense of presence. Results might differ with other VR systems. Taking this in consideration, the participants' familiarity and comfort with (these or other) VR technology could influence their experience of presence as well, potentially confounding the relationship between personality traits and presence.

Recommendations for further research

Further exploration of the personality trait model(s)

In this study, the HEXACO-60 model including these six personality traits does not effectively predict or explain the dependent variable of presence. Further exploration or refinement of the model, possibly including additional variables or interactions, may be necessary to better understand the relationship between personality traits and the dependent variable. Exploring other models that determine personality traits might be explored.

Investigating the impact of gaming experience, age, and gender

Secondly, a regression analysis done in this study indicates that age, gaming experience, and gender are significant predictors of presence in a VR public speaking training

environment. The amount of gaming experience a participant has may be affected by their age and gender. In this study, the model accounts for approximately 44.29% of the variance in presence, suggesting a moderate level of explanatory power. This finding can be further explored in future research. Future research could explore the mechanisms behind this negative correlation, potentially involving cognitive and perceptual factors, to develop strategies for enhancing presence across diverse user groups.

Investigating different VR environments

In this study, a VR public speaking training setting was used to find a relation between personality traits and presence in VR. However, VR is much broader and more diverse than just training settings, and the creators of VR environments differ strongly in technical ability and budget. For example, a VR entertainment setting like the racing videogame Gran Turismo 7, created by Poliphony Digital, with estimated budgets going up to hundreds of millions of dollars, will likely produce different results in testing VR presence than a relatively small application made by a much smaller team with a significantly smaller budget, like Ovation VR.

To better understand these different types of VR experiences, future research may be conducted to understand how the context and nature of a VR application influences the user's sense of presence and overall experience. Besides differences in budget and technical abilities of creators, the purpose of the VR setting might also influence the feeling of presence. Some examples of different VR purposes are education, recreation, therapy, social spaces, creative VR, and entertainment.

Investigating subjective vs. objective measures

As participants had to judge their feeling of presence, and measure their personality themselves, in this study, only subjective measures have been analysed. To gain a comprehensive understanding of how users experience presence in VR, it might prove valuable to investigate both subjective and objective measures.

Subjective measures typically involve self-reported data, where participants describe their feelings and perceptions of presence through surveys and questionnaires. Objective measures, on the other hand, rely on physiological and behavioral data that can provide a more unbiased assessment of the user's experience. Examples of objective measures could be to implement physiological monitoring, eye-tracking, motion capture, and measuring response times. It might prove valuable to investigate the interplay between subjective self-

reports as used in this study and objective physiological and behavorial data as well. This might allow researchers to achieve a more nuanced understanding of the data collected in this study and might validate self-reported data.

Conclusion

This study concludes that in this research, individual differences in personality traits, as measured by the HEXACO Personality Inventory Test, do not directly influence presence, as measured by the I-Group Presence Questionnaire, in virtual reality training designed to enhance presentation skills.

Secondly, this study concludes that in this research, individual differences in gaming experience influence the feeling of presence in VR. Gaming experience is significantly negatively correlated with the feeling of presence in VR.

In summary, these findings contribute to a more nuanced understanding of what influences the sense of presence in VR environments. They suggest a shift in focus away from personality traits towards more dynamic user factors such as prior gaming experience, which can guide the development of more engaging and effective VR applications.

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Appendix A – I-Group Presence Questionnaire

Vraag	Helemaal niet		Redelijk aanwezig			Zeer aanwezig	
1. Ik had het gevoel aanwezig te zijn in de computerwereld.	1	2	3	4	5	6	7

Vraag	Helemaal mee oneens		Redelijk eens			Helemaal eens	
2. Ik had het gevoel omgeven te zijn door de virtuele wereld.	1	2	3	4	5	6	7
3. Ik had het gevoel slechts plaatjes te aanschouwen.	1	2	3	4	5	6	7
4. Ik had niet het gevoel in de virtuele ruimte aanwezig te zijn.	1	2	3	4	5	6	7
5. Ik had meer het gevoel bezig te zijn in de virtuele ruimte, dan dat ik het gevoel had iets van buitenaf te bedienen.	1	2	3	4	5	6	7
6. Ik voelde me aanwezig in de virtuele ruimte.	1	2	3	4	5	6	7

Vraag	Zeer bewust		Redelijk bewust			Helemaal niet bewust	
7. Hoe bewust was u zich van de echte omgeving (bv. Geluiden van buiten, kamertemperatuur), terwijl u zich bevond in de virtuele ruimte?	1	2	3	4	5	6	7

Vraag	Helemaal mee oneens		Redelijk eens			Helemaal eens	
8. Ik was mij niet bewust van mijn echte omgeving.	1	2	3	4	5	6	7
9. Ik lette nog op de echte omgeving.	1	2	3	4	5	6	7
10. Ik ging volledig op in de virtuele wereld.	1	2	3	4	5	6	7

Vraag	Helemaal niet echt		Redelijk echt			Heel echt	
11. Hoe echt kwam de virtuele omgeving op u over?	1	2	3	4	5	6	7

Vraag	Geen overeenstemming		Redelijke overeenstemming			Volledige overeenstemming	
12. In hoeverre kwam uw ervaring in de virtuele omgeving overeen met uw ervaringen in de echte wereld?	1	2	3	4	5	6	7

Vraag	Als een fantasiewereld		Redelijk werkelijk			Niet te onderscheiden van de echte wereld	
13. Hoe werkelijk kwam de virtuele wereld op u over?	1	2	3	4	5	6	7

Vraag	Helemaal mee oneens		Redelijk mee eens			Helemaal mee eens	
14. De virtuele wereld kwam echter op mij over dan de werkelijke wereld	1	2	3	4	5	6	7

Bonusvragen

Vraag	Geen ervaring	1 of 2 keer geprobeerd	Tussen de 2 en de 10 uur	Tussen de 10 en 40 uur	Meer dan 40 uur
15. Hoeveel ervaring heb je met VR?					

Vraag	Nooit	Minder dan een uur	Tussen 1 en 4 uur	Tussen 4 en 10 uur	Meer dan 10 uur
16. Hoeveel uren game je per week?					

_____   _____   _____

Leeftijd   Geslacht   Beroep

Appendix B – Participants' consent form

'De wisselwerking tussen persoonlijkheid en aanwezigheid in VR-training voor openbaar spreken'

Doel van dit onderzoek

Het doel van deze studie is om de relatie tussen persoonlijkheidstrekken en het gevoel van aanwezigheid in een VR-training voor het openbaar spreken te onderzoeken. Meer specifiek zal de studie onderzoeken of individuen met verschillende niveaus van openheid, consciëntieusheid, extraversie, vriendelijkheid en neuroticisme variërende niveaus van aanwezigheid ervaren tijdens VR-trainingen voor het openbaar spreken. Om deze relaties te bestuderen, maakt deze studie gebruik van een kwantitatief onderzoeksontwerp. De belangrijkste focus ligt op het verkennen van mogelijke verschillen in de niveaus van aanwezigheid ervaren door individuen met uiteenlopende gradaties van openheid, consciëntieusheid, extraversie, vriendelijkheid en neuroticisme. Via gevestigde kwantitatieve methoden heeft dit onderzoek als doel een systematische analyse van deze relaties te maken en waardevolle inzichten te verschaffen in hoe specifieke persoonlijkheidstrekken de effectiviteit van VR-trainingen voor het openbaar spreken kunnen beïnvloeden. Dit onderzoek zal bijdragen aan het bestaande corpus van kennis en beoogt de kloof in de bestaande literatuur te overbruggen door systematisch de rol van persoonlijkheid als een variabele te onderzoeken in de context van VR-aanwezigheid in een VR-training voor het openbaar spreken. Door onderzoeksmethoden toe te passen en te putten uit relevante theorieën van leren en technologieadoptie, beoogt deze studie waardevolle inzichten te verschaffen die onderwijsdeskundigen, instructieontwerpers en beleidsmakers kunnen informeren bij het benutten van het volledige potentieel van VR-technologieën voor educatieve doeleinden. De primaire onderzoeksvraag in deze studie luidt: *"In hoeverre beïnvloeden individuele verschillen in persoonlijkheidstrekken, zoals gemeten door de HEXACO Persoonlijkheidstest, de aanwezigheid in virtual reality-trainingen die zijn ontworpen om presentatievaardigheden te verbeteren?"*

Risico's van deelname

Dit onderzoeksproject is beoordeeld en goedgekeurd door de BMS Ethics Committee (domein Geesteswetenschappen & Sociale Wetenschappen) en toont geen gevaarlijke risico's voor deelnemers. Dit onderzoek omvat deelname in een VR-omgeving. Een soms voorkomend probleem in VR waar deelnemers mee te maken kunnen krijgen is bewegingsziekte. Dit treedt op wanneer de visuele signalen die de ogen van een persoon waarnemen niet overeenkomen met de fysieke beweging die ze ervaren (zoals in een VR-game waarbij het personage beweegt maar het lichaam van de speler stil staat). Dit verschil kan leiden tot misselijkheid, duizeligheid en ongemak. In dit onderzoek wordt geen fysieke beweging van de deelnemer geëist. Echter, de onderzoeker zal voortdurend controleren of er enig ongemak wordt ervaren en de deelnemer eraan herinneren dat zij de optie hebben om de virtuele omgeving te verlaten. Deelnemers zullen na het onderzoek een debriefing ontvangen, en zij hebben te allen tijde de mogelijkheid om zich terug te trekken uit de studie zonder consequenties.

Data verzameling

In de data-analysefase van dit project zal verzamelde kwantitatieve data worden onderworpen aan statistisch onderzoek. Deelnemers zullen voorafgaand aan deelname geïnformeerde toestemming verstrekken, en hun privacy zal gedurende het onderzoek worden beschermd. Alle verzamelde data, inclusief persoonlijke informatie, zal worden beveiligd, vertrouwelijk blijven en worden geanonimiseerd.

Contactgegevens

Deelnemers zullen de persoonlijke gegevens van de onderzoeker en contactgegevens van de BMS Ethics Committee ontvangen om vragen te kunnen stellen of een klacht in te dienen. Deelnemers zijn vrij om op elk moment contact op te nemen met beide voor vragen, suggesties of klachten.

Toestemmingsformulier voor 'De wisselwerking tussen persoonlijkheid en aanwezigheid in VR-training voor openbaar spreken'

Gelieve de juiste vakjes aan te vinken	Ja	Nee
Deelname aan de studie		
Ik heb de studie-informatie gelezen en begrepen, of het is aan mij voorgelezen. Ik heb vragen kunnen stellen over de studie en mijn vragen zijn naar tevredenheid beantwoord.		
Ik geef vrijwillig toestemming om deel te nemen aan deze studie en begrijp dat ik vragen kan weigeren te beantwoorden en op elk moment uit de studie kan terugtrekken, zonder een reden te hoeven geven.		
Ik begrijp dat deelname aan deze studie inhoudt dat ik twee vragenlijsten invul en deelneem aan een activiteit in een VR-omgeving en de bijbehorende mogelijke problemen.		
Ik begrijp dat persoonlijke informatie die over mij wordt verzameld en mij kan identificeren, zoals mijn naam of waar ik woon, niet buiten het onderzoeksteam zal worden gedeeld.		
Ik geef toestemming voor de informatie die ik verstrek om gearchiveerd te worden op een beveiligde server, zodat het gebruikt kan worden voor toekomstig onderzoek en leren.		

Handtekeningen

_____ _____ _____
Naam van deelnemer   Handtekening   Datum

Ik heb de informatiebrochure nauwkeurig voorgelezen aan de potentiële deelnemer en, naar beste vermogen, ervoor gezorgd dat de deelnemer begrijpt waar zij vrijwillig mee instemmen.

Remco Schakelaar_____ _____
_____
Naam van onderzoeker   Handtekening   Datum

Onderzoek contactgegevens voor verdere informatie:

Remco Schakelaar, +31623250674, r.schakelaar@student.utwente.nl

BMS Ethics Committee, ethicscommittee-hss@utwente.nl

Als u vragen heeft over uw rechten als onderzoeksdeelnemer, of informatie wenst te verkrijgen, vragen wilt stellen, of eventuele zorgen over dit onderzoek met iemand anders dan de onderzoeker wilt bespreken, neem dan contact op met de Secretaris van de Ethiekcommissie van de Faculteit Gedragswetenschappen, Management en Sociale Wetenschappen aan de Universiteit Twente.

Appendix C – Instructor guide

INSTRUCTIES

In Ovation:

- Kijk om je heen, kijk naar je handen. Ervaar hoe het aanvoelt om in een VR ruimte te zijn.
- Probeer het menu te verplaatsen met je handen.
- Probeer het menu te laten verschijnen en verdwijnen.

Check gemoedstoestand deelnemer.

Er staat: 'Speech, Conversation of Interview'

- Kies voor 'Speech'
- Kies voor 'Hotel conference room, capacity 128'
- Luiken gaan open, laadscherm begint

Er staat: 'Speech'

- Druk op 'Start'
- 'Start now'
- Toespraak begint na het aftellen.
- Ik geef een seintje als het genoeg is.

Einde.

- Open het menu.
- Het menu verschijnt. Selecteer 'End'
- Selecteer 'Save'
- Je krijgt applaus, en een beoordeling voor je speech

Opties:

- Terugkijken naar jezelf
- Statistieken bekijken
- Afsluiten

Appendix D – HEXACO-60 Personality Inventory Test

HEXACO Zelfbeoordeling

Op de volgende pagina's vindt u een aantal uitspraken over uzelf. U wordt verzocht de uitspraken te lezen en aan te geven in hoeverre deze uitspraak bij u past. Alle data wordt genanonimiseerd. Het verzoek is om deze vragenlijst zo eerlijk mogelijk in te vullen.

U geeft uw antwoord in de ruimte naast de vraag met behulp van de volgende antwoordcategorieen:

1 = Helemaal mee oneens 2 = Mee oneens 3 = Neutraal 4 = Mee eens 5 = Helemaal mee eens

01. Ik zou me vervelen bij een bezoek aan een kunstgalerie.	1	2	3	4	5
02. Ik maak vooraf plannen en regel alvast zaken om te vermijden dat ik op het laatste moment nog dingen moet doen.	1	2	3	4	5
03. Ik houd zelfden een wrok tegen iemand, zelfs niet als ik erg slecht behandeld ben.	1	2	3	4	5
04. Alles bij elkaar heb ik wel een tevreden gevoel over mijzelf.	1	2	3	4	5
05. Ik zou bang worden als ik in slecht weer zou moeten reizen.	1	2	3	4	5
06. Ik zou niet vleien om op het werk opslag of promotie te krijgen, zelfs al zou het succes hebben.	1	2	3	4	5
07. Ik kom graag meer te weten over de geschiedenis en politiek van andere landen.	1	2	3	4	5
08. Ik span me vaak tot het uiterste in als ik een doel tracht te bereiken.	1	2	3	4	5
09. Mensen vertellen me soms dat ik te kritisch op anderen ben.	1	2	3	4	5
10. Ik geef zelden mijn mening in groepsbijeenkomsten.	1	2	3	4	5
11. Ik maak me soms zorgen over onbenulligheden.	1	2	3	4	5
12. Als ik niet gepakt zou worden, dan zou ik er geen probleem mee hebben om een miljoen Euro te stelen.	1	2	3	4	5
13. Ik zou graag iets kunstzinnigs doen, zoals een boek schrijven, een lied componeren of een schilderij maken.	1	2	3	4	5
14. Als ik aan iets werk, besteed ik weinig aandacht aan kleine details.	1	2	3	4	5
15. Mensen vertellen me soms dat ik te koppig ben.	1	2	3	4	5
16. Ik heb liever een baan waarin men veel met andere mensen omgaat dan 1 waarin men alleen dient te werken.	1	2	3	4	5
17. Na een pijnlijke ervaring heb ik iemand nodig om me te troosten.	1	2	3	4	5
18. Veel geld bezitten vind ik onbelangrijk.	1	2	3	4	5
19. Ik vind het tijdverlies om aandacht te besteden aan radicale ideeen.	1	2	3	4	5
20. Ik neem beslissingen op basis van 'hier-en-nu' gevoelens in plaats van zorgvuldig beraad.	1	2	3	4	5
21. Mensen vinden me een heethoofd.	1	2	3	4	5
22. De meeste dagen voel ik me blij en optimistisch.	1	2	3	4	5
23. Ik voel tranen opkomen als ik anderen zie huilen.	1	2	3	4	5
24. Ik vind dat ik meer recht op respect heb dan de gemiddelde persoon.	1	2	3	4	5
25. Als ik de gelegenheid had, zou ik graag een klassiek concert bijwonen.	1	2	3	4	5
26. Ik haal me soms problemen op de hals omdat ik slordig ben.	1	2	3	4	5

27. Mijn houding ten aanzien van mensen die mij slecht behandeld hebben is 'vergeven en vergeten'.	1	2	3	4	5
28. Ik heb het gevoel dat ik een impopulair persoon ben.	1	2	3	4	5
29. Als het gaat om fysiek gevaar, ben ik een angsthaas.	1	2	3	4	5
30. Als ik iets van iemand wil, lach ik om diens slechtste grappen.	1	2	3	4	5
31. Ik heb nooit met veel plezier in een encyclopedie gekeken.	1	2	3	4	5
32. Ik verricht zo min mogelijk werk, maar net genoeg om rond te komen.	1	2	3	4	5
33. Ik heb de neiging andere mensen mild te beoordelen.	1	2	3	4	5
34. Als ik anderen ontmoet, ben ik meestal diegene die het contact op gang brengt.	1	2	3	4	5
35. Ik maak me veel minder zorgen dan de meeste mensen.	1	2	3	4	5
36. Ik zou nooit ingaan op een poging tot omkoping, zelfs niet als het om een erg hoog bedrag ging.	1	2	3	4	5
37. Mensen vertellen me vaak dat ik een levendige verbeelding heb.	1	2	3	4	5
38. Ik probeer altijd zo nauwkeurig mogelijk te werken, zelfs al kost het me extra tijd.	1	2	3	4	5
39. Ik ben gewoonlijk vrij flexibel in mijn opvattingen als mensen het met mij oneens zijn.	1	2	3	4	5
40. Het eerste dat ik altijd doe als ik ergens nieuw ben, is vrienden maken.	1	2	3	4	5
41. Moeilijke situaties kan ik aan zonder emotionele steun van anderen nodig te hebben.	1	2	3	4	5
42. Ik zou veel plezier beleven aan het bezit van luxe goederen.	1	2	3	4	5
43. Ik houd wel van mensen met onconventionele ideeen.	1	2	3	4	5
44. Ik maak veel fouten omdat ik niet nadenk voordat ik iets doe.	1	2	3	4	5
45. De meeste mensen hebben de neiging sneller boos te worden dan ik.	1	2	3	4	5
46. De meeste mensen zijn levenslustiger en dynamischer dan ik over het algemeen ben.	1	2	3	4	5
47. Ik raak erg geemotioneerd als iemand die me na staat voor een lange tijd weg gaat.	1	2	3	4	5
48. Ik wil dat mensen weten hoe belangrijk ik ben.	1	2	3	4	5
49. Ik beschouw mezelf niet als een artistiek of creatief type.	1	2	3	4	5
50. Mensen noemen me vaak een perfectionist.	1	2	3	4	5
51. Zelfs als mensen veel fouten maken, zeg ik zelden iets negatiefs.	1	2	3	4	5
52. Soms heb ik het gevoel dat ik een waardeloos persoon ben.	1	2	3	4	5
53. Zelfs in crisissituaties blijf ik rustig.	1	2	3	4	5
54. Ik zou niet net doen alsof ik iemand mag om te zorgen dat die persoon mij een dienst bewijst.	1	2	3	4	5
55. Ik vind het saai om over filosofie te discussieren.	1	2	3	4	5
56. Ik doe liever dingen spontaan dan vast te houden aan een plan.	1	2	3	4	5
57. Als mensen mij vertellen dat ik het mis heb, is mijn eerste reactie om dit aan te vechten.	1	2	3	4	5
58. Als ik met andere mensen samen ben, ben ik vaak de woordvoerder van de groep.	1	2	3	4	5
59. Ik raak niet snel geemotioneerd, zelfs niet in situaties waarin anderen erg sentimenteel worden.	1	2	3	4	5

60. Ik zou in de verleiding komen om vals geld te gebruiken als ik er zeker van was dat ik er mee weg zou komen.	1	2	3	4	5

U wordt vriendelijk verzocht op elke vraag antwoord te geven, zelfs als u twijfelt over uw antwoord.

Hartelijk dank!

Appendix E – HEXACO-60 Scoring Keys

	Honesty-Humility *(eerlijkheid/bescheidenheid)*		
	Sincerity *(oprechtheid)*	6, 30R, 54	
	Fairness *(eerlijkheid)*	12R, 36, 60R	
	Greed-Avoidance *(hebzucht-vermijding)*	18, 42R	
	Modesty *(bescheidenheid)*	24R, 48R	
	Emotionality *(emotionaliteit)*		
	Fearfulness *(zenuwachtigheid)*	5, 29, 53R	
	Anxiety *(angst)*	11, 35R	
	Dependence *(afhankelijkheid)*	17, 41R	
	Sentimentality *(sentimentaliteit)*	23, 47, 59R	
	Extraversion *(extraversie)*		
	Social Self-Esteem *(zelfverzekerdheid)*	4, 28R, 52R	
	Social Boldness *(vrijmoedigheid)*	10R, 34, 58	
	Sociability *(gezelligheid)*	16, 40	
	Liveliness *(levendigheid)*	22, 46R	
	Agreeableness *(meegaandheid)*		
	Forgiveness *(vergeveningsgezindheid)*	3, 27	
	Gentleness *(zachtheid)*	9R, 33, 51	
	Flexibility *(flexibiliteit)*	15R, 39, 57R	
	Patience *(geduld)*	21R, 45	
	Conscientiousness *(zelfbeheersing)*		
	Organization *(organisatievermogen)*	2, 26R	
	Diligence *(zorgvuldigheid)*	8, 32R	
	Perfectionism *(perfectionisme)*	14R, 38, 50	
	Prudence *(voorzichtigheid)*	20R, 44R, 56R	
	Openness to Experience *(openstaan voor ervaringen)*		
	Aesth. Appreciation *(esthetische waardering)*	1R, 25	
	Inquisitiveness *(nieuwsgierigheid)*	7, 31R	
	Creativity *(creativiteit)*	13, 37, 49R	
	Unconventionality *(onconventionaliteit)*	19R, 43, 55R	

Appendix F – IPQ Scoring Keys

Dutch IPQ Item

	#	IPQ	Dutch question	
	1	G1	Ik had het gevoel aanwezig te zijn in de computerwereld	
	2	SP1	Ik had het gevoel omgeven te zijn door de virtuele wereld	
	3R	SP2	Ik had het gevoel slechts plaatjes te aanschouwen	
	4R	SP3	Ik had niet het gevoel in de virtuele ruimte aanwezig te zijn	
	5	SP4	Ik had meer het gevoel bezig te zijn in de virtuele ruimte, dan dat ik het gevoel had iets van buitenaf te bedienen	
	6	SP5	Ik voelde me aanwezig in de virtuele ruimte	
	7	INV1	Hoe bewust was u zich van de echte omgeving (bv. geluiden van buiten, kamertemperatuur), terwijl u zich bevond in de virtuele ruimte	
	8	INV2	Ik was me niet bewust van mijn echte omgeving	
	9R	INV3	Ik lette nog op de echte omgeving	
	10	INV4	Ik ging volledig op in de virtuele wereld	
	11	REAL1	Hoe echt kwam de virtuele omgeving op u over	
	12	REAL2	In hoeverre kwam uw ervaring in de virtuele omgeving overeen met uw ervaringen in de echte wereld?	
	13	REAL3	Hoe werkelijk kwam de virtuele wereld op u over	
	14	REAL4	De virtuele wereld kwam echter op mij over dan de werkelijke wereld	