

The Role of Expectations in the Perceived Usefulness and Acceptance of Virtual Reality as a Preventative Technique for Post-Traumatic Stress Disorder

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THE ROLE OF EXPECTATIONS IN THE PERCEIVED USEFULNESS AND
ACCEPTANCE OF VIRTUAL REALITY AS A PREVENTATIVE
TECHNIQUE FOR POST-TRAUMATIC STRESS DISORDER

by

CHRISTINE KREUTZER

A thesis submitted in partial fulfillment of the requirements
for the Honors in the Major Program in Psychology
in the College of Sciences and in the Burnett Honors College
at the University of Central Florida
Orlando, Florida

Fall Term 2013

Thesis Chair: Clint Bowers, Ph.D.

ABSTRACT

Expectancy theory is based on the subjective probability (expectancy) and projected value (valence). Based on this notion, an individual chooses his or her behaviors based on the interaction between the valences perceived to be associated with the outcomes, and the appraisal of the probability of that behavior resulting in those outcomes. Expectancies have been found to be predictive of many outcomes, such as treatment outcomes, behavioral change, and training reactions. The goal of the present study is to empirically investigate this issue within the mental health field. While virtual reality appears to be a promising preventative technique for post-traumatic stress disorder, the literature has not yet accounted for expectations and their influence on reactions. More specifically, it is unknown how expectancies influence reactions. Therefore, this study examines videogame self-efficacy as a mechanism through which expectations influence reactions. In the present study 60 participants completed an expectancy scale, VGSE scale, played a serious game designed to prepare soldiers for the psychological challenges associated with deployment, and completed a reactions survey. A mediation analysis was conducted to examine if videogame self-efficacy is a mechanism through which expectations predict reactions. Analyses revealed that videogame self-efficacy partially mediated the relationship between expectancies and reactions.

ACKNOWLEDGEMENTS

I would like to express the deepest gratitude to all of my mentors who have enabled me to reach this point. First and foremost, I would like to express my sincerest gratitude to my mentor Dr. Clint Bowers for his invaluable guidance, encouragement, and dedication throughout the course of this project. I would also like to thank the other members of my committee, Dr. Deborah Beidel and Dr. Rudy McDaniel for their suggestions and support. Last but not least, I would like to thank Katelyn Procci for her assistance with the setup of this study.

TABLE OF CONTENTS

INTRODUCTION	1
BACKGROUND	2
Overview of Post-Traumatic Stress Disorder.....	2
Current Preventative Techniques	3
Psychological Debriefing	4
Collaborative Care.....	5
Cognitive Behavioral Therapy.....	6
Virtual Reality	7
Psychopharmacological Approaches	7
Technology for PTSD	10
The Influence of Expectations on Reactions.....	12
Videogame Self-Efficacy as a Mediator	13
METHODS	16
Participants	16
Measures.....	16
Demographic Information	16
Expectations.....	16
Videogame Self-Efficacy (VGSE)	17

Technology Acceptance Model (TAM)	17
Procedure.....	17
RESULTS	18
DISCUSSION.....	21
Implications.....	21
Study Limitations	23
Future Research.....	23
APPENDIX A: EXPECTANCIES SCALE.....	25
APPENDIX B: VIDEOGAME SELF-EFFICACY SCALE	27
APPENDIX C: TECHNOLOGY ACCEPTANCE MODEL SCALE.....	29
APPENDIX D: APPROVAL OF HUMAN RESEARCH	31
REFERENCES	33

LIST OF TABLES

Table 1: Means, Standard Deviations, and Intercorrelations 19

Table 2: Regression Analyses 20

LIST OF FIGURES

Figure 1: Mediation Model	20
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INTRODUCTION

This thesis seeks to explore the use of a serious game (Walk in my Shoes) as a preventative technique for Post-Traumatic Stress Disorder (PTSD). Since Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF), there has been a rise in the number of people seeking help for PTSD (Cohen, Gima, Bertenthal, Kim, Marmar, & Seal, 2010). Therefore, the need for efficacious preventative techniques and treatments is irrefutable. While many treatment methods have been found to be effective (Resick, Nishith, Weaver, Astin, & Feuer, 2002), few techniques within the realm of PTSD prevention have been met with success. Among the few preventative techniques believed to be effective is virtual reality. However, the literature has failed to examine a critical aspect of virtual reality in the mental health field; how expectancies influence the development of user acceptance and perceived usefulness. Tannenbaum, Mathieu, Salas, and Cannon-Bowers (1991) found that fulfillment of pre-training expectations play a role in the development of post-training attitudes among military trainees. The goal of the present study is to translate the work of Tannenbaum et al. (1991) into the mental health field by examining how pre-training expectations impact reactions regarding acceptance and perceived usefulness of technology in the prevention of PTSD. Furthermore, this study explores videogame self-efficacy as a potential mechanism through which this relationship exists.

BACKGROUND

Overview of Post-Traumatic Stress Disorder

The DSM categorizes post-traumatic stress disorder as an anxiety disorder, characterized by subjective distress and functional deficits (Thorp and Stein, 2005). PTSD comprises a combination of intrusion, avoidance, and hyper arousal symptoms ranging from sleep disturbances, irritability, hyper vigilance, and exaggerated startle response (DSM). According to the DSM, the onset of this disorder is triggered by an extreme stressor; not unlike those faced by military personnel- especially front-line combat troops. There are many distinctive risks that one faces during deployment, such as roadside bombs and witnessing the death of comrades. Such threatening and traumatic events place soldiers at heightened risk for the development of mental health issues; especially PTSD. As suggested in previous literature, current military personnel are at greater risk for PTSD due to the wars in Afghanistan and Iraq (Rizzo, Rothbaum, Difede, Mclay, Johnston, Reger, et al., 2008). Furthermore, a review of the Canadian DND and Canadian Forces proposes that high numbers of soldiers suffering from mental health problems upon arriving home from deployment because of rising levels of combat in Afghanistan (McFadyen, 2008).

Nearly two million troops have been deployed since the start of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). There have been significantly high levels of combat exposure acknowledged among OEF/OIF-deployed soldiers. Consistent with approximations from preceding conflicts (Dohrenwend, Turner, Turse, Adams, Koenen, & Marshall, 2007) about 10-17% of soldiers deployed to OIF/OEF faced the onset of PTSD

(Sundin, Fear, Iversen, Rona, & Wessely, 2010). The prevalence of PTSD among OIF/OEF veterans seeking help from the Department of Veterans Affairs (VA) is even greater (Cohen, Gima, Bertenthal, Kim, Marmar, & Seal, 2010). Further, the Ombudsman for National Defence and the Canadian forces determined PTSD to be an issue faced by a multitude of Canadian Forces members and that the military does not currently have any efficacious treatment approaches to mental health problems. Wood, Murphy, Center, McLay, Reeves, Pyne, and Wiederhold (2006) suggest that early intervention is essential in order to ease future healthcare system burdens.

Current Preventative Techniques

Due to the recognized link between level of exposure and subsequent PTSD (Brewin, Andrews, & Valentine, 2000; Dohrenwend, Turner, Turse, Adams, Koenen, & Marshall, 2006), it may be obvious that limiting the number and duration of operational deployments could serve as a strategy. While tangential evidence exists to support this attractive notion (e.g., Rona, Fear, Hull, Greenburg, Earnshaw, Hotopf, & Wessely, 2007), a reduction in the number of soldiers deployed is not likely to be a major part of the movement to prevent PTSD. Instead, military organizations have tested multiple tactics which aim to increase emotional resilience (Bowles & Bates, 2010). While there is evidence that suggests that brief coping skills training might be of some benefit to soldiers (Cohn & Pakenham, 2008), no evidence exists that supports anticipatory training interventions on the prevention of PTSD. While several treatment options have demonstrated efficacy (Bradley, Greene, Russ, Dutra, & Westen, 2005; Resick, Nishith, Weaver, Astin, & Feuer, 2002) and are continuously improved upon (Wald & Taylor, 2005), considerably less progress has been made within the realm of PTSD prevention.

Psychological Debriefing

Prevention programs have been predominantly directed at those at heightened risk for the onset of PTSD, as indexed by exposure to trauma. The majority of psychological debriefing tests fall under this category, usually testing a variant of Critical Incident Stress Debriefing (CISD) (Mitchell, 1983). The CISD intervention is designed to mitigate stress reactions within days of a traumatic event so that the onset of chronic psychopathology is prevented (Raphael & Wilson, 2000). The CISD allows for a cathartic experience through discussion of a traumatic event, while support and psychoeducation is offered by the facilitator (Everly, Flannery, & Eyer, 2002). An additional goal of CISD is to provide resources to help sufferers manage the ramifications of PTSD (e.g. divorce). This includes a time-limited early support system which leads to the cognitive reconstruction of memories through verbal expression; thus stress on homeostatic mechanisms and rumination is reduced (Everly et al., 2002; Everly & Mitchell, 1992). While the majority of individuals who receive psychological debriefing consider it to be helpful, it does not necessarily mean that it is efficacious in preventing psychopathology (Small, Lumley, Donohue, Potter, & Waldenstrom, 2000). According to Raphael & Wilson (2000), this method has become increasingly controversial, as previous research has failed to validate psychological debriefing as an effective approach to PTSD prevention. A multitude of reviews conclude that CISD does not appear to be successful in preventing the onset of PTSD (e.g. Litz, Gray, Bryant, & Adler, 2002; van Emmerik, Kamphuis, Hulsbosch, & Emmelkamp, 2002; Watson, Friedman, Gibson, Ruzek, Norris, & Ritchie, 2003). Indeed, some believe that psychological debriefing may actually heighten the possibility of PTSD (Bisson, Jenkins, Alexander, & Bannister, 1997; McFarlane, 1986), and others warn that it may sustain PTSD symptoms (Mayou, Ehlers, & Hobbs, 2000).

Rachman (2001) points out that some individuals may be overwhelmed when forced to discuss their thoughts and/or feelings immediately, therefore making the approach counterproductive. Accordingly, CISD may interfere with natural recovery processes (Brewin, 2001; McNally, Bryant, & Ehlers, 2003). Psychological debriefing does not seem to reduce the occurrence of PTSD.

Collaborative Care

Another prevention approach is collaborative care, which commonly involves an adjusted level of care under a case manager (Zatzick, Roy-Byrne, Russo, Rivara, Koike, Jurkovich, & Katon, 2001). In a study by Zatzick, Roy-Byrne, Russo, Rivara, Droesch, Wagner, Dunn, Jurkovich, Uehara, & Katon (2004), a case manager organized a stepped care approach for those seeking treatment from a trauma center for various injuries. A team comprised of the case manager, a trauma support specialist, a psychiatrist, and psychologist was formed in order to facilitate psychopharmacological and psychotherapeutic treatments. Patients who met criteria for PTSD at 3 months post-injury chose to receive a combination cognitive-behavioral therapy (CBT) and pharmacological treatment, or one of these treatments individually over a twelve month period. Collaborative care did not result in increased PTSD, as opposed to a 6% increase in symptom levels in the usual care condition. While collaborative care models have been met with success in other studies (Katon, Von Korff, Lin, Walker, Simon, Bush, Robinson, & Russo, 1995; Rost, Nutting, Smith, Elliot, & Dickinson, 2002), there are several obstacles in the way of funding and implementation of collaborative care; therefore, these interventions must become more user- friendly (Pincus, Pechura, Keyser, Bachman, & Houtsinger, 2006).

Cognitive Behavioral Therapy

Other prevention approaches have aimed to reduce initial signs of PTSD in order to mitigate the onset of chronic PTSD, such as cognitive behavioral therapy (CBT). This approach ranges from four to sixteen sessions, and includes a multitude of techniques such as psychoeducation, cognitive restructuring, exposure, and anxiety management training (Bryant, 2005). Multiple randomized controlled trials have demonstrated CBT as superior to other approaches, such as supportive counseling, in preventing chronic PTSD (Bryant, Harvey, Dang, Sackville, & Basten, 1998; Bryant, Sackville, Sang, Moulds, & Guthrie, 1999; Bryant, Moulds, Guthrie, & Nixon, 2005). CBT has been found to be effective in 60-100% of patients receiving one round, with low attrition rates as well, ranging from 10-25% (Foa, Hembree, Cahill, Rauch, Rigs, Feeny, & Yadin, 2005; Mitte, 2005; Otto & Deveney, 2005). Foa, Hearst-Ikeda, and Perry (1995) compared the effectiveness of repeated assessment to a brief CBT intervention given to assault victims soon after the trauma occurred. At two months, CBT resulted in considerably lower symptom levels, but no change in regard to diagnostic status was found at five months. While CBT has been shown to be an evidence-based approach, clinician training is not available in many places. Therefore, the use of computer-assisted programs in the presence of a therapist may be one way to increase diffusion (Christensen, Griffiths, & Jorm, 2004; Richards, Barkham, Cahill, Richards, Williams, Heywood, 2003; Wright, Wright, Albano, Basco, Goldsmith, Raffield, & Otto, 2005). Additionally, computerized CBT enables learning without the therapist having to remember the precise details and sequences of the steps (Sullivan, Craske, Sherbourne, Edlund, Rose, Golinelli, Chavira, Bystritsky, Stein, & Ron-Bryne, 2007).

Virtual Reality

Researchers have begun using virtual reality (VR) as a preventative technique. Stress Inoculation Training (SIT) is among the methods currently being used to attempt to prevent PTSD. The goal of SIT is to reduce anxiety in potentially traumatizing situations (Meichenbaum & Turk, 1976). Throughout preventative SIT, repeated exposure progressively desensitizes individuals to stimuli that may have originally led to psychological trauma. Some research supports the notion of SIT as a preventative measure. Deahl, Srinivasan, Jones, Thomas, Neblett, & Jolly (2000) found drastically reduced incidence of PTSD in soldiers who received pre-deployment SIT as part of their training, in comparison to other military samples. Furthermore, Wiederhold (2003) found that individuals who had stressors added to the VR simulation during training performed more efficaciously during the test phase in comparison to the persons trained in a “sterile” environment (meaning no additional stressors were added). Those who received SIT developed divided attention skills, and learned how to regulate physiological stress responses while concentrated on a given task. Those who did not receive SIT were more easily distracted and experienced significantly higher levels of physiological arousal throughout the test phase, which ultimately led to more mistakes.

Psychopharmacological Approaches

Within the domain of psychobiological PTSD prevention, Yehuda, Southwick, Nussbaum, & Wahby, (1990) have proposed a link between depleted cortisol levels and PTSD. It has been suggested that averting a decrease in cortisol levels may help prevent the onset of PTSD. To test this, hydrocortisone was administered before, during, and after cardiac surgery (Schelling, Briegel, Roozendaal, Stoll, Rothenhäusler, & Kapfhammer, 2001). Schelling and

colleagues (2001) found that PTSD rates were much lower in the individuals receiving the hydrocortisone treatment (11%) than those in placebo group (64%) approximately 31 months after the surgery. Likewise, Bonne, Brandes, Segman, Pitman, Yehuda, and Shalev (2003) found lower levels of cortisol within the first week after traumatic exposure to be correlated with greater PTSD symptoms. There are four possible nonmutually exclusive explanations for this. First, administration of hydrocortisone prevented the upregulation of glucocorticoid receptors, therefore reducing the chances of HPA alterations. Next, it may allow for a sufficient level of cortisol to decrease sympathetic arousal (Friedman, 2002; Schelling, Roozendaal, & de Quervain, 2004). Additionally, it may impair the excessive retrieval of traumatic event memories (Schelling et al., 2004). Lastly, high glucocorticoid levels might cease fearful responses learned in the course of traumatic exposure (Schelling et al., 2004).

Within another thrust of research, the effects of the administration of β adrenergic antagonists proximately following exposure to trauma has been examined. The objective of this approach is to inhibit posttraumatic arousal while concurrently mitigating reconsolidation of traumatic event related memories enabled by unnecessary arousal (McCleery & Harvey, 2004; Cahill, 1997). It is believed that β adrenergic antagonists such as propranolol administered before (Roozendaal, Quirarte, & McGaugh, 1997) or after (Cahill, Pham, & Setlow, 2000) training diminishes the overconsolidation of memories and fear conditioning which is facilitated by epinephrine during learning. Pitman, Sanders, Zusman, Healy, Cheema, Lasko, & Orr, (2002) tested this intervention by administering propranolol up to 6 hours after a car accident for ten days. At the one and three month follow up, those who received the β adrenergic-blocker showed no differences in terms of symptoms or diagnoses. Conversely, those that did receive the

β adrenergic-blocker showed considerably less autonomic reactivity when shown images tailored to their own traumatic event at three months, which is significant enough to decipher those with PTSD from those without (Orr, Meyerhoff, Edwards, & Pitman, 1998).

Lastly, benzodiazepines have been administered to individuals with recent traumatic event exposure in order to improve sleep and reduce anxiety by targeting an overconsolidation of traumatic memories. Studies that have observed the use of the alprazolam and clonazepam do not appear to successfully reduce the core symptoms of PTSD (Braun, Greenberg, Dasberg, & Lerer, 1990; Friedman, Davidson, Mellman, & Southwick, 2000). Conversely, Mellman, Bustamante, David, and Fins (2002) administered temazepam for 7 nights to 22 adults who recently experienced (within 14 days) a traumatic event. Within nearly six weeks of the trial beginning, 55% of those who were given temazepam met the criteria for PTSD, whereas 27% who received placebo met the criteria. Furthermore, Gelpin, Bonne, Peri, and Brandes (1996) found that the administration of a benzodiazepine soon after traumatic exposure and resulted in greater PTSD incidence at six months (69%) in comparison to the control group (15%). While some benzodiazepines may appear to be an effective approach to PTSD prevention, many risks are associated with prescribing these agents. Friedman (2003) suggests that benzodiazepines may intensify depressive symptoms, lead to CNS depression, or may be detrimental to patients that have previous or present problems with drug/alcohol abuse. Furthermore, benzodiazepines such as alprazolam can lead to rebound anxiety.

Technology for PTSD

The current literature on the use of serious games and virtual learning environments suggests that this is an efficacious approach to many mental health issues. The most effective techniques are those that comprise a combination of training and education, target PH knowledge acquisition, and facilitate stress management strategies. The Serious Games Forum (2008) suggests that, “a serious game may be a simulation which has the look and feel of a game, but corresponds to non-game events or processes, including business operations and military operations.” An Immersive Learning Simulation, which is considered to be a Serious Game, is a combination of “simulation, game element, and pedagogy” which allows the learner to become motivated and engaged in meeting the objectives of the interactions (Wexler, Corti, Derryberry, Quinn, & Barneveld, 2008). By allowing opportunities to simulate real-life situations, games are an excellent option for teaching behavioral and cognitive skills. In addition, intrinsic motivation is sparked because serious games encourage learners to be responsible for their own learning. Learners build cognitive maps when engaged in gameplay, leading to retention of information (Andrews, 2011).

Virtual Reality Exposure Training (VRET) is an expanding treatment for anxiety, including but not limited to panic disorders, phobia, and PTSD (Parsons & Rizzo, 2008). It is believed that new brain patterns will emerge as a result of repeated exposure to feared conditions experienced within a controlled environment. Exposure training is administered by a clinician who verbally guides the client to envision, discuss, and understand the event. While this has proven to be effective with PTSD sufferers, there is a major issue with visualization method, as a fundamental sign of PTSD is evasion of the feared stimuli. It is common for patients to refuse to

imagine the feared event or object (Rizzo, A., Reger, G., Gahm, G., Difide, J., Rothbaum, 2009). By engrossing patients into a computer-generated environment, VRET evades the desire to avoid, and patients have to confront the feared stimuli. *Virtual Iraq* and *Virtual Afghanistan*, designed by the University of Southern California, Institute for Creative Technologies, provide relevant visual stimuli which mimics Middle Eastern scenery. Further, the program emits auditory, olfactory, and tactile stimuli. The approach has been met with success thus far (Andrews, 2011).

A virtual environment designed to assist veterans readjust to civilian life is Second Life. Second Life serves as a social networking site to help soldiers find companionship, discuss and find out about treatment options, practice relaxation techniques, and access human agents to provide additional resources. According to Morie (2009), Second Life is healing for returning soldiers. Because of geographical differences, many have difficulty creating a community of returning soldiers. Additionally, virtual therapies are not yet prevalent, and are therefore not available to most soldiers. However, these issues are circumvented by the use of such an online social networking site where veterans can communicate and find resources from their own homes.

Another virtual environment designed for soldiers and veterans (as well as family members and friends) is “Walk in My Shoes”. The goal of the game is to familiarize the player with the mental health issues that current military personnel deal with through digital storytelling (Andrews, 2011). “Walk in My Shoes” is comprised of two segments; Pre-Deployment and Post-Deployment. These segments are further divided into seven mini-games. Within the Pre-

Deployment segment, players receive psychoeducation through learning about the different resources accessible to veterans and soldiers (Phone Dash). Additionally, advice is offered as to what tasks should be completed before deployment (To-Do List). Players are then introduced to two components of CBT, an empirically supported approach to PTSD prevention; cognitive reframing, (Devil's Advocate I), and conflict management skills (Conflict Management). Reintegration skills are provided in the Post- Deployment segment (Conflict II: Fear Fighter), and players' reframing skills are reinforced (Devil's Advocate II). After these segments are completed, a mini-game is used to assess which components of "Walk in my Shoes" the player should revisit (Garden Defense).

The Influence of Expectations on Reactions

Originally conceptualized by Vroom (1964), and further developed by Porter and Lawler (1968), expectancy theory is based on the subjective probability (expectancy) and projected value (valence). According to this notion, an individual chooses his or her behaviors based on the interaction between the valences perceived to be associated with the outcomes, and the appraisal of the probability of that behavior resulting in those outcomes (Wabba & House, 1974). Expectations have been found to be significant predictors of several variables among many areas of research. For example, alcohol outcome expectancies have been found to be predictive of consumption behavior (Jones, Corbin, & Fromme, 2001), as well as treatment outcomes (Brown, 1985; Rather & Sherman, 1989). Furthermore, a study by Price, Anderson, Henrich, and Rothbaum (2008) suggested that higher expectations of virtual reality for the treatment of anxiety led to stronger symptom reduction. In congruence with this notion, Tannenbaum,

Mathieu, Salas, and Cannon-Bowers (1991) found that met expectations influenced the development of post-training reactions.

While the use of technology appears to have promise in preventing the onset of PTSD (e.g. Andrews, 2011, Morie, 2009), previous literature has failed to examine expectancies and their impact on post-training attitudes regarding perceived usefulness and acceptance of it as a preventative technique. Many authors have proposed that expectancy theory may be central to the theoretical explanation of user behavior regarding information technology (DeSanctis, 1983). Furthermore, it has been suggested that expectancy theory is an appropriate framework for examining user acceptance of technology. Empirical evidence suggests that expectancies may generate affective reactions (Venkatesh, 2000), resulting in a relationship between attitude and intention. The Technology Acceptance Model (Davis, 1989) proposes that technology usage is a result of the intention to utilize it, which is influenced by a person's attitude towards the device regarding its alleged usefulness (Chau, 1996).

Videogame Self-Efficacy as a Mediator

While the notion that trainee expectancies predict reactions has garnered substantial empirical support (e.g. Tannenbaum, Mathieu, Salas, & Cannon-Bowers, 1991), examining the influence of well-known psychological constructs (i.e. self-efficacy) may add considerable value in understanding how or why this relationship exists. Self-Efficacy can be broadly defined as the confidence in one's abilities to successfully meet the demands of a given task (Wood & Bandura, 1989). Because self-efficacy is context specific in that it differs depending upon the domain or task, the definition of self-efficacy must be altered to be relevant to the pertinent task (Bandura,

1977). Hence, the form of self-efficacy applicable to videogame-based training is video game self-efficacy; the belief of one's capacity and ability to effectively play video games (Orvis, Horn, & Belanich, 2009). Distinct from personality traits which are generally stable, self-efficacy is malleable; it can be strengthened with learning or practice. Therefore, self-efficacy is a variable that has been of considerable interest within the realm of training development research.

Individuals high on self-efficacy put forth greater effort and tenacity in achieving the goals of a given task. When people strive for, and master the desired performance, a sense of satisfaction is achieved (Locke, Cartledge, & Knerr, 1970). Furthermore, individuals who exhibit self-efficacy pertinent to the task at hand have a tendency to develop a greater interest in the activity, in turn resulting in more positive reactions. In contrast, those who experience lower levels of context-specific self-efficacy are less likely to develop an interest in the task, in turn resulting in more negative reactions (Bandura & Schunk, 1981). A review by Peters, O'Connor, and Eulberg (1985) found a negative relationship between perceived constraints (e.g. inability to successfully complete a task) to be negatively related to post-training reactions. In line with this finding, self-efficacy has also been found to be related to post-training outcomes. For example, Orvis, Orvis, Belanich, and Mullin, 2005 found trainee self-efficacy beliefs to be predictive of reactions in terms of perceived ease in using the training mechanism. Moreover, a significant linear relationship between self-efficacy and post-training reactions was found by Mathieu, Martinieu, and Tannenbaum (1993).

Furthermore, it is proposed that self-efficacy may be related to pre-training expectations. Trainees with more positive expectations of a particular training are more motivated to meet the

goals of the training, and are therefore likely to exhibit behaviors that will result in the expected and desired outcomes (Noe, 1986). As trainees execute these beneficial behaviors, they may improve their performance, in turn increasing beliefs of self-efficacy. Given the substantial evidence of the link between self-efficacy and trainee reactions and that it may perhaps be predicted by expectancies as argued above, the following was hypothesized:

Hypothesis 1: Videogame self-efficacy will mediate the relationship between pre-training expectancies and post-training reactions.

An alternative hypothesis is that the total effects of expectations on reactions may not be entirely mediated through videogame self-efficacy. As previously mentioned, the relationship between expectancies and reactions has been well supported by many studies. Thus, it may be that videogame self-efficacy is a partial rather than a complete mediator, revealing that the effects of trainee expectations on reactions may be indirect through videogame self-efficacy. Based on this notion, the following was hypothesized:

Hypothesis 2: Videogame self-efficacy partially mediate the relationship between expectations and trainee reactions in that expectancies will have direct effects on reactions as well as indirect effects through the mechanism of videogame self-efficacy.

METHODS

Participants

Sixty undergraduate students were recruited to participate in the present study. Of this, 63% were female and 37% were male. Participants were an average of 19.65 years old ($SD=2.86$). Participants rated their own video game self-efficacy as an average of 39.87 ($SD=10.02$) out of 60 possible points, where higher scores indicate more video game self-efficacy. Expectancy scores were an average of 37.37 ($SD=3.89$) out of 50 possible points, and reactions measured using the technology acceptance model were rated as an average of 57.56 ($SD=8.54$) out of 80 possible points, where higher scores indicate more positive reactions.

Measures

Demographic Information

Basic demographic information was gathered in which participants responded to items regarding their age and gender.

Expectations

A pre-training expectancies scale was developed to measure expectations regarding the training game. This self-reporting scale measures expectancies about usefulness, ease of use, effectiveness, and appropriateness of the training format. This scale consists of 10 items. Participants were asked to indicate the extent to which they agree with each statement using a 5-point Likert scale ranging from 1, “strongly disagree,” to 5, “strongly agree”. The scores were totaled to find a total expectancy score where higher scores indicate more positive expectations.

Videogame Self-Efficacy (VGSE)

Participants completed a ten-item measure of video game self-efficacy (Pavlas, 2010), which was adapted from the general self-efficacy scale (Schwarzer & Jerusalem, 1995). Participants were asked to rate their endorsement each item on a scale from 1 (strongly disagree) to 6 (strongly agree). The scores were totaled to find a total self-efficacy score where higher scores indicate more video game self-efficacy.

Technology Acceptance Model (TAM)

Participants rated their reactions towards the training game with 16 items on a 5-point Likert scale ranging from 1, “strongly disagree” to 5, “strongly agree”. This measure consists of five distinct subscales including: application, perceived usefulness, behavioral intention, ease of use, and enjoyment, where higher scores indicate a more positive reaction. The scores were totaled to find a total reaction score where higher scores indicate more positive reactions.

Procedure

Participants were recruited from a university participant pool and received course credit. When participants reported to the laboratory for the 1-hour experimental session, they read the informed consent document. After reading and agreeing to the terms outlined in the informed consent document, participants completed the demographic information survey, pre-training expectancies scale and videogame self-efficacy scale. The participants then played *Walk in my Shoes* for 15 minutes. After interacting with the intervention, participants immediately completed the technology acceptance model scale.

RESULTS

The means, standard deviations, and intercorrelations of all the variables are presented in Table 1. H1 is that videogame self-efficacy will possess a mediating role between expectancies and reactions. Following Baron and Kenny (1986), in the first regression equation, trainee reactions were regressed on pre-training expectancies (see Table 2). To satisfy this part of the test, expectancies must affect post-training reactions. The simple regression analysis revealed that expectancies significantly predicted reactions, $b=.39$, $t_{(58)}= 3.29$, $p= .002$. Expectancies also explained a significant proportion of variance in reaction scores, $R^2= .15$ ($F_{(1,58)}= 10.83$, $p=.002$). Therefore, the results of the first regression analysis satisfied the first part of the Baron and Kenny test for mediation.

In the second regression equation, videogame self-efficacy was regressed onto pre-training expectations (see Table 2). This test required that the expectancies affect reactions in the second regression equation. The simple regression analysis revealed that expectations significantly predicted videogame self-efficacy, $b= .38$, $t_{(58)}= 3.21$, $p= .002$. Expectations also explained a significant proportion of variance in videogame self-efficacy scores, $R^2= .15$ ($F_{(1,58)}= 10.33$, $p=.002$). Thus, Baron and Kenny's second test for mediation was satisfied.

In the final regression equation (see Table 2), reactions were regressed onto videogame self-efficacy at step one. This test required that videogame self-efficacy significantly predict reactions. At step one, videogame self-efficacy explained a significant proportion of variance in reaction scores, $R^2= .23$, ($F_{(1,58)}= 17.09$, $p=.000$). These results indicate that the final condition

for mediation according to Baron and Kenny (1986) was met. Together, these findings indicate support for H1.

The second hypothesis states that videogame self-efficacy will be a partial rather than complete mediator of the relationship between expectancies and reactions. At step two of the final regression, the effect of expectancies on reactions when controlling for videogame self-efficacy was still significant $b = .25$, $t = 2.04$, $p = .046$, indicating a partial rather than a complete mediation. Therefore, H2 was supported.

Table 1: Means, Standard Deviations, and Intercorrelations

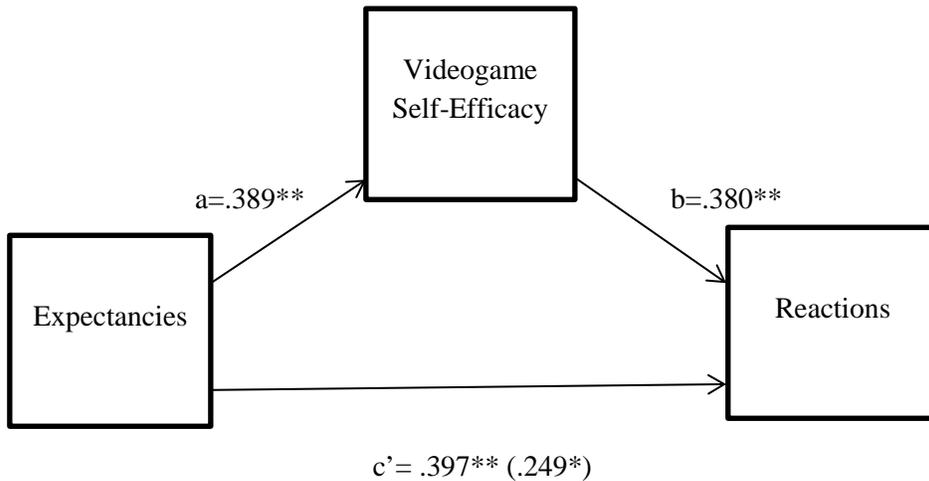
	M	SD	1	2	3
Expectancies	37.36	3.88	-		
VGSE	39.86	10.02	.389*	-	
Reactions	57.66	8.54	.397*	.477	-

Note: * $p < 0.01$

Table 2: Regression Analyses

	R	R ²	R ² Change	Beta
Regression 1:				
Reactions on Expectancies	.397	.157**		.397**
Regression 2:				
VGSE on Expectancies	.389	.151**		.389**
Regression 3:				
Step 1: Reactions on VGSE	.477	.228**		.380**
Step 2: Reactions on Expectancies	.529	.280*	.053	.249*

Note: * $p < 0.05$ ** $p < 0.01$



Note: * $p < 0.05$ ** $p < 0.01$

Figure 1: Mediation Model

DISCUSSION

Implications

The findings supported both the first and second hypotheses. Videogame self-efficacy was found to mediate the relationship between pre-training expectancies and post-training reactions. However, as the results show, videogame self-efficacy partially, rather than completely, mediates this relationship.

The first analysis revealed that expectancies significantly predicted trainee reactions. This suggests that what the trainees expected in terms of the utility of the treatment mechanism in attaining desired outcomes (e.g. prevention of PTSD) remained relatively stable even after playing the game. This is consistent with a substantial amount of prior research within the training literature (e.g. Tannenbaum, Mathieu, Salas, & Cannon- Bowers, 1991) that have found expectancies to play a critical role in the development of reactions. Thus, this study revealed that this relationship holds true within a mental health context. These findings could have potential implications regarding the effectiveness of the game as a treatment or preventative technique. If expectancies predict reactions, this implies that attitudes regarding the training remain relatively fixed, regardless of how efficacious the training may actually be. According to expectancy theory, which is based on motivation, a trainee with low expectations for a training program would not likely exude a sufficient amount of effort to successfully complete the training program. Furthermore, based on the findings in the present study, it would be expected that the trainee would also experience more negative reactions towards the training. As past research has found reactions to be predictive of training effectiveness (e.g. Mathieu, Tannenbaum, & Salas,

1992), it can be expected that negative reactions could reduce the effectiveness of even the most well designed treatment.

According to past research, the idea that expectancies predict reactions is unequivocal. However, the literature has not established how or why this relationship exists. In seeking a cause for this relationship, videogame self-efficacy was examined as a potential mediator. While videogame self-efficacy was found to mediate the relationship between expectancies and reactions, it was a partial rather than a complete mediator. This indicates that videogame self-efficacy is one of multiple mechanisms through which expectancies influence reactions, or that expectancies has a direct as well as an indirect effect on reactions. That is, part of the effect of expectations is mediated by videogame self-efficacy, but other parts are either direct or mediated by other variables not included in the model. Therefore, a fruitful avenue for future research may involve the examination of other potential mediating variables of the expectancy-reaction relationship.

Videogame self-efficacy as a partial mediator of the expectancy-theory relationship has implications regarding the use of virtual reality as a preventative technique for PTSD. First, this implies that self-efficacy is the mechanism by which expectations lead to reactions. Therefore, the use of a serious game may be more effective for patients that hold high expectations for the game, and are thus high on videogame self-efficacy. As mentioned early, individuals high on self-efficacy not only exude greater effort in completing the task, but also experience greater enjoyment throughout the task, and are therefore more likely to have positive reactions. If self-efficacy influences reactions (as suggested by the present study), and reactions influence training

effectiveness (e.g. Mathieu, Tannenbaum, & Salas, 1992), then it may be that individuals high on self-efficacy will experience greater outcomes as a result of the game than individuals who are not. However, it is important to note that self-efficacy can be increased. According to Bandura (1997), psychological arousal is one of four ways to enhance self-efficacy. Therefore, it may be that if the game presented in a way that is likely to engage the learner, expectations will become more positive, in turn increasing self-efficacy. Bandura (1997) goes on to suggest that enactive mastery (positive and rewarding experiences with the treatment or learning tool), vicarious learning (modeling), or simple verbal persuasion can also increase self-efficacy. Given the malleability of this construct, it is possible that virtual reality has the potential to be accepted and perceived as useful, regardless of initial levels of videogame self-efficacy.

Study Limitations

This study would have benefited from a larger sample size. In order to increase statistical power and generalizability of the findings, this should be replicated with a larger sample size. Another study limitation includes the use of an undergraduate student sample. While the results revealed in the study have practical implications for the use of serious games in the mental health field, results obtained from individuals within the target population would be more meaningful. Thus, this study should be replicated using a military sample.

Future Research

As only a partial mediating effect of videogame self-efficacy was found, it is implied that other variables may be at work in the expectancy- reaction relationship. Consequently, it may prove useful to examine the role of other potential mediators, such as learning orientation or

openness to experience. A greater understanding of the expectancy-reaction relationship may also be harnessed through extending the model tested in the present study to a moderated mediation model by considering the effects of potential moderators (e.g. immersion or flow) . The effect of expectations on reactions via videogame self-efficacy may differ depending on levels of a moderating variable.

While the present study demonstrated that the expectancy-reaction relationship holds true in the mental health field, future research should examine how this relationship predicts treatment outcomes. As mentioned earlier, previous research within the training literature has established that training reactions predict training outcomes. Therefore, future studies should examine how reactions to a serious game for mental health predict treatment outcomes in terms of transfer of learning and effectiveness.

APPENDIX A: EXPECTANCIES SCALE

#	Item	Strongly Disagree				Strongly Agree
1	I expect that the game will be useful for preparing for the psychological challenges faced during deployment.	1	2	3	4	5
2	I expect that the game will be an effective tool for learning techniques to cope with post-traumatic stress.	1	2	3	4	5
3	I expect that I will be to apply what I learn throughout the game in the real world.	1	2	3	4	5
4	I expect that the game will be interesting.	1	2	3	4	5
5	I expect that my interaction with the game will be clear and understandable.	1	2	3	4	5
6	I expect that the game will be capable of bringing about a change in behavior and attitude.	1	2	3	4	5
7	I expect that the game will cover topics that are important to learn.	1	2	3	4	5
8	I expect that learning to play the game will be easy.	1	2	3	4	5
9	I expect to be provided with opportunities to practice what I learn throughout the game.	1	2	3	4	5
10	I expect that the format of the training game is appropriate for learning.	1	2	3	4	5

APPENDIX B: VIDEOGAME SELF-EFFICACY SCALE

#	Item	Strongly Disagree					Strongly Agree
1	I can always manage to solve difficult problems within a video game if I try hard enough.	1	2	3	4	5	6
2	In a video game, if someone opposes me, I can find the means and ways to get what I want.	1	2	3	4	5	6
3	It is easy for me to stick to my plans and accomplish my goals in a video game.	1	2	3	4	5	6
4	I am confident that I could deal efficiently with unexpected events in a video game.	1	2	3	4	5	6
5	Thanks to my resourcefulness, I know how to handle unforeseen situations in a video game.	1	2	3	4	5	6
6	I can solve most problems in a video game if I invest the necessary effort.	1	2	3	4	5	6
7	I can remain calm when facing difficulties in a video game because I can rely on my coping abilities.	1	2	3	4	5	6
8	When I am confronted with a problem in a video game, I can usually find several solutions.	1	2	3	4	5	6
9	If I am in trouble in a video game, I can usually think of a solution.	1	2	3	4	5	6
10	I can usually handle whatever comes my way in a video game.	1	2	3	4	5	6

APPENDIX C: TECHNOLOGY ACCEPTANCE MODEL SCALE

1	Playing the game would improve my overall performance while learning techniques to cope with post-traumatic stress.	1	2	3	4	5
2	Playing the game would increase my productivity while learning techniques to cope with post-traumatic stress.	1	2	3	4	5
3	Playing the game would enhance my effectiveness while learning techniques to cope with post-traumatic stress.	1	2	3	4	5
4	I find playing the game to be useful for learning how to cope with post-traumatic stress.	1	2	3	4	5
5	To better learn how to cope with post-traumatic stress, I would intend on playing the game frequently.	1	2	3	4	5
6	To better learn how to cope with post-traumatic stress, I would intend on playing the game competitively.	1	2	3	4	5
7	Learning to play the game is easy for me.	1	2	3	4	5
8	I find it easy to do what I want it to do in the game.	1	2	3	4	5
9	My interaction with the game is clear and understandable.	1	2	3	4	5
10	I find the game is easy to use.	1	2	3	4	5
11	I believe I have the ability to access the game myself.	1	2	3	4	5
12	I believe I have the ability to operate the functions of the game myself.	1	2	3	4	5
13	I believe I have the ability to understand the scoring output of the game program myself.	1	2	3	4	5
14	I believe I have the ability to complete the game myself.	1	2	3	4	5
15	I enjoyed playing the game.	1	2	3	4	5
16	I thought the game was a lot of fun to play.	1	2	3	4	5

APPENDIX D: APPROVAL OF HUMAN RESEARCH



University of Central Florida Institutional Review Board
 Office of Research & Commercialization
 12201 Research Parkway, Suite 501
 Orlando, Florida 32826-3246
 Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1
 FWA00000351, IRB00001138**

To: **Clint A. Bowers and Co-PI: Christine P. Kreutzer**

Date: **October 11, 2013**

Dear Researcher:

On 10/11/2013, the IRB approved the following human participant research until 10/10/2014 inclusive:

Type of Review: UCF Initial Review Submission Form
 Project Title: The Role of Expectations in the Perceived Usefulness and Acceptance of Virtual Reality as a Preventative Technique for Post-Traumatic Stress Disorder
 Investigator: Clint A Bowers
 IRB Number: SBE-13-09618
 Funding Agency:
 Grant Title:
 Research ID: N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <https://iris.research.ucf.edu>.

If continuing review approval is not granted before the expiration date of 10/10/2014, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewska, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 10/11/2013 03:07:20 PM EDT

IRB Coordinator

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