

The role of presence in virtual reality exposure therapy

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Abstract

A growing body of literature suggests that virtual reality is a successful tool for exposure therapy in the treatment of anxiety disorders. Virtual reality (VR) researchers posit the construct of presence, defined as the interpretation of an artificial stimulus as if it were real, to be a presumed factor that enables anxiety to be felt during virtual reality exposure therapy (VRE). However, a handful of empirical studies on the relation between presence and anxiety in VRE have yielded mixed findings. The current study tested the following hypotheses about the relation between presence and anxiety in VRE with a clinical sample of fearful flyers: (1) presence is related to in-session anxiety; (2) presence mediates the extent that pre-existing (pre-treatment) anxiety is experienced during exposure with VR; (3) presence is positively related to the amount of phobic elements included within the virtual environment; (4) presence is related to treatment outcome. Results supported presence as a factor that contributes to the experience of anxiety in the virtual environment as well as a relation between presence and the phobic elements, but did not support a relation between presence and treatment outcome. The study suggests that presence may be a necessary but insufficient requirement for successful VRE.

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Recent reviews suggest that virtual reality exposure (VRE) is an effective treatment for anxiety disorders (Anderson, Jacobs, & Rothbaum, 2004; Krijn, Emmelkamp, Olafsson, & Biemond, 2004b). Virtual reality exposure uses a computer-generated environment to recreate a feared stimulus. The utility of virtual reality (VR) as a tool for exposure has rested on the assumption that virtual environments can elicit anxiety and provide the opportunity for

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habituation, a view which remains widespread today (Rothbaum, Hodges, Kooper, & Opdyke, 1995; Wiederhold & Wiederhold, 2005b). The construct of presence, defined as the interpretation of an artificial environment as if it were real (Lee, 2004), has been discussed as the mechanism by which VR may be an effective tool for exposure therapy (Wiederhold & Wiederhold, 2005a). Presumably, presence contributes to the amount of anxiety felt during an exposure to a feared virtual stimulus. Despite a widespread theoretical assumption, the empirical support for the relation of presence, anxiety, and treatment outcome in VRE is unclear. The present study intends to contribute to the conflicting findings of previous work by examining the role of presence in VRE.

A literature review revealed three empirical studies that have examined the relation between presence and anxiety. Regenbrecht, Schubert, and Friedmann (1998) examined whether or not a sense of presence was related to anxiety in a virtual environment simulating elevated heights. Thirty-seven non-phobic participants were presented a virtual heights environment. The results did not support a bivariate relation between a self report measure of presence and anxiety. However, a more comprehensive multiple regression that included presence, trait anxiety, and avoidance behaviors as predictors of in-session anxiety showed that presence was significantly related to in-session anxiety, offering some support for the relation between presence and anxiety during exposure to a virtual environment.

Robillard, Bouchard, Fournier, and Renaud (2003) examined the relation between presence and anxiety using a sample that contained both clinically anxious participants ($n = 13$) and non-anxious controls ($n = 13$). The results suggested a strong bivariate relation between self reported presence and anxiety that were provided during exposure to feared virtual environments. However, the study had some methodological limitations. First, presence and anxiety measurements were taken concomitantly during and after the exposure, which may have inflated the strength of the relationship. Second, the study combined the groups of phobics and non-phobics when examining the bivariate relation.

The only study to examine the relation between presence and anxiety in the context of treatment was conducted by Krijn, Emmelkamp, Biemond, et al. (2004) and Krijn, Emmelkamp, Olafsson, et al. (2004). Twenty-four phobic participants undergoing treatment for acrophobia were randomly assigned to either a high ($n = 14$) or low ($n = 10$) presence virtual environment. The high presence environment was created by a computer automated virtual environment (CAVE) which projected the virtual environment on the floor and walls of a compartment. The low presence environment was created by using a head mounted display (HMD), a helmet that contains headphones and screens to present the virtual environment. Four separate environments were used during the course of treatment. Results did not support a bivariate relation between measures of anxiety and presence across any of the sessions in either group. Further, treatment outcomes were comparable for both groups, suggesting presence did not have an effect on treatment outcome. These results provide evidence that there is no relation between presence and anxiety or presence and treatment outcome.

In summary, results from empirical work on the relation between presence and anxiety have been inconclusive. Though a few studies show a positive relation between presence and anxiety (Regenbrecht et al., 1998), these studies have used small, non-clinical samples, and have methodological limitations. The sole study to examine presence in the context of a treatment study using virtual reality reported null findings, but used a small sample as well (Krijn, Emmelkamp, Biemond, et al., 2004; Krijn, Emmelkamp, Olafsson, et al., 2004). Furthermore, virtual reality research in the field of communications has suggested that presence should be examined as a mediator to explain the relation between behavior towards an actual stimulus and behavior towards a virtual stimulus (Lee, 2004). Prior work has focused on the bivariate

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