INTRODUCTION

The possible use cases for virtual reality (VR) in disciplines beyond the scope of entertainment and gaming have been been under investigation for many years. Long before the myriad of technological advancements that birthed the Oculus Quest and Valve Index, scholars were beginning to recognize VR's potential to enhance numerous industries, including education, skills training, and psychological therapy. In 1995, a group of academics at Emory University published the first-ever controlled study on VR's efficacy as a treatment protocol (Rothbaum et al., 1995). The study compared the effect of a seven-session therapy program for acrophobia conducted in a virtual environment (VE) to a control group which received no treatment. Indeed, despite the 1990s' most prominent VR systems lacking the visual specifications and degrees of interactivity expected in the modern era, the 12 students who received VR exposure therapy (VRET) reported decreases in anxiety and avoidance of heights.

Over the next two decades, exploration of VR's viability in the treatment of psychiatric disorders became significantly more prevalent. A 2017 literature review referenced over 100 studies that presented evidence of VRET assisting patients in overcoming post-traumatic stress disorder, social anxiety disorder, panic disorder, and isolated phobias (Maples-Keller, Bunnell, Kim, & Rothbaum, 2017). The analysis conducted in such studies has historically indicated that VRET performs on par with traditional *in vivo* practices (Powers & Emmelkamp, 2008). Furthermore, in rare cases, VRET was determined to have outperformed conventional therapy methods, such as a 2002 study conducted on acrophobia patients (Emmelkamp et al., 2002).

In addition to exposure therapy, scholars and organizations have begun experimenting with VR-based learning at various levels of education. In 2016, two corporations in Beijing collaborated on a study that used VR to teach astrophysics to high school students (Beijing Bluefocus E-Commerce Co., Ltd & Beijing iBokan Wisdom Mobikle Internet Technology Training, 2016). Of the ten participants in the VR test group, nine scored 80% or higher on their first post-VR examination. In contrast, six of the ten students in the control group failed to score 80% on their first post-lecture examination. The average score on this initial examination for the VR test group was 93%, compared to merely 73% for the control group. Furthermore, both test groups wrote a retention examination two weeks later; the VR group's average score was 90%, while the control group's average score was just 68% (Ibid.). As well, several universities have adopted VR into their arsenal of instructional media. For example, the University of Westminster designed a VE for criminal law students, enabling them to physically search for clues in a virtual murder case rather than being forced to simply role-play (VIAR, 2020). As well, the Mendel Grammar School in Opava City, Czech Republic teaches its biology students about the anatomy of the human eye through an Oculus Rift experience.

In subsequent sections of this article, we discuss features of VR systems and experiences that are hypothesized as contributing factors to the technology's multidisciplinary potential. We present formal definitions for several terms that pertain to the mechanism by which VR is believed to affect the subconscious. Next, we explain the difference between *senses* and *sensory inputs*, and propose a VR-specific definition for *immersion* that is predicated on sensory inputs. Furthermore, we discuss three subconscious phenomena, *place illusion* (PI), *plausibility illusion* (PSI), and *embodiment illusion* (EI), addressing the elements of VR environments and systems that cause them to develop, and their subsequent contributions to the sensation of *presence*. Finally, we provide insight into the role of presence in VR's efficacy as an educational and therapeutic tool.

BACKGROUND

It is clear that VR demonstrates extensive potential as an instructional and therapeutic tool, but why, exactly, is this the case? For one, there are numerous advantages for VR with respect to practicality. VR's ability to synthesize visual, auditory, and haptic stimuli enables construction of essentially any environment. As a result, VR is a cost-effective solution for situations where *in vivo* exposure is impractical or impossible, such as historical sites and outer space for students, or airplane travel for aviophobic patients (Majumdar, 2019). Next, in contrast to conventional teaching methods, which only supply two dimensions of spatial projection, VR is able to effectively display three-dimensional concepts. For example, our research team previously explored the use of VR as an instructional tool for Karnaugh map (K-map) simplification. Participants in this study responded favourably to both the use of VR as a solution space and the representation of the K-map as a three-dimensional toroid object, as opposed to the traditional two-dimensional table (Norton, Sauer, & Gerhard, 2020). Furthermore, VR's capacity to simulate dynamic object interactions is unparalleled among modern technology. This is an especially powerful argument for VR's viability in practical training, as it enables individuals to develop skills in a controlled setting that can be applied to dangerous or high-pressure scenarios. In the spring of 2020, for instance, the University of Saskatchewan began developing a VR experience to prepare nursing students for anxiety-inducing situations in clinical training. Dr. Don Leidl of the university's College of Nursing noted that, due to the prevalence of distressful or life-threatening scenarios, "the clinical environment itself [is] a barrier to student learning" (Saskatchewan Health Research Foundation, 2020). The College thus intends to simulate a mental health clinic in order for its students to gain experience completing mental health evaluations and suicide risk assessments.

Multisensory stimuli, three-dimensional imagery, and interactive potential have not only assisted in identifying specific use cases for VR; they are also frequently discussed in the context of beneficial psychological effects that VR can precipitate (Hofer et al. 2020). These three aspects relate to the well-documented concepts of *immersion* and *presence*, and much of VR's potential efficacy as an instructional tool arises from these concepts. There are numerous definitions of these terms in the academic world, but most scholars use them in relation to the experience of physical and psychological involvement in the VE rather than the real world (Parsons, 2015). The user is likely to experience presence if they are immersed in a VE, meaning that real-world inputs to sensory processing systems are replaced with virtual stimuli, and these stimuli conform to the user's expectations of reality (Sanchez-Vives & Slater, 2005). Presence encompasses a subconscious interpretation that the overall VR experience is reality, which causes the user to respond to the virtual stimuli authentically; that is, based on the notion that the stimuli incur real consequences.

The ability of well-constructed VR experiences to positively manipulate the subconscious is the predominant reason why VR demonstrates multidisciplinary potential, especially as a therapeutic tool. In the Pavlovian model for classical conditioning, the individual experiences the synthesis of a conditioned stimulus (CS) and an unconditioned stimulus (UCS), and subconsciously develops a fearful response (CR) associated with the CS (Myers & Davis, 2006). For example, an individual may initially view the unfinished basement of their home as benign, but if they witness the presence of raccoons in their basement, then they may become fearful and reluctant to enter it. The individual has developed an aversive response to an environment because they now associate said environment with a dangerous creature, despite the environment itself being safe. In order to treat this new phobia, it is necessary to re-condition the subconscious, as this is where phobias are formed (Shrivastava, 2017).

In many cases, systematic and prolonged confrontation of feared stimuli can reduce anxiety, aversion, and avoidance, which is why the popularity of *exposure therapy* has increased in recent years (Kaplan & Tolin, 2011). The practical advantages of VR in exposure therapy were previously discussed, but its psychological capabilities are much more significant. As mentioned in the previous paragraph, presence causes users to accept the VE as reality and behave authentically as a result. Presence requires a sustained assumption that consequences of actions carried out in the VE will manifest in reality; this phenomenon is described by Slater (2009) as *plausibility illusion* (PSI). If PSI is maintained by the user throughout a VRET session, then similar benefits to *in vivo* exposure therapy are experienced. The user associates the VE with reality, behaves as they would in reality, and subconsciously applies these behaviours and strategies to future real-world experiences. Therefore, VR's potential as an educational and therapeutic tool does not arise merely from practicality; rather, the technology's ability to positively manipulate the subconscious is its predominant advantage.

METHODOLOGY

It is, at this point, widely accepted that VR demonstrates efficacy as a tool for numerous situations in which knowledge is acquired subconsciously. As a result, research into VR's multidisciplinary potential has deviated away from specific use cases, and gravitated towards the underlying psychological mechanism that enables VR to be efficacious. Slater's paper on immersion, sensorimotor contingencies, place illusion, and plausibility (2009) is perhaps the most notable attempt at uncovering this mechanism;

within Slater's work, several examples of both system and experiential characteristics that strengthen the sensation of presence are outlined.

It is necessary for developers and scholars focused on VR's interdisciplinary efficacy to understand, at a conceptual level, the VR-inducing psychological effects that are believed to positively affect VR users' subconsciouses. We believe that the Slater (2009) framework, as well as followup studies related to this framework, contains valuable knowledge and insight into the psychology of VR, specifically due to its explanation of place and plausibility illusion. However, there exists no subsequent literature that provides an all-encompassing association between VR system characteristics, intermediate psychological illusions, and the overall sensation of presence. We argue that this literature would be a significant enhancement to future research regarding VR's multidisciplinary potential, as it could eventually lead to the establishment of development practices for eliciting the aforementioned psychological responses from users. Thus, this paper is structured as a meta-analysis of academic literature that pertains to the relationship between immersion, the replacement of a sensory input with a virtual stimulus, and presence, the subconscious interpretation that a VR environment is reality.

CLARIFYING THE DEFINITION OF IMMERSION

Prior to defining immersion itself, we must first clarify the difference between a *sensory input* and a *sense*. The term *sense* is traditionally used in the context of five ubiquitous methods of perception: smell, touch, taste, hearing, and vision. This classical definition is unsuitable for VR, as it fails to encompass the intricacies of each sensory processing system, and omits additional senses such as balance and proprioception. Thus, we believe the term *sensory input*, which refers to any measured quality or quantity relayed to the brain by a sensory organ, to be more pertinent. For instance, if one perceives that an object is blue, then the sense is vision, but the specific sensory input is colour. Similarly, if one burns their finger by touching the stove, then the sense is touch, and the sensory input is pain. Sensory inputs can therefore be treated as sub-classes of the overarching sense to which they relate.

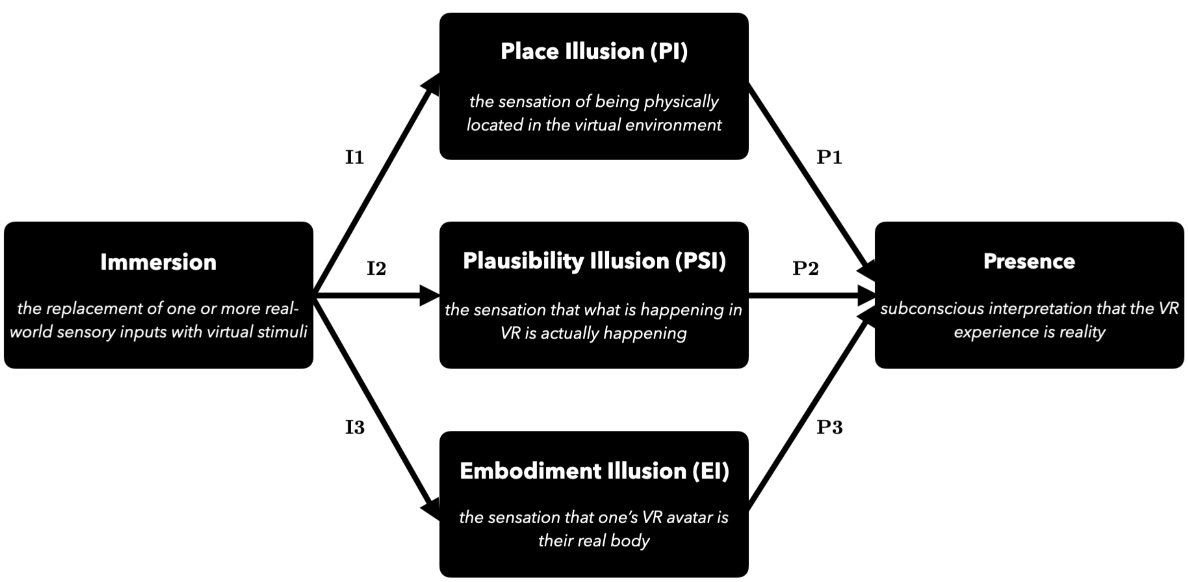
We define *immersion* as the replacement of a sensory input with a virtual stimulus. Any VR system with visual and audio output is immersive with respect to certain visual and auditory inputs. Immersion is sometimes believed to be a psychological illusion that is integral to the user's ability to subconsciously learn from a simulation (Parsons, 2015). However, Slater (2009) writes that presence is a more appropriate descriptor for this phenomenon, and that immersion is merely a sensory experience which contributes to presence. Presence may be observed through a variety of psychological effects, including time dilation, reduced self-awareness, intense emotional responses, sustained focus on the simulation, and perception of control over the activity (Visch, Tan, & Molenaar, 2010; Nordin et al., 2013; Michailidis, Balaguer-Ballester, & He, 2018). These effects can occur as a consequence of being immersed, but immersion itself simply describes a system's characteristics; namely, parameters that determine the quality of a simulation (Slater, 2009). The actual illusion of reality, from which the aforementioned effects arise, occurs due to presence. The magnitude at which presence is experienced is dependent on the similarity of the VE to a real setting. However, regardless of this similarity, the very existence of a VE indicates that the user is immersed, as the VE is substituted for the real world as the primary stimulus for the visual processing system. Thus, we treat immersion as a binary concept of sensory input replacement, which is merely an input variable impacting the overall state of presence.

Note that the term *immersion* is also prevalent in psychological contexts with tangential similarity to presence, such as flow states and emotional investment in media. These interpretations, although perhaps valid in non-VR contexts, are incompatible with our aforementioned definition. For example, Visch, Tan, and Molenaar (2010) discuss immersion in relation to the experience of viewing a compelling film. They explain that, despite the events of a film being fictional, many can create an illusion of reality, which assists in provoking intense emotions such as fear, joy, and sympathy. Lee (2006) suggests that a crucial element in developing a sensation of presence in a virtual medium is losing awareness of the medium itself. To corroborate this claim, Visch, Tan, and Molenaar (2010) argue that the emergence of vivid emotional responses to a film's subject matter represents "immersed viewers [experiencing] the [film's] virtual world as immediate and present." In a similar vein, the word *immersion* is used to describe the phenomena of "losing touch with reality" (Liao, 2017). Liao asserts that individuals immersed in an experience cease attending to cognitive states that typically motivate behaviour. Instead, they ignore these pretences and instinctively respond only to stimuli presented by the experience. Liao (2017) further notes that, in order to achieve this type of immersion, neither conscious behaviour arising from said instinct nor imagination is necessary. Based on this interpretation, it is possible to "immerse" oneself in a compelling novel, film, or make-believe game. Our definition of immersion, however, can only be experienced in simulations where sensory inputs are directly replaced with virtual stimuli. Likewise, presence can only occur in VR or the real world, as it requires the user to interpret the environment as a physical location (Slater, 2009).

THE IMMERSION-PRESENCE RELATIONSHIP

Immersion occurs when at least one sensory input is entirely represented by virtual stimuli. Modern VR systems predominantly immerse ocular sensory inputs, but with current technology, it is possible to immerse certain auditory and haptic sensory inputs as well. In accordance with Slater terminology, we identify three key components of presence: *place illusion* (PI), *plausibility illusion* (PSI), and *embodiment illusion* (EI). The respective intensities of these illusions, indicated by the hypothetical relationships I1, I2, and I3, are determined by the quality, accuracy, and authenticity of the immersive stimuli. Furthermore, three positive correlations P1, P2, and P3 describe the impacts of the three illusions on presence. As exposure to seemingly real scenarios enables individuals to combat their maladies and re-condition their subconsciouses, users can begin to benefit from VR when presence occurs (Myers & Davis, 2006). We argue that it is for this reason that VR demonstrates potential in the disciplines of teaching, training, and therapy. The remaining arguments of this paper are asserted based on the flowchart pictured in Figure 1, which represents a hypothesized progression from the initial introduction of virtual stimuli (immersion) to the developed sensation of presence.

Figure 1 – A flowchart detailing the proposed mechanism by which presence occurs, beginning with immersion and extending to three intermediate subconscious illusions



Place Illusion

Immersive systems can be distinguished from one another by the *sensorimotor contingencies* (SCs) that they support (Slater, 2009). SCs are defined as actions conducted by an individual resulting in perception of the environment; for example, smelling the air, touching an object, rotating one's head, or even passively examining an object with one's eyes. A particular SC is said to be supported in a VR experience if it is represented by a *valid action* (VA). In order for an action to be valid, it must either elicit an appropriate change in perception to the user, or update the environment accordingly (Slater, 2009). Consider the case of a VR user rotating their head to the left. If the view of the HMD is updated accordingly, then the action correctly changes the user's perception. Similarly, if the orientation of the user's virtual avatar is updated, then the action appropriately alters the VE. If either condition is true, then the SC of rotating one's head is adequately supported with a valid action.

Place illusion (PI) is the sensation of being located within the VE rather than reality. Slater (2009) uses the terms *place illusion* and *presence* synonymously, but per our definitions, PI refers only to a physical illusion, while the all-encompassing phenomenon of presence occurs on physical, psychological, and physiological levels. Note that PI neither represents a conscious belief that the VE is reality, nor requires this belief in order to be maintained. Rather, PI occurs on a subconscious level, and often provokes behaviours which contradict the user's ability to distinguish the VE from reality (Slater, 2009). The intensity at which PI can be sustained in an immersive experience is dependent on the range of SCs that the experience supports. A greater number of supported SCs creates the potential for stronger PI and, by extension, stronger presence. For example, an immersive experience is more likely to induce PI if it is played on a system that enables body translation and user-object interaction, rather than a system that only enables head rotation (Bozorgzadeh, 2018). Similarly, consider the difference between a VR system and a wall projector once again. In addition to the previously mentioned immersion class disparity, a VR system's stereoscopic display allows it to accurately support the SC of merely looking ahead, while the imagery of a typical wall projector is insufficient. The findings of several studies indicate that stereoscopy enhances the sensation of presence, as it better simulates environments interpreted by the brain's visual cortex as three-dimensional (Hendrix & Barfield, 1996; Freeman, Avons, Davidoff, & Pearson, 1997).

Further demonstrating the distinctive psychological effects of VR is the assertion that, if PI is purely based on the simulation of normal perceptive actions, then it cannot occur in lower-order systems such as desktop computers (Slater, 2009). It is certainly possible to create an immersive desktop environment, as this simply requires simulating a sensory input with appropriate virtual stimuli. However, the sensorimotor knowledge necessary to perceive this environment is vastly different from real 3D space (Noë, 2004). Rather than tilting one's head, for example, the user must rotate a joystick or press a specific key to look left or right. A disparity of such significance affects the ease and extent to which a user can experience presence in a lower-order system:

> In the case of a highly immersive system, the qualia of "being there" is a direct illusion of the same type as many visual illusions –it just happens without trying or doing anything special, as soon as the participant enters the environment and especially as soon as they move. In the case of a desktop system the situation is quite different; the feeling reported as "being there" if it comes at all is after much greater exposure, requires deliberate attention and is not automatic. (Slater, 2009)

To summarize, PI refers to a subconscious interpretation of the virtual environment as a physical space, and a subsequent sensation of being located in this environment rather than the real world. The strength of PI is contingent on the amount of sensorimotor contingencies supported by the VR system and the immersive environment itself. Thus, a positive correlation I1 is hypothesized, with the SCs supported by the immersive system as the independent variable, and the intensity of PI as the dependent variable.

Plausibility Illusion

Prior to discussing the second illusive state induced by VR, it must be reiterated that PI describes the manner in which the overall VE is perceived, but not the elements of the VE themselves. The subconscious interpretation that specific events in the VE are real occurrences is a separate phenomenon, which constitutes the majority of the psychological aspect of presence. Plausibility illusion (PSI) is the sensation that the events occurring in the VR experience are genuinely happening; in other words, PSI is a latent association of virtual animations with real events (Slater, 2009). In similar fashion to PI, PSI can exist regardless of the user's conscious analysis of the VE. Note that PSI can develop from the direct agency of the user, but is not dependent on it. Additionally, PSI can occur from both user-initiated events on the environment, such as smashing a piece of glassware on the ground, and environment-initiated events on the user, such as a non-playable character interacting with the user. Two previous studies explored the latter case; the VR experiences featured a virtual female character who instigated conversation with male participants of varying social anxiety. In both cases, participants commonly reported a heightened sense of connectedness to the VE when the character was present (Pan & Slater, 2007; Pan et al., 2012). Essentially, the interpreted realism of a VE is enhanced when its elements address the user regardless of the user's provocation (Slater, 2009).

Nonetheless, situations whose responses are contingent on direct interaction from the user are crucial in maintaining PSI. These situations provide empirical evidence for a potential explanation of VR's effectiveness in therapy and skills development. For example, consider a VR environment where the user must traverse from one side of a narrow ledge to another, with the ledge surrounding a pit. A study conducted for this exact situation found that the vast majority of participants carefully maneuvered around the ledge, despite there being no legitimate danger in crossing the virtual pit directly (Slater, Usoh, & Steed, 1995). In circumstances such as this, PSI is reinforced by the formation of a cause-effect relationship in the user's subconscious (Slater, 2009). The VR experience conditions the user to believe that an action conducted within said experience (walking off of the ledge) will trigger a consequence in reality (serious injury). Ergo, the user exhibits a fearful response followed by cautious behaviour, and as mentioned previously, such authenticity is indicative of presence within the VE.

We previously explained the I1 correlation between supported SCs and place illusion. Is there a similar variable influencing the intensity at which PSI is experienced? Several studies have discussed the relevance of user- and environment-initiated actions as contributing factors, in addition to appropriate visual effects such as shadows and reflections (Pan & Slater, 2007; Pan et al., 2012; Slater, Khanna, Mortensen, & Yu, 2009). However, each of these metrics differ from SCs in two critical areas, as they are neither discrete nor quantitatively measurable. Instead, the credibility of objects and occurrences within the VE are analyzed with reference to a spectrum of realism. Slater et al. (2006) clearly asserts that PSI does not require such realism in order to be formed and sustained; in their study, participants expressed anxiety upon causing harm to a VR character, despite said character merely possessing low-fidelity humanoid features. Thus, an alternative metric unrelated to objective realism must be devised for the I2 correlation between immersion and PSI.

Consider a VR experience which situates the user atop a tall building, allowing them to walk along a wooden plank overlooking the city. If a physical plank is registered with the virtual plank in the VE, then the experience induces PI and PSI. PI occurs due to the sensorimotor contingency of stepping onto the wooden plank being supported with a VA, while PSI occurs due to an intense anxiety response upon assessment of a seemingly perilous situation (Meehan, Insko, Whitton, & Brooks, 2002). However, immediately upon stepping off of the plank, PSI is broken, as the user usually does not fall in reality. Even if the user does fall, PSI is broken upon impact with the ground, as since they have fallen no more than one foot in actuality, they do not suffer the critical or fatal injuries that would be expected from a multiple-story fall. Slater (2009) notes that PI can often be recovered if the user simply ignores SCs that break it, but that PSI is unlikely to be recovered if it is broken. PSI breaking causes the user to cease subconscious acceptance of an event as "real", and this illusion of reality usually cannot be re-formed. It is thus equally important to ensure that PSI can be *sustained* throughout a VR experience, as opposed to simply being *maximized*. Consequently, we conclude that a VR experience's ability to both maintain the illusion of cause-and-effect and respond in an appropriate manner when provoked by the user is the predominant contributor to PSI and psychological presence.

Plausibility illusion refers to the user's subconscious interpretation that events in a VR experience are legitimately occurring. PSI develops if the VE both engages the user and responds to them in a manner paralleling reality. It also occurs when the user instinctively associates actions in the VE with consequences in reality, and is strengthened if this perception is sustained throughout the experience. Thus, a positive correlation I2 can be formulated on a theoretical basis; the overall authenticity of a VR experience's events and interactions is the independent variable, and the extent to which PSI is experienced is the dependent variable.

Embodiment Illusion

Earlier in this paper, presence was separated into three illusions: one primarily physical (PI), one primarily psychological (PSI), and one primarily physiological. The physiological illusion refers to the user's interpretation of their avatar within the VE. Slater (2009) describes the subconscious analysis of a virtual avatar as a synthesis of PI and PSI; the former occurs if the user is able to observe the existence of an avatar, while the latter occurs if the avatar responds to the actions of the user's real body. However, the user is additionally likely to experience a sense of ownership over their virtual avatar, which differs from PI and PSI, as it relates to the presentation of the user rather than the VE. This sensation occurs intuitively, and can exist despite the user consciously understanding that the avatar is not their real body. No distinctive terminology was assigned to this façade at the time, but based on external resources as well as Slater's own future research, the ideas are consistent with the concept of *embodiment illusion* (EI) (Pyasik, Tieri, & Pia, 2020; Gonzalez-Franco & Peck, 2018; Maselli & Slater, 2013). EI is the sensation that the body has been replaced by an avatar, both in physiology and functionality.

Gonzalez-Franco and Peck (2018) explain that EI is contingent on numerous factors, such as parallelism between real and virtual visuo-tactile stimuli, synchronized movement between the body and avatar, and the avatar's external appearance. Visuo-tactile stimuli can enforce the illusion of ownership over specific body parts. For example, the user may subconsciously associate their virtual hands with their real hands if they grab a real object that is appropriately tracked in the VE. Next, synchronous movement of the body and avatar, as well as voluntary control over such movement, can increase EI by creating an illusion of agency over the avatar (Kokkinara & Slater, 2014). Furthermore, numerous studies have demonstrated that human-resemblant avatars, regardless of consistency with gender or race, tend to enhance EI (Pyasik, Tieri, & Pia, 2020). EI is thus a complex physiological phenomenon requiring sustained sensations of ownership, agency, motor control, and physical resemblance.

The factors influencing the intensity of EI are difficult to quantify. In theory, VR experiences could be rank-ordered based on their avatar-related software and hardware elements, in a similar vein to the immersion classes framework for SC support. However, the overall performance of these elements with respect to synchronization of the real body and virtual avatar must be analyzed on a per-interaction basis. Regardless of the extent to which the body is simulated, EI is extremely difficult to maintain if the avatar behaves incorrectly at any moment. Inverse kinematics (IK) is perhaps the most notorious culprit in this circumstance, as improper arm behaviour is a strong disturbance to embodiment (Parger, Mueller, Schmalstieg, & Steinberger, 2018). The participants of a study on the novel IK system built by these four individuals consistently preferred that no arms be displayed if the IK estimations were inaccurate.

Therefore, a dilemma arises in the decision about how to evaluate EI. It is evident that the potential for EI can be enhanced by the capabilities of the VR system. However, due to the ubiquitousness of motion and interaction within VR experiences, these elements must perform properly in order for said potential to be realized and maintained. In a similar vein to PSI, EI is unlikely to recover if it is broken. As evidenced by the results of the Parger et al. (2018) study, it may be prudent to omit a specific feature from a VR experience if said feature is likely to break EI. Consequently, it appears appropriate to prioritize both the stability and intensity of EI.

Overall, embodiment illusion refers to the subconscious sensation that a virtual avatar has physiologically replaced one's real body. EI is strengthened by the synchronization of virtual-avatar movement with real-body movement, the user's perception of agency, and the authenticity of the avatar itself. A positive correlation I3 can thus be hypothesized between immersion and EI, with the accuracy of system elements related to the avatar as the independent variable, and the extent to which EI is experienced as the dependent variable.

Illusions and Presence

In the previous three subsections, three correlations I1, I2, and I3 between immersive systems and intermediate illusions were proposed and explained. Still undiscussed, however, are the relationships between said illusions and the overall phenomenon of presence. These relationships are predicated on a simple conjecture: VR experiences capable of maintaining intense levels of PI, PSI, and EI enable the user to develop an unparalleled sensation of presence. In other words, if the user senses that they are located in a VE, interprets that the events in the VE are actually occurring, and associates the virtual avatar with their real body, then they subconsciously conclude that the VE is reality (Slater, 2009). As a result, positive correlations P1, P2, and P3 are predicted between the three intermediate illusions and presence.

However, these correlations differ in two crucial areas: areas of consideration for the independent variables, and extent of their individual effect on presence. Since PI can usually be recovered after it is broken, its intensity is the predominant factor for the potential to experience presence. However, both intensity and sustenance must be considered for the P2 and P3 relationships, as PSI and EI are unlikely to recover if they are broken. Slater (2009) acknowledges that PSI is significantly more difficult to achieve and maintain than PI, and also distinguishes the former as a cognitive illusion, while the latter is merely a perceptual illusion. Likewise, the writings of Gonzalez-Franco and Peck (2018) indicate that EI can also be considered a powerful cognitive illusion. It was previously explained that PSI and EI further differ from PI with respect to the user; PI encompasses the perceived legitimacy of the VE itself, while PSI and EI pertain to the user's connectedness with the VE. As noted by Hofer et al. (2020), numerous prior studies describe an often-strong correlation between the perceived *realism* of a VR experience (which creates this sense of connectedness) and presence. For these reasons, the P2 and P3 relationships may have a larger impact than the P1 relationship on presence. We recommend that future investigations in this area utilize VR experiences with stimuli affecting all three intermediate illusions. Additionally, it is likely prudent for post-VR questionnaires in these studies to inquire about specific feelings and sensations related to the three illusions, as well as the overall experience of presence.

CONCLUSION

Presence itself can be observed qualitatively through questionnaire responses and simple observation of the user's behaviour. For example, Slater (2009) discusses a self-explanatory concept called *response-as-if-real* (RAIR), which is often obvious depending on the occurrences within the VE. Consider the example of a VR experience where debris hurtles towards the user's head; if the user is experiencing presence, then they are likely to perform the RAIR of ducking to avoid this debris. Similarly, if the user is experiencing presence in the narrow-ledge environment described previously, then they are likely to perform the RAIR of moving slowly and cautiously. The user interprets both VEs as real settings with potentially dire consequences for unwise decisions, and instinctively attempts to protect themselves. In other words, the user subconsciously develops an aversive response to a situation that they interpret as being dangerous, which parallels the aforementioned process of Pavlovian classical conditioning (Myers & Davis, 2006). As well, recall the rationale behind exposure therapy: confrontation of challenging or fear-inducing situations often reduces anxiety and aversion (Kaplan & Tolin, 2011). If immersive VR experiences can evoke phobic behaviours, then these experiences must be valid candidates for exposure therapy, as exposure therapy re-conditions the subconscious from which these behaviours originate.

Furthermore, VR's potential effectiveness as an education tool also arises from its ability to convey presence-inducing environments. Individuals can undergo training or receive instructions within a VE and immediately apply their skills in an environment that they interpret as reality. This process aligns with the framework of *experiential learning*, which involves four sequential steps of abstract conceptualization, active experimentation, reflective observation, and reinterpretation (Kolb, 1984). If a sufficient degree of interactivity is provided in the VE, then the learning experience becomes personal. This enables the user to evaluate their ideas and understanding in real time and instantly receive feedback; depending on the suitability of the VE's responses, beneficial habits and tendencies can be formed (Jantjies, Moodley, & Maart, 2018). In addition, the inclusion of failure conditions within these experiences provides opportunities to practice and prepare for adverse circumstances, which is often impossible in real-world scenarios. Enabling accidental ignition of a fire in a laboratory environment, for example, can allow the user to develop coping strategies which may prevent panic responses from occurring in reality. Thus, VR's alignment with the experiential learning paradigm, which originates from the sensation of presence that it produces, enhances its viability as an instructional tool.

The previously-discussed practical advantages cannot be ignored; complete circumvention of danger, cost-effectiveness, and three-dimensional imagery enables scholars to identify numerous specific use cases for VR. However, the process of subconscious stimulation, which originates from immersion, impacts the three intermediate illusions, and culminates in presence, is the predominant reason why VR demonstrates potential in educational disciplines. If the stimuli within an immersive VR experience is able to produce sensations of physical location within the VE, agency and connectedness to the events of the VE, and identification with the virtual avatar, then the user interprets the VR experience as reality. These elements comprise the sensation of presence, which causes the user to respond to the VR experience authentically, and enables the formation of beneficial responses and subconscious instincts.

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