Use of Immersive Virtual Reality for Treating Anger

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Abstract. Poorly managed anger responses can be detrimental to one's physical and psychosocial well-being. Cognitive behavior therapies (CBT) have been found to be effective in treating anger disorders. A key component of CBT treatment is exposure to the anger arousing stimuli. Virtual reality (VR) environments can elicit potent reactions and may facilitate the treatment of anger. An anger VR environment with six video vignettes was developed by this study to examine the anger arousal potential of VR. Outcome measures included assessment of emotional reactivity, state anger, and presence. The results showed that significant anger arousal occurred during exposure to the VR environment, and arousal was greater when viewed in an immersive HMD than a non-immersive flat screen. In addition, presence was found to moderate the effects of VR. Low presence resulted in low reactivity regardless of the display modality.

Keywords. Virtual reality, anger treatment, cue arousal, presence.

Introduction

Anger is a powerful human emotion that has serious health, social, and psychological consequences when not appropriately managed. Research has documented its adverse effects on cardiovascular disease [1], domestic violence [2], and posttraumatic stress disorder[3]. Strong empirical support was reported by a meta-analysis of the efficacy of CBT in the treatment of anger [4]. CBT involves relaxation training, exposure to anger arousing stimuli, cognitive re-framing, and rehearsal of adaptive thoughts and behaviors during imaginal or role play exposure to anger provoking situations. Reactivity to anger stimuli during exposure is critical to successful treatment outcomes that will generalize to real life situations. Studies have shown that VR environments can elicit potent reactions to the stimuli that are experienced [5-6]. This suggests a very useful role for VR in the treatment of anger by exposing participants to realistic virtual anger provoking scenarios. VR technology allows treatment providers to immerse participants into a virtual environment, assess their responses in a structured, systematic manner, and promote the development of self-regulatory skills using realistic VR cues. Recent innovations in VR technologies enable the production of panoramic video environments, which provide a more realistic immersive experience than computer-generated images, and may improve exposure treatment interventions to manage the expression of uncontrolled anger.

The current investigation utilized a VR 360° panoramic video environment with six anger provoking video vignettes to examine the anger reactivity potential of VR. The effect of the display modality, i.e., immersive and non-immersive, on anger arousal was also examined to determine if there is a comparative advantage of presenting the VR stimulus cues in a head-mounted display helmet (HMD) as compared to flat-screen images to elicit anger reactivity in study participants.

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1. Methods

1.1. Participants and Procedures

Sixty normal, healthy soldiers and military retirees (33 males, 27 females), ages 18-75 years (Mean=40.05) participated in this study. An equal number of participants were randomly assigned to either a head-mounted display (HMD) or a flat-screen monitor (FSM) condition. All participants viewed the identical six brief video vignettes depicting anger-provoking situations in an office setting, e.g., supervisor criticizing work performance or firing the individual. Participants in the immersive HMD condition viewed the brief vignettes in a 360° panoramic format through a high resolution HMD equipped with headphones and a head tracking sensor. The panoramic format allowed the participant to see any aspect of the office, including co-workers, on a horizontal dimension when the participant turned in that direction. FSM participants viewed the vignettes on a standard 17" computer monitor and wore headphones. They did not have panning capabilities and viewed the critical scenes in the video from a single camera perspective. Each video vignette was approximately 15 seconds, and the order of presentation of the videos was counterbalanced to control for sequencing effect.

1.2 Relevant Outcome Measures

The following outcome measures were administered before and after viewing the videos, except for the Presence Visual Analog Scale which was completed only after viewing the video:

- *State-Trait Anger Expression Inventory 2 (STAXI-2)* is 57-item inventory that includes six scales including state anger, trait anger, anger expression in, anger expression out, anger control in, and anger control out. The coefficient alphas for the scales range from r=.73-.94[7].

- *Emotional Assessment Scale (EAS)* is a 24-item scale using 100mm visual analog responses where "0" represents "least possible" and "100" represents "most possible". The scale measures eight fundamental emotional states (happiness, sadness, fear, anger, surprise, guilt, anxiety, and disgust) and has a split-half reliability of r=0.94[8].

- *Presence Visual Analog Scale (P-VAS)* is a 100mm visual analog scale where "0" represents "I did not feel like I went into the virtual world at all" and "100" represents "I went completely into the virtual world". The measure has been used in prior research on VR, but reliability data are not available[5].

1.3 Statistical Analysis

Emotional reactivity and presence were compared between the two study conditions using repeated measures and paired samples tests ($p<.05$) of the STAXI-2, EAS, and P-VAS.

2. Results

An independent samples t-test between the HMD and FSM groups on the presence ratings (P-VAS) revealed a significant difference ($t[58]=-2.131$; $p<.04$) between the two groups with the HMD group reporting greater presence than the FSM group.

Paired samples t-tests for the HMD and FSM groups on the pre-post scores of the anger reactivity measures, STAXI-2 and EAS, yielded significant differences within the HMD group, but not the FSM group (see Table 1).

Table 1. T-Test Results for Differences between Pre-Post Anger Scores by Display Type

Anger Reactivity Measure	Flat-Screen Monitor (N=30)	Head-Mounted Display (N=30)
STAXI-2: State Anger Subscale	-1.94	-2.89**
EAS: Anger Subscale	-1.90	-2.52*

*p<.05
**p<.01

Comparisons of the mean EAS anger subscale pre-post viewing scores for the HMD and FSM groups by presence level (high/low) found significant differences (p<.04) between the HMD-high presence group and the FSM-low presence groups (see Figure 1).

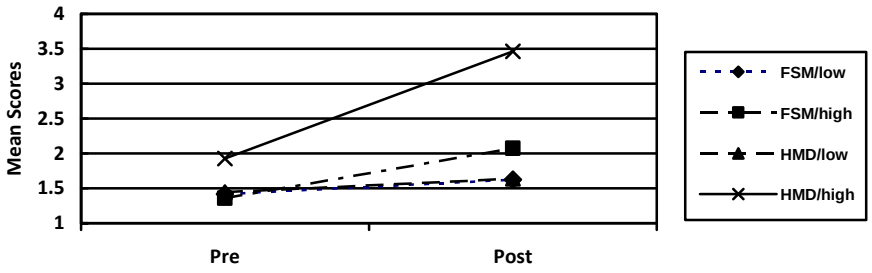

Figure 1. EAS Mean Pre-Post Anger Scores by Display Type and Presence Level

A significant difference (p<.03) was also found on the STAXI-2 pre-post anger-verbal subscale mean scores between the HMD-high presence and the HMD-low presence groups (see Figure 2).

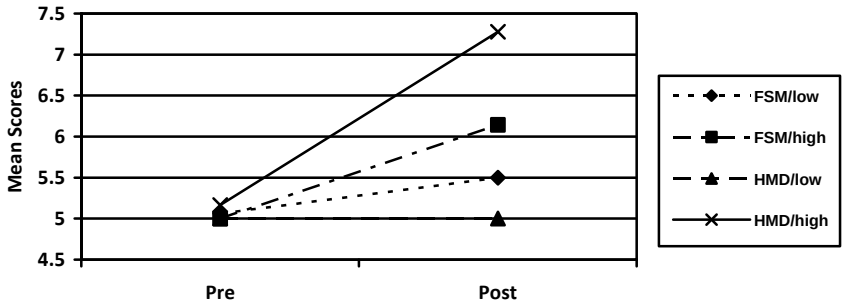

Figure 2. STAXI-2 Mean Pre-Post Anger-Verbal Scores by Display Type and Presence Level

3. Discussion and Conclusions

The panoramic anger video vignettes viewed in an immersive VR environment (HMD) produced significantly higher levels of presence than when the same videos were viewed on a non-immersive flat screen monitor. When the interaction between display type and presence level was examined anger arousal reported within the HMD panoramic video group was greater among participants who reported a high level of presence compared to HMD viewers who experienced a low level of presence. Interestingly, if presence was low, reactivity to anger stimuli was low regardless of display type, i.e., HMD or flat screen. These findings suggest that panoramic videos of anger-provoking scenarios presented in an immersive display

type, e.g., stereoscopic HMD, are more effective in creating a sense of presence in the virtual environment than when presented on non-immersive display device such as a flat screen monitor. More importantly, anger stimuli experienced through immersive displays elicit greater anger reactivity to the anger stimuli than non-immersive displays. However, the effectiveness of the immersive virtual environment to produce anger reactivity varies with whether or not the viewer experiences a high level of presence while in the virtual environment. Viewers with a high sense of presence are more likely to experience greater emotional reactivity to anger-provoking stimuli than those with a low sense of presence.

Based on results of this study, presence appears to moderate the effects of VR on emotional reactivity. This has implications for the use of immersive virtual environments in anger management interventions and when evaluating the effectiveness of VR to elicit emotional cue response. Immersive VR environments are potentially useful tools in simulating real life experiences when learning to better manage reactions to anger-provoking stimuli. They may also improve the generalization of newly acquired behaviors to the real life situations. It is important to assess the individual's level of presence in a virtual environment prior to utilizing the VR environment in an anger management intervention program as presence level may affect the likelihood of benefiting from the VR intervention. While the results of this study are promising, more research is needed to evaluate the effectiveness of immersive VR environments to produce anger cue responsivity, and to determine if VR may contribute to the development of efficacious anger management treatment interventions.

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