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**How Can Presence in Psychotherapy
Employing VR be increased?
Chapter for inclusion in:
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Abstract. Virtual Reality (VR) technology has been effectively implemented in psychotherapy as an alternative to exposure. Yet, as with any other treatment, efficacy varies among clients. One of the parameters that has been suggested as increasing treatment efficacy is presence. "Presence" is the subjective experience that the client/subject feels as if s/he is "in" the situation even though it is not real. Presence is influenced by both personality and technological factors. This chapter will present a comprehensive review of studies examining variables impacting on presence, with the aim of elucidating the optimal VR user profile.

Keywords: Virtual Reality, Presence, Psychotherapy

1 Introduction

Virtual Reality (VR) has become an effective therapeutic tool as well as a viable alternative to various elements in traditional therapy, such as (but not limited to) exposure (Rothbaum et al, 2006). Since this is a relatively new technology, it is still uncertain which elements are necessary or significant to increase VR effectiveness. One of the most probable candidates is presence, especially for VR exposure. For example, for exposure to be effective, therapy must activate the fear structure and modify it. This necessitates a feeling of "being" in the VR exposure environment. Other usages of VR such as for eating disorders, sexual dysfunctions, etc., also require presence. However, little research has been done on presence's effects in treatment of psychological disorders beyond the realm of anxiety disorders.

2 Presence

Presence is the feeling or experience of "being" in the VR environment. Witmer and Singer (1998) define presence as "the subjective experience of being in one place or environment, even when one is physically situated in another" (pg. 225). Similarly, Nicovich, Boller, and Cornwell (2005) define presence as the subjective feeling of existence in an experienced environment. Sacau, Laarni, & Hartmann, (2008) term this spatial presence. They divide presence into two factors: a "physical or perceptual dimension",... "the sense of being physically located in a mediated space" which they term spatial presence and a "social dimension" "the perceived existence of others and the perceived possibility of interaction" which they term social presence (pg. 2256). This chapter will deal with spatial presence. Slater (2009)

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claims that presence is composed of two orthogonal components: the feeling of "being there" which he calls Place Illusion (PI) and the illusion that what is apparently happening is really occurring which he calls Psi. This is closely related to the plausibility of events and the appearances and properties of objects. Slater proposes that "If you are there (PI) and what appears to be happening is really happening (Psi), then this is happening to you! Hence you are likely to respond as if it were real." (pg. 3554). Casati, and Pasquinelli, (2005) agree that the plausibility of events is more important than the exact photo-duplication of reality. "An interesting point here is the difference between a quest for realism and a quest for believability. Photorealism intends to approximate the model, the real world, in a very accurate way,...non-photorealism does not attempt to provide a "one-to-one" reproduction of the reality but is after creations that are believable, which include only those details, which are considered relevant or representative of the intention behind the model" (page 429-430).

However, Persky, Kaphingst, McCall, Lachance, Beall, and Blascovich, (2009) were unable to identify presence's influence on learning in VE. Price and Anderson (2007) failed to find a relationship between presence and treatment outcome, even though they found that presence contributed to the experience of anxiety in the virtual environment (VE) and was related to the phobic elements in this environment. Furthermore, although Krijn et al (2004) reported a significant difference between treatment drop-outs and completers on both presence and anxiety elicited in the VE, they found no treatment effects for those who experienced high presence VE (cave) versus those who experienced low presence VE (head mounted display). One possible conclusion suggested by these studies is that presence levels must be high enough to elicit anxiety, and maintain treatment adherence. However, beyond these minimal levels, further presence enhancement may not be necessary.

Research on the variables necessary to induce presence has been inconclusive. It is both theoretically and practically important to determine the critical elements that contribute to the sense of presence in VR (Banos et al., 2004). This chapter will summarize the existing literature on presence.

3 Variables which affect Presence

Possible "candidates" that may influence presence may be divided into three categories for ease of reference: technological variables (e.g. vividness of imagery), user variables (e.g. personality variables), and interaction variables (e.g. control over the environment) (Steuer, 1992).

3.1 Technological variables

There appears to be some disagreement in the field as to how dissimilar from the reality the VR environment may be, and still induce sufficient presence and success in therapy. In fact, "a person may experience a sense of virtual presence similar to the real world even when the virtual environment does not accurately or completely represent the real-world situation" (North, North, & Coble, 1996, pg. 161).

In earlier studies (Wallach, Safir, & Bar-Zvi, 2009a; Wallach, Safir, & Bar-Zvi, 2009b), subjects reported that VR environments containing elements discordant to their actual every day experiences, resulted in difficulties to immerse. Thus, we propose that VRE similarity to the real world is less important, than excluding discordant elements. People appear to be able to "fill in the gaps" in a VR environment, but may be unable to "erase" discordant elements. In a pilot study, Israeli combat soldiers from differing units viewed the Virtual Iraq environment. They tended to focus on discordant elements (difference in uniforms, weapons, vehicles, etc.) and were disturbed by them. Therefore, it is reasonable to hypothesize that presence is influenced by the existence of or lack of discordant elements in the VR environment. This is a novel question which we hope to examine in future research.

Casati, and Pasquinelli, (2005) present a convincing argument as to the importance of taking psychological sensation/perception theories into account. "It is not the fidelity to the real model (the world) that makes the synthetic environment looking and feeling real, but the fidelity to the perceptual conditions involved in the mental construction of perceived objects. This fidelity could be attained by taking into account the specific sensorimotor determinants of visual perception, or some higher level features such as object files. The believability of synthetic objects depends on the adequacy of the reproduction of the relevant aspects of the perceptual mechanism involved, and not on the realism of the reproduction of the stimulus" (page 435).

Therefore, if the sensory input from the VE is discordant in different sensory modalities, lower presence will be experienced.

Technological variables found to influence presence are vividness of imagery, consistency of sensory inputs, engagement of multiple senses, and obtrusiveness of medium.

Vividness of imagery, consistency of sensory inputs and engaging multiple senses. Vividness is defined as the degree of sensory richness in the Virtual Environment (Schubert, Friedman, & Regenbrecht, 2001). Sensorial breadth and sensorial depth of the stimuli are associated with vividness. These variables affect the involuntary attention the subject/client allocates to the virtual environment (Wirth et al., 2007). Sensorial breadth relates to the number of sensory dimensions that are presented simultaneously. As we have suggested, employing multiple sensory modalities increases presence (Schuemie, Van Der Straaten, Krijn & Van Der Mast, 2001). However, it is important that there is congruence between the different sensory modalities, otherwise using multiple modalities will result in less rather than more presence (Wirth et al., 2007). Sensorial depth relates to the degree of resolution in each sensory dimension (Wirth et al., 2007). Many factors impact on sensorial depth: detail, continuous versus discontinuous movements, update rate of the program, and stereoscopy. On the other hand, field of view and illumination of the real environment seem not to impact on presence (Schubert et al., 2001; Schuemie, et al., 2001; Steuer, 1992; Wirth et al., 2007). Vividness has been found to influence presence (Biocca, Kim, & Choi, 2001; Schubert, et al., 2001; Steuer, 1992). Of the various senses that are engaged, sight is the most important in influencing presence. This may be due to the fact that our visual cortex comprises 70% of our cortex (Park, Cho Hong, Kim, & Han, 2003).

Obtrusiveness of medium. Presence is increased using a VR helmet when compared with viewing images on a flat two-dimension television screen (Wiederhold & Wiederhold, 2005). However, a VR helmet which is cumbersome or uncomfortable reduces presence (Held & Durlach, 1992 in Witmer and Singer, 1998).

Two additional medium related variables that affect presence are transparency and continuity of the interface. Transparency is "the elimination of mediation: the lack of consciousnesses of the medium itself." Continuity is "lack of disruption during interaction. Disruption may occur when the user becomes overly aware of the medium and the physical interface." (Tang, Biocca, & Lim, 2004, pg. 1)

3.2 User variables

User variables which have been found to influence the experience of presence in Virtual Reality include: personality variables, cognitive abilities, level of anxiety, ethnicity, and gender.

Personality variables. Several personality variables have been examined in relation to the experience of presence. Variables that were found to be unimportant in inducing presence are: neuroticism, reactivity to reward and punishment, sensation seeking (Laarni, Ravaja, Saari, & Hartmann, 2004) and the Big Five personality traits (Sacau, Laarni, Ravaja, & Hartmann, 2005). For example, employing Big Five, Sacau et al (2005) predicted a correlation between openness to experience, agreeableness, and presence. They assumed that as creativity and a tendency to appreciate art is part of openness to experience, this would lead to an increased ability for visual imagination (which has an effect on presence). In addition, openness to experience is connected to absorption, which also is an important factor in presence. In addition, they assumed that obedience and trust, which are factors in agreeableness will increase presence, perhaps by neutralizing judgment. However, no correlation was found between openness to experience and presence, and the correlation between agreeableness and presence was very weak (0.17). Thus they concluded that the Big five does not significantly impact on presence. Other variables for which the picture is unclear include: introversion and extraversion (Laarni Ravaja, Saari, & Hartmann, 2004; Jurnet, Beciu, & Maldondo, 2005), absorption (Sas & O'hare, 2003; Murray, Fox, & Pettifor, 2007) and self-forgetfulness (Laarni et al., 2004; Ravaja et al., 2004). For example, Laarni, et al. (2004) found that extroverts experienced significantly more presence than introverts. They explain this results from extroverts being involved in more simultaneous external events than introverts. Thus they assumed that extroverts have greater ability to process many simultaneous stimuli. However, Jurnet et al, (2005) reported an opposite correlation – introversion, and not extroversion, correlated with presence. It is unclear why these two studies found such contradictory results.

Six personality variables were found to have a clear association with presence. These variables are; empathy, imagination, immersive tendencies, dissociation tendencies, locus of control and cognitive style. Attachment was examined in one study and was found to be associated with presence. Sensory processing is currently under investigation in our lab.

Empathy. Davis (1994) defines empathy as a set of constructs associated with responses of one individual to the experience of another. Empathy involves the ability to engage in the cognitive process of adopting another's psychological point of view, together with the capacity to experience affective reactions observed in others' experience. Nicovich, et al. (2005) assumed that empathy and presence use the same projective "tool set". They suggest that presence, like empathy, is a form of emotional projection. Thus, presence may be understood as an emotional connection to a place, as opposed to the cognitive recognition of being in a space. They propose that the emotional connection strengthens the bond between the subject and his/her virtual environment.

Nicovich, Boller, & Cornwell, (2005) found that as one's empathic ability increases so does his/her ability to experience presence ($R^2=.134$). Wickramasekera and Szlyk (2003) found a correlation between empathy and hypnotizability. Sas and O'hare (2003), using the Interpersonal Reactivity Index (Davis, 1980), found a significant correlation (.605) between empathy and presence among 15 subjects. As hypothesized, the Index's fantasy subscale had the highest correlation with presence (.753). In a previous study, (Wallach, Safir and Samana, 2009) we found a significant positive correlation between empathy and presence among subjects who were active in the Virtual Environment. Empathy correlated with presence in a simple regression (.40), and was the most important factor in a multiple regression ($\beta=.39$). Thus, empathy seems to be an important factor influencing presence, at least among those who are active in the VE.

Imagination. Mental imagery may be defined as an experience that significantly resembles perceptual experience, but which occurs in the absence of appropriate external stimuli for the relevant perception (Thomas, 1999). Sas and O'hare (2003) assumed that the ability to imagine, which was found to be related to hypnotizability (Laidlaw & Large, 1997) was related to ability to experience presence. Sas and O'hare (2003) examined the correlation between imagination and presence using Barber and Wilson's (1979) Creative Imagination Scale (CIS), a measure that assesses the ability to vividly imagine images and situations on demand. They reported a significant positive correlation (.721) between imagination and presence. In a previous study (Wallach, Safir, & Samana, 2009) a significant correlation between imagination and presence was found only among subjects that were inactive in the VE and thus experiencing a sensorial "deprived" VE. Based on Sas and O'hare's findings (2003), we had also predicted a correlation among active subjects who experienced the VE's full impact. However, one possible explanation of difference in outcome between these two studies may have resulted from the fact that the questionnaire they used is actually a measure of hypnotic susceptibility (Yu, 2005) rather than a measure of imaginative ability. Accepting Yu's critique, we choose to employ a measure of imaginative ability (Sheehan, 1967). Therefore, our study is actually the first to examine the correlation between presence and imagination. In addition, Sas and O'Hare employed a relatively primitive virtual environment, whereas we employed an advanced technological environment. Therefore, in our study, imagination was not important for subjects who experienced the full impact of the VE. However, subjects who were inactive, and thus experiencing an impoverished VE, resembled the subjects in Sas and O'Hare's (2003) study.

As previously stated in the section on technological variables, vividness has an impact on presence. Thus when the VE is rich, imagination has less significance as the subject does not need to employ imagination to experience the environment as convincing. However, when there are technological limitations, as in Sas and O'Hare's (2003) study, or when, as in our study, subjects limit their utilization of the technological capabilities, sensorial depth of the stimuli is decreased (Steuer, 1992), and it is necessary to employ imagination to fill in what is missing (Jacobson, 2001). This is also in accord with both Wirth et al.'s (2007) claim that "...spatial imagination becomes more relevant if the mediated representation of the space is less intuitive and more fragmented" (p. 502) and Lee's (2004) claim that when an environment is poor in sensorial stimuli, imagination can simulate the missing sensorial cues, thus creating a convincing sense of realism. However, it should be noted that these claims had not been experimentally tested in the context of VR.

Immersive tendencies. Immersive tendencies is a theoretical construct that relates to the tendency to behave playfully and to become involved in a continuous stream of stimuli. Unlike presence, this is a trait. Immersive tendencies appear to be related to cognitive and behavioral elements such as concentration, imagination and self-control (Psotka & Davidson cited in Kaber, Draper & Usher, 2002). Individuals who are high on immersive tendencies are able to ignore external distractions and focus on their virtual experiences so that they are unaware of their immediate environment and the passage of time. Such individuals tend to be playful, spontaneous, creative and imaginative (Webster & Martocchio, 1992; Newman, 2005), and to feel as if they are within video games they play (Witmer & Singer, 1998).

Witmer and Singer (1998) reported a significant positive correlation (.24) between immersive tendencies and presence. Johns et al. (2000) also reported a significant positive correlation (.86) between immersive tendencies and presence, but only within an environment that included factors that are thought to facilitate presence (for example: a multitude of sensorial information, adequate isolation from the outside world). Both Laarni, Ravaja, Kallinen, and Saari, (2005) and Laarni et al. (2004) using a different presence questionnaire found that immersive tendencies had a significant main effect in predicting presence. In a previous study (Wallach, Safir, & Samana, 2009), we also found a correlation between immersive tendencies and presence. However, although a correlation was found between immersive tendencies and presence in a simple correlation, immersive tendencies failed to play a major role in the multiple regression analysis. This may have resulted from the strong correlation ($r=.67$) between empathy and immersive tendencies, rendering immersion unimportant beyond empathy.

Dissociation tendencies. Dissociation may be defined as a disruption of the normally integrated functions of consciousness, memory, identity, or perception of the environment (Banos et al., 1999). Perhaps the ability to dissociate from the surroundings enables the person to "connect" to the virtual environment and thus experience presence. Banos et al., (2004) found a significant positive correlation between the tendency to dissociate and presence. However, this study is problematic as presence was measured by only one item. Murray et al., (2007), using a presence questionnaire that measures three aspects of presence also found a positive correlation (.308).. Murray et al.'s sample (2007) was composed of a non clinical pool of students. However, their average dissociation tendencies scores were high, equal to that of patient groups such as PTSD patients (Somer, Dolgin, & Saadon, 2001). Therefore Murray et al.'s results appear non representative of a normal population. In a previous study (Wallach, Safir, & Samana, 2009) we failed to find such a correlation. Thus, we hypothesize that only when dissociation tendencies levels are very high they correlate with presence.

Locus of control. Locus of control refers to the degree to which subjects feel they control events in their own lives, or that such events are influenced by external forces, chance or luck (Rotter, 1966). Murray et al. (2007) claim that people who feel they lack control over the events in their lives (those with external locus of control), should report a higher sense of presence in the virtual environment. In contrast, Witmer and Singer (1998) claim that one experiences greater presence the more control one has over the virtual environment, or over interaction within it (i.e. internal locus of control.). People who feel in control over events in their lives (internal locus of control) focus on elements they are able to control, in contrast with those who feel they lack control (external locus of control) who focus on elements they cannot control (Lefcourt, 1982). Witmer and Singer (1998) argued that "(a sense of) control... is essential for a strong sense of presence" (p. 239). Additionally, Hair, Renaud, and Ramsay (2007) found that a negative correlation exists between external locus of control and the ability to ignore distractions, an ability that is crucial in developing and maintaining presence (Wirth et al., 2007). Furthermore, Taylor, Schepers, and Crous (2006) found that the tendency to experience flow has a positive correlation with internal locus of control, while Jacobson (2002) stated that the feeling of presence can be conceptualized as a "flow experience".

Murray et al.,(2007) found a significant positive correlation (.218) between locus of control and presence. Wallach, Safir, & Samana, (2009) failed to find a significant correlation between locus of control and presence. However, locus of control was a significant predictive variable in the multiple regression analysis ($\beta = -.25$). In our multiple regression analysis, internal locus of control correlated positively with presence. These conflicting results may be explained by taking into account that our subjects scored significantly higher on the external scale than results reported in previous studies (e.g. Sun, 2005, Valecha & Ostrom, 1974). In addition,

Murray et al. (2007) used a brief presence questionnaire. The SUS includes only six items, none of which examine locus of control.

Cognitive style. The term cognitive style refers to the unique way in which unconscious mental processes are used in approaching and/or accomplishing cognitive tasks (Sas & O'hare, 2003), and in processing and reasoning information (Sacau, et al., 2008). Cognitive style is a combination of mental abilities (Sacau, et al., 2008). Sas and O'hare used Myers-Briggs Type Indicator (Myers & McCaulley, 1998) to assess the effect of cognitive style on presence. Both *Feeling* cognitive style and *Sensitive* cognitive style correlated with presence. Slater, Usoh and Steed (1994) examined the correlation between presence and the dominant representation among visual, auditory and kinesthetic systems. They found that both visual and kinesthetic dominance positively correlated with presence, while auditory dominance negatively correlated with presence.

Field dependency is a cognitive style that relates to the degree that a person is affected by the context of the surrounding perceptual field. In the VE, field-independents selectively attend only to relevant cues and fill in gaps in the information with previous knowledge. Thus, they are better at reorganizing and constructing the perceptual (VE) field. This should result in increased presence. Accordingly, Hecht and Reiner (2007) found that field dependency correlates negatively with presence. Perhaps this also is due to the high correlation between field dependency and simulator sickness and visual vertigo (Sacau et al., 2008).

Attachment style. Attachment style is closely linked with reaction to threat (Ainsworth, Blehar, Waters, & Wall, 1978; Mikulincer & Florian, 2000; Wegner & Smart, 1997). Individuals with a secure attachment style show balance between exploration and closeness. They may move from their attachment figure without being anxious or concerned about availability in time of need. They trust their ability to regulate distress and thus permit themselves to be exposed to new and sometimes threatening information (Bowlby, 1973; Mikulincer, 1997; Simpson, Rholes, & Nelligan, 1992). Therefore, they feel free to explore and engage in a novel situation, and would be expected to experience heightened presence in a VRE. In contrast, insecure attachment may lead to overestimation of potentially threatening elements when exploring the environment. These individuals may develop serious doubts about their ability to handle such threats, and serious doubts about the availability of their secure base when exploration becomes threatening, resulting in difficulty in exploring the environment (Mikulincer & Florian, 1998; Mikulincer, Gillath, & Shaver, 2002). Thus, insecure individuals would be less able to explore and to engage in a novel situation, experiencing lower presence in a VRE than secure individuals.

Attachment may be viewed as occurring along two continuous dimensions: anxiety and avoidance. The anxiety dimension reflects the degree of fear of being left without care and support of others, thus experiencing distress or anxiety. The avoidant dimension reflects the degree of lack of trust and emotional distance in interpersonal connections. Insecure attachment may result in high avoidance levels, high anxiety levels, or both. In times of stress, individuals high on avoidance remove themselves from the stressor cognitively or physically. Highly anxious individuals experience arousal of negative thoughts and emotions, and tend to focus on their distress. Those high on both avoidance and anxiety will experience the greatest difficulties as they both approach and distance themselves. Therefore, we propose that securely attached individuals will experience the highest levels of presence, and anxious-ambivalent individuals will experience lower levels of presence than securely attached individuals because of arousal of negative thoughts and emotions. Anxiety, unlike avoidance, may increase presence by increasing alertness to the surroundings. Thatcher, James and Todd (2005) found that anxious people report high levels of immersion. Since dismissing-avoidant individuals tend to remove themselves cognitively from new situations, we predicted that dismissing-avoidant individuals would experience lower levels of presence than anxious-ambivalent individuals. Finally, we predicted that fearful-avoidant individuals would experience the lowest levels of presence as they employ the most inadequate coping strategies.

To this date, we conducted the only study examining the relationship between presence and attachment (Wallach, Safir, & Almog, 2009). We found a negative correlation between avoidance level and the IC scale (measuring control and involvement) of the presence questionnaire. The higher the individual's score on the avoidance dimension, the less control and involvement he/she feels in the VRE. However, no significant correlation was found between anxiety and presence. When we examined the four attachment categories, we found a significant difference between them. If only the avoidant dimension was relevant, there would

have been no difference between the anxious ambivalent and the secure groups or between the dismissive avoidant and the fearful avoidant groups. However, correlations between anxiety and presence were not significant. Perhaps our manipulation, virtual flight experience, was not relevant or intense enough for significant differences to be found on the anxiety dimension. Also, unlike avoiders, who do not seek personal contact while dealing with discomfort but try to rely on themselves (Shaver & Mikulincer, 2002), anxious people tend to request help and "cling" while distressed. Thus, it may be that the presence of the researcher in the room acted as a mediator for reduced anxiety.

However, we did find that the level of presence was influenced by attachment category. As predicted, "secure" participants reported highest levels of presence, followed by "anxious-ambivalent", then "dismissive-avoidant" and finally "fearful avoidant" reported the lowest levels of presence in the VRE.

Sensory processing. Just as the sensory characteristics of technology affect presence, the individual's sensory processing style also affects it. Sensory processing relates to the way in which we interpret, organize, regulate and react to sensory stimulus (Royeen & Lane, 1991). Sensory processing has three components: 1. degree of attention we pay to the sensation; 2. regulation of the sensation; and 3. sensory integration, which affects the sensation and the response (Ayres, 1972). Sensory processing enables us to respond in an adaptive manner. Maladaptive processing can lead to difficulties in daily functioning, as well as inadequate interpersonal and cognitive development (Dunn, 1997; Tal-Saban, Yuchman, & Parush, 2002). People differ in the sensitivity of their sensory systems. Some are very sensitive and react to very low levels of stimuli (low threshold), while others need high levels in order to detect stimulus (high threshold) (Knickerbocker, 1980; Wilbarger & Wilbarger, 1991). People react passively, accepting the stimuli they experience (or lack of the experience), or actively – avoiding it (if it is too high) or seeking it out (if it is too low). Dunn (1997, 2001) integrated the threshold with behavioral response and created a model with four types: 1. Poor registration – High threshold and passive response. These individuals do not often notice daily sensory events, for example dirt on their hands. It is difficult to engage their attention, they react slowly to external stimuli, and a strong stimulus is necessary for them to respond. Therefore, they will experience low levels of presence; 2. Sensory seeking – high threshold and active response. These individuals actively seek out stimuli. They crave intensive sensory experiences, often to the point of endangering themselves (Dunn, 1997; Miller, et al., 2007). Therefore, in a virtual environment that enables them to actively seek stimuli, they will experience high levels of presence, but in an environment that is limited in the level of stimuli, they will experience low levels of presence; 3. Sensory sensitivity – low threshold and passive response. These individuals are very sensitive to sensory stimuli, are easily distracted, and have difficulty concentrating. They are jumpy, nervous, anxious, and have a hard time calming down. They react negatively to sensory stimuli (Brown, et al., 2001; Dunn, 1997, 2001). High anxiety increases presence. Likewise their reactivity to stimuli should increase presence. Therefore, sensory sensitivity should correlate with increased presence; 4. Sensory avoiding – low threshold and active response. These individuals attempt to reduce their sensations by avoiding various activities, or by using daily rituals designed to reduce sensations by providing a familiar set of stimuli (Dunn, 1997, 2001; Miller, et al., 2007). In a virtual environment that enables them to avoid stimuli, they should experience low levels of presence, however, if they cannot avoid the stimuli, they will experience high levels of presence in the environment.

Cognitive abilities. Cognitive abilities, such as performance on a cognitive task, require processing of information. It is probable that these abilities impact on presence. For example, memory and reasoning ability may increase comprehension of the plot of the media stimulus which may increase presence. Or, perhaps, strong spatial and psychomotor abilities render spatial scenes as more fluid thus increasing presence. Unfortunately, these hypotheses have not been empirically tested (Sacau, et al., 2008).

Level of anxiety. Environments that induce an emotional reaction result in higher presence levels than neutral environments. Banos et al. (2004) found that subjects in a sad environment rated presence higher than subjects in a neutral environment. Similarly, we may expect that level of anxiety will increase presence experienced in the VRE. Riva, Mantovani, et. al. (2007) found that the feeling of presence was greater in "anxious" VRE's, than in "neutral" or "relaxing" VRE's, and that the level of anxiety during immersion was influenced by the level of presence.

They manipulated the emotional content of the VRE using sound and music, shadows, lights and textures.

Robillard, Bouchard, Fournier, and Renaud (2003) found that phobics reported higher presence ratings for a VRE that contained elements relevant to their phobia, than non phobic subjects. Bouchard, St.-Jacques, and Renaud (2005) found that for snake phobics, knowing that the environment will contain snakes resulted in higher e presence ratings than those reported in a neutral environment. However, they found this correlation for verbal ratings of presence (on a one question rating scale), whereas the neutral environment induced higher presence ratings than the "frightening" environment on the full presence questionnaire. This raises questions about various presence questionnaire ratings, especially their validity. Schubert, Friedman and Regenbrechth (1999), using a VRE to induce fear of heights, found a significant correlation in non-phobic participants, between state anxiety (anxiety experienced during the immersion in the VRE) and presence, when they controlled for avoidance and trait anxiety. Similarly, Riva, Mantovani, et. al. (2007) reported that the feeling of presence was greater in "anxious" VRE's, than in "neutral" or "relaxing" VRE's, and a correlation between level of anxiety during immersion and level of presence. They manipulated the emotional content of the VRE using sound and music, shadows, lights and textures. However, only one study examined the correlation between presence and both anxiety prior to immersion, as well as anxiety during immersion. Employing phobic subjects, Price and Anderson (2007) found that anxiety prior to immersion in the VRE increased presence ratings, which in turn increased the anxiety experienced in the VRE. They also found a significant correlation between the number of phobic elements in the VRE and presence ratings.

These five studies demonstrate that individuals who experience high levels of anxiety (i.e. phobics) experience higher levels of presence than non phobic individuals, and they experience higher levels of presence in a VRE containing elements relevant to their phobia. Higher levels of presence are correlated with higher levels of anxiety in the immersion in non-phobic participants as well. In addition, anxiety prior to immersion seems to increase presence ratings, which in turn, increases anxiety experienced during immersion. However, not all studies found these correlations. For example, Krijn, Emmelkamp, Biemond, et al (2004) measured level of anxiety during immersion for spider phobics and found no correlation between presence and anxiety. However, they did find that subjects who dropped out of the study experienced low levels of anxiety and presence. This may have resulted in the lack of statistical significance. An alternative explanation may be that a minimal level of presence is necessary to invoke anxiety, and beyond this, there is no correlation between presence and anxiety. We examined the correlation between attachment and presence and found that although there was a significant negative correlation between the avoidance dimension of attachment, and presence, we failed to find a significant correlation between the anxious dimension of attachment, and presence (Wallach, Safir, & Almong, 2009). However, anxiety dimension of attachment relates to the degree the individual fears that s/he will not have the support of a significant other at times of discomfort or anxiety, and does not necessarily relate to anxiety or phobic anxiety.

Ethnicity and gender. Riva, Molinari and Vincelli (2003) suggest that "experiencing presence in a clinical VE (environment -*authors' notation*).....requires more than reproduction of the physical features of external reality; it requires the creation and sharing of the cultural web that makes meaningful – and therefore visible – both people and objects populating the environment" (p. 97).

Research has demonstrated a unique effect of ethnicity on individuals' connection to computers or the internet. Three National Telecommunications and Information Administration (NTIA) reports (1995, 1999, 2000), based on Current Population Survey data, revealed ethnicity as a significant cultural factor, after controlling for income and education, in the digital divide. From extended focus group data, Wilhelm and Thierer (2000) also reported a significant unique ethnicity effect on the level of internet connections. Albarran and Umphrey (1994) and Subervi-Velez et al., (1994) also reported a unique ethnic effect on motivation for media usage. Newhagen (1994) and Children's Partnership (2000) report similar results for media effects. Albarran and Umphrey (1994) also reported the effect of ethnicity on program preferences. Ribisl, Winkleby, Fortmann & Flora (1998) found that ethnicity effects types of information sought through media use. Becker, Kosicki & Jones (1992) found effects on both evaluation of media content as well as on level of understanding of media system operation. Finally, Carroll et al. (1993) found such an effect on level of active use. In a recent survey among Arabs in middle-eastern countries, 46% expressed concern that family and community life may be threatened by

the Internet; 58% disagreed that computers are well-accepted in Arab society, a necessary component for the Internet; and 40% disagreed that the Internet would have a positive impact on Arab family and community ties (2003).

VR entails the use of technology similar to internet. From these reports we may assume that ethnicity will effect motivation to engage in VR, the ability to feel comfortable in VR immersion, and the degree of presence experienced in VR. We conducted a study in which we compared subjects from two different ethnic groups in Israel– Jewish and Arab. As it had been reported that Arabs are not comfortable with internet usage, we anticipated lower levels of presence for Arab when compared with Jewish subjects. Although we did not find a difference on our presence rating questionnaire, there was a significant difference between Jewish participants and Arab females in their behavior within the VRE. This resulted from the significantly higher percentage of Arab women who avoided viewing the virtual window. Turning one's head and viewing the virtual window may be considered an objective measure of presence in comparison with the self report questionnaire (Almog, Wallach, & Safir, 2009).

3.3 Interaction variables

Interactivity in the Virtual Environment is defined as the degree to which the environment allows the subject/client to influence the content or the design of the environment (Steuer, 1992). Interaction includes control over the environment and interactivity. Interaction is presumed to influence presence both directly and indirectly by focusing attention and increasing involvement (Van Der Straaten, 2000). Persky, et al. (2009) used VE in a learning task and found when students were able to actively control the environment they reported higher levels of presence than when they passively experienced the VE. Groenegrass, Thomsen, and Slater, (2009) propose that actual body movements performed while immersed in the VE increases the sense of presence. They entitled these movements "body-centered interaction". They found that this control is more important than the realistic depiction of the environment in a series of studies. Subjects, who were able to control an abstract form in the VE by using their voices, gave higher presence ratings than subjects in a conventional VE with limited control and interactivity. They concluded that "there appears to be a quality beyond the conventional "sense of being there" that relates not to the realism of the environment but to whether it responds realistically to a person's own actions" (pg. 430).

Movement in the VE is important over and beyond the control it affords. Riva (2009) states that an important dimension of presence is the perception of the feasibility and possibility of motor actions in the VE "In other words, the subject is "present" in a space if he/she can act in it. Moreover, the subject is "present" in the space—real or virtual—where he/she can act in. Interestingly, what we need for presence are both the affordance for action (the possibility of acting) and its enaction (the possibility of successfully acting)." (page 161). Riva goes on to state that action is more important than perceptual aspects of the environment. Moreover, in his opinion, action is closely tied to intention. Therefore, since intention is individually defined, so too presence will vary between individuals in the same VE. A closely related issue is body engagement. Movement in the VE can be performed with a joystick or mouse, or actual body movements. When using body movements, the easiest to implement is "walking in place" as actual walking is difficult due to technological shortcomings such as tracker and hmd cable length. Usoh et al (1999) found that actual walking induced higher levels of presence than walking in place. The latter was superior to moving a joystick or mouse. The importance of body engagement in producing presence was replicated by Slater, Steed, McCarthy, & Maringelli, (1998) and by Slater and Steed (2000).

A related issue is the degree of relevance of the VE. The VR environment is "generic" and therefore often lacking in personal links which are necessary to increase belief in the environment. This belief increases the feeling of presence (Wiederhold & Wiederhold, 2005). Riva (2006) stated that the more the environment has intellectual and/or emotional meaning, the more it will induce presence. This is further explicated by Hoffman, Prothero, Wells, & Groen, (1998) and by Kizony, Katz, and Weiss, (2003). Hoffman et al (1998) found that chess players reported higher presence when the virtual chess pieces were placed in a meaningful way. Kizony, et al (2003) found that scenes that were functionally relevant to rehabilitation patients (soccer, street crossing) produced higher levels of presence than scenes that were less relevant (snowboarding, birds and balls and shark bait). We propose that an additional method to increase meaning is to employ guided imagery prior to entering the VR environment. This guided imagery can contain personal references which will make the experience more personal. We are currently investigating this question in a research project.

4 Summary

An important personality variable that has not been discussed or previously addressed is expectations. Expectations have a powerful effect on treatment (Wallach, 2000; Zoellner, Feeny & Bittinger, 2009), so perhaps they are important in inducing presence as well? Casati, and Pasquinelli, (2005) allude to this when they discussed the motor and sensory expectations naturally evoked in a VE and the effect on presence of discordance between these expectations and the VE. However, we can manipulate expectations, by providing convincing rationales, to ensure that participants expect what they receive (Wallach, 1988). This is an important variable that has yet to be examined in the context of VR.

Although the picture is still not clear, we can start to sketch the optimal VR user profile. In terms of VRE: the environment need not be an accurate depiction of reality, however it should not contain discordant elements, it should be "believable". Using multiple sensory dimensions (which are congruent), detail, continuous movements, high update rate of the program and stereoscopy all add to the presence. AVR hmd is superior to a flat TV screen, only if the hmd is comfortable. And finally, it is important that the medium be as unobtrusive as possible.

Regarding user variables, empathy, imagination, immersive tendencies, dissociation tendencies, locus of control and cognitive style have all been found to influence presence. Unfortunately, most of these studies examined these variables independently. When they have been combined in a multi variable design, we discover that only locus of control and empathy remains influential when the VE is rich. Imagination is important in an impoverished environment. Perhaps, several variables correlate highly with one another, thus adding little to predicting presence. Closely linked to locus of control is the degree of interactivity and movement the VE enables. Higher levels of control and movement have been found to increase presence. In addition, both attachment and cognitive style seem to influence presence. Sensory processing holds promise as an additional important variable.

And finally, the more relevant the individual experiences the VE the greater s/he experiences presence. Relevance can be influenced, for example, by employing anxiety relevant VEs for phobic participants, or a VE that is personally meaningful to the participant.

In summary, it is necessary to conduct research examining several variables together in order to determine how they may interact and which remain important, and which "disappear". In addition, it is unclear how gender and culture influence responsivity to the VE. These important issues are just beginning to be studied. We suggest that as individuals from traditional societies have less technological exposure they will be less comfortable in a VE and experience less presence, however this must be further investigated.

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