Integrating Gaming-Based Technologies into Exposure-Based Therapies: Fostering Warfighter Preparedness

Kelly Reene, Marjorie Crozier
Lockheed Martin/University of Pennsylvania
King of Prussia, PA/Philadelphia, PA
kelly.j.reene@lmco.com, marjorie.crozier@lmco.com

Garabed (Gary) Sarkessian
Lockheed Martin
King of Prussia, PA
gary.a.sarkessian@lmco.com

ABSTRACT

A substantial number of returning service men and women experience symptoms of Post Traumatic Stress Disorder (PTSD). One study (Hoge et al., 2004) found that as many as 20% of returning soldiers from Iraq met the criteria for PTSD. The preparedness of these individuals for non-deployed activities, as well as future deployments, hinges on their seeking and receiving effective psychological treatment. The veteran population may perceive a high level of stigma associated with seeking mental health treatment (Friedman, 2004) and thus may not seek out treatment opportunities that would enhance quality of life and optimize their ability to execute future military missions. Therefore, removing barriers that may lead to the avoidance of treatment is essential. Leveraging innovative gaming technologies for therapeutic purposes may help reintegrate returning soldiers into their personal and professional lives without the fear and uncertainty that often accompanies PTSD.

This paper focuses on integrating gaming and exposure-based treatment approaches for those with anxiety disorders such as PTSD. Recent research has examined the incorporation of Virtual Reality (VR) immersion and simulation techniques that utilize equipment such as helmets to increase a sense of presence in re-created scenes. In contrast, this paper focuses on the potential benefits of utilizing first-person game technology that does not rely on Virtual Reality apparatuses. The ultimate goal is to reach a state of enhanced preparedness for returning to duty and navigating life circumstances. This paper describes the strategy and use of first-person gaming technologies based on frameworks such as Virtual Battle Space 2 (VBS2) and Unity, with a focus on the advantages that these approaches may offer for successful preparedness outcomes.

ABOUT THE AUTHORS

Kelly Reene: Lockheed Martin Information Systems & Global Solutions (IS&GS).
Ph.D., Developmental Psychology, Temple University; MBA, Drexel University. Dr. Reene is a member of Lockheed Martin's Human Terrain campaign, a group which focuses on utilizing a blend of social sciences theory and technology to understand or analyze socio cultural dynamics. Her research interests include fostering of resiliency via virtual environment experiences.

Marjorie Crozier: Lockheed Martin Information Systems & Global Solutions (IS&GS).
Ms. Crozier has a Master's in Clinical Psychology and is currently completing a Doctorate in Clinical Psychology at La Salle University in the Doctor of Psychology Program. She has previously done research at the Center for the Treatment and Study of Anxiety at the University of Pennsylvania in the areas of Post Traumatic Stress Disorder and Obsessive Compulsive Disorder. She has also done extensive clinical work with anxiety disorders in adults. She is interested in the incorporation of new technologies into the existing cognitive behavioral treatments for PTSD.

Garabed (Gary) Sarkessian: Lockheed Martin Information Systems & Global Solutions (IS&GS)
B.S. Mechanical Engineering and Applied Science, University of Pennsylvania, Philadelphia, PA. Mr. Sarkessian is a systems engineer and integrator working on IS&GS' Human Terrain campaign. Recent accomplishments include submittal of a paper in response to an IARPA Request for Information.

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In our current and continuing world climate, where as many as 20% of service men and women return from deployment experiencing symptoms of PTSD (Hoge et al., 2004), the use of virtual environments (VEs) as a supplement to traditional therapy offers positive possibilities for reintegration back into their personal and professional lives. Alternatives to traditional therapy may be especially key for the soldier population, in which a high stigma of seeking mental health treatment is still evidenced (Friedman, 2004). Wilson et al. (2008) found that in a survey of over 300 U.S. soldiers, a third who indicated that they were not inclined to meet in person with a therapist expressed willingness to use technologies for their therapy, such as contact via e-mail, therapy programs via the Internet, and VR-based therapy. Though promising, it should be noted that this survey sample was predominantly young and male, a population that may be more prone or open to using VE technology, given that their generation has a higher proportion of digital natives than those generations who did not grow up in an era where technology was omnipresent. Successful re-acclimation is three-fold and key to what is being put forth for consideration in this paper: 1) reaching the population of service men and women who are experiencing PTSD in a way that minimizes the stigma of seeking treatment, 2) reaching those in remote or rural areas who likely do not have access to the breadth of services offered at large-scale treatment centers, and 3) ensuring that this potentially stigma-reducing therapeutic approach has a level of ease-of-use that fosters its adoption by therapists.

Although there are early adopters of VE technology in its various technological forms, the psychological community has been slow to embrace its adoption. Root causes for this lack of widespread use include the lack of empirical data about its efficacy and the absence of cost-effective and user-friendly applications. For these reasons, we see the opportunity to examine new methods of incorporating technology into traditional therapy models in an effort to facilitate widespread access to effective treatment for all of our veterans and military personnel. The approach under consideration and that will be described in this paper does not, on the surface, radically depart from current exposure types of therapies. Rather, it identifies key parts of the therapeutic process (in-session narratives as well as between-session assignments) for which VE technology can potentially bolster the effectiveness of therapy as well as provide a level of lightness that does not require an extensive VE clinical lab (which is often only available at major treatment centers). In this paper we describe a way to integrate existing VE technology into a therapeutic setting to address current gaps in PTSD treatment.

PTSD OVERVIEW

Before we describe the approach under consideration, we summarize the symptomatology of PTSD to underscore its debilitating effects. PTSD is a specific type of anxiety disorder that occurs following a traumatic event in an individual's life. Traumas can come in many forms, including natural disasters, physical or sexual assault, car accidents, or combat experience. Over the course of a lifetime, 81% of people will experience the type of trauma that could lead to PTSD (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). While not all traumas result in a diagnosis of PTSD, most people experience some of the symptoms common in PTSD immediately following the traumatic event. For the majority of people, these symptoms go away after a brief period of time, but for some individuals these symptoms become chronic (Kessler et al., 1995). It is these individuals who then meet criteria for a PTSD diagnosis.

Symptoms of PTSD are clustered into three general categories: re-experiencing, hyperarousal, and avoidance. Re-experiencing symptoms can come in several forms, but often include nightmares about the trauma, flashbacks of the trauma, and intrusive thoughts or memories of the incident. Hyperarousal symptoms include the inability to sleep, concentration problems, being easily startled, checking for safety, increased irritability, and outbursts of anger. Avoidance symptoms typically involve avoidance of situations, places, or people that trigger memories of the trauma, avoidance of thoughts and feelings related to the trauma, avoidance of close relationships, foreshortened future, difficulty remembering the entire trauma memory, and emotional numbing or flattening. In order to meet diagnostic criteria for PTSD, an individual must have multiple symptoms in each symptom cluster that persist for a period of at least one month and cause significant impairment in their daily functioning (DSM-IV-TR). Adverse implications for one's daily life can be profound.

Epidemiology of PTSD

The prevalence of PTSD in the general population varies depending on a variety of factors, including age, gender, and socioeconomic status, with some types of trauma more likely to result in a PTSD diagnosis than others. Combat trauma is the second most likely type of trauma to result in a diagnosis, exceeded only by sexual assault (Kessler et al., 1995). For example, a study conducted in the late 1980s examining the rate of PTSD in Vietnam-era veterans found that 31% of men and 27% of women had a lifetime diagnosis of PTSD, while 15% of men and 8% of women still carried a diagnosis of PTSD (Kulka et al., 1990). A similar study conducted with Gulf War veterans indicated that the lifetime prevalence of PTSD in that population was 12%, with 10% currently meeting criteria for PTSD five years after the war ended (Kang, Natelson, Mahan, Lee, & Murphy, 2003). For Operation Enduring Freedom (OEF)/Operation Iraqi Freedom (OIF) military personnel and veterans, the estimates of prevalence for current diagnoses of PTSD range from 13% to 20% (Hoge, et al., 2004; Tanielian, & Jaycox, 2008; United States Government Accountability Office, 2009). These numbers indicate that not only is this a significant problem for service members returning from deployment, but many are not seeking or receiving effective treatment.

Financial Cost of PTSD

In addition to the effects of PTSD on quality of life, with its many ramifications both personally and professionally, the financial costs are immense. Since 2001, the U.S. has deployed over 1.6 million soldiers to Iraq or Afghanistan. This figure indicates that at least 36,000 OIF/OEF veterans are experiencing symptoms consistent with a diagnosis of PTSD. For each member of the armed services diagnosed with PTSD, the military can expect to spend approximately $1 million dollars in health care-related costs over that individual's lifetime, resulting in billions of dollars spent on health care related to a single psychological condition (Weiderhold, 2010). Each year in the U.S. alone, over $42 billion is spent on medical and psychological care for individuals diagnosed with PTSD. Given this high cost on multiple levels (financially; oneself, as well as family and friends; professional; military missions), it is no surprise that the Department of Defense and the Department of Veterans Affairs have made training, dissemination, and research in effective treatment for PTSD a priority throughout the health care systems over the past several years.

THERAPEUTIC APPLICATIONS OF VEs

Therapeutic applications of VEs have increasingly expanded since their advent two decades ago. As has been extensively noted (e.g., Botella et al., 2006), early applications showed promising results with simple phobias, and while not without methodological limitations, subsequent studies continue to produce promising results in areas ranging from pain management to addictions to PTSD. Further, project consortiums have been created to empirically explore how therapeutic change can be achieved via a VR system for treating conditions such as panic disorders and eating disorders.

Use of VEs to treat PTSD began in the mid 1990s. Virtual Vietnam (Rothbaum, Hodges, Ready, Graap, & Alarcon, 2001) used a combination of Virtual Reality Exposure Therapy (VRET) and imaginal exposure to treat 16 Vietnam veterans. For this study, two separate immersive environments were created in a VR system, one of a Huey helicopter and another of a clearing in a jungle. Veterans were exposed to the VR scenario that was the most similar to their trauma. Two sessions were devoted to learning about the VR environment and all remaining sessions were conducted in the VR scenario while the veteran narrated his trauma. Throughout the process, the therapist made an effort to control the VE so that it matched the veteran's narrative. Thus, neither was the patient in control of the scenario nor was the scenario customized for the patient's specific trauma. There was some limited personalization used by the therapist to control sound effects and the position of the helicopter. While significant reductions in PTSD symptoms were seen at post-treatment and three- and six-month follow-up, the average symptom severity score was still in the clinical range at post-treatment and follow-up. While these findings are consistent with previous research in PTSD treatment, particularly in studies examining Vietnam veterans, it leaves room for improvement in future supplements to traditional treatment packages. Although there were drop-outs in the study, the attrition rate was not statistically different from other studies of a similar nature. This similarity in attrition to traditional therapy shows that this is a palatable option for patients of varying age ranges, including those that are not considered digital natives.

This research group later developed two additional VR systems: Virtual Iraq, which is designed for those suffering from PTSD related to OEF/OIF; and a second system designed for those experiencing symptoms following the attacks on the World Trade Center (Difede et al., 2007). Together these systems have been used to treat individuals in the therapist's office using gradual exposure to trauma-related cues. These systems use a graduated exposure strategy that starts with a less anxiety-provoking stimulus before gradually stepping up the intensity of the exposure activity. This type of graduated exposure varies slightly from traditional Prolonged Exposure therapy (PE), which focuses on repeated and prolonged exposure to the trauma memory in its entirety, starting in the first exposure session. These systems have so far been incorporated in larger health facilities in a clinical lab setting, making extensive use of head-mounted displays (HMDs) and multi-sensory experiences. There is little data published on the efficacy of these newer systems in large-scale research trials, but preliminary findings have shown this multi-sensory VR experience to be effective in reducing symptom severity in PTSD.

Clinical Considered Approach

To help bolster service members' re-acclimation to their lives after evidencing PTSD, we suggest consideration of an approach that incorporates concepts and practices that have been emphasized as instrumental in effecting physical or real-world (RW) change. We suggest utilization of a theory-driven approach, based on Foa's emotional processing of fear model (Foa and Kozak, 1986). Using the treatment principles based on this model, a person faces a situation or memory that triggers his or her fear and anxiety and, through additional encounters with that situation, habituates to and eventually extinguishes the anxiety. Current PTSD treatments that utilize VEs do not incorporate use of VE technology outside of the therapy session, whereas this is a key element of the considered approach.

It is important to consider that VE technology is intended to supplement therapy and not to replace traditional therapy. Incorporating a VE into traditional exposure-based treatment for PTSD involves several steps to effectively create a treatment protocol for the individual patient. After collecting basic demographic and trauma information and explaining the exposure rationale for treatment, the clinician and the patient work together to create the trauma scene within a VE. This process involves selecting a pre-created starting scenario and customizing it with patient input on important people, events, and situations that were present at the time of the trauma. Once this individualized scenario has been created, the patient "walks" through the VE while narrating his or her trauma in as much detail as possible, just as he or she would in an imaginal exposure. The important difference here is that, instead of visualizing the scene with eyes closed as in a typical session, the scene is displayed in the VE to enhance the realism of the experience.

Further, both the visual scenario "walk-through" and the audio narration are recorded so that they can be replayed repeatedly as homework between the sessions in the same way that imaginal exposure tapes are replayed at home in PE. This added visual element dimension is likely to bolster the effect of the exposure exercise by adding an additional sensory dimension. At the beginning of each new session, the clinician and patient would have the option to add additional details to the VE if new details are remembered.

This feature is not currently available in systems such as Virtual Iraq, due in part to the hardware needs of such a system. A gaming-based system such as the one we suggest offers the possibility of increased access to the VE between sessions. Several additional key factors set this approach apart from other existing systems of technology-enhanced treatment. Early research into treatment for anxiety disorders using VR technology was aimed at specific phobias, such as fear of flying and fear of heights. For these conditions, it is difficult and expensive to utilize *in vivo* exposure, the most effective treatment for specific phobias. VR systems aimed to replace *in vivo* exposure by providing a high-fidelity, immersive experience to simulate the RW environment of the feared stimuli; i.e., heights or flying. The ability of the patient to feel the realism in these VR systems has enabled the generalization of learning to the RW. A preponderance of VE therapeutic applications utilize HMDs and tracking systems (e.g., Riva et al., 2003; Malbos et al., 2008; Galimberti & Belloni, 2003; Botella et al., 2004; Moon & Lee, 2009). Although it is commonly cited that the use of HMDs increases the level of immersion (and therefore, presumably presence) experienced by the patient and potentially increases efficacy of therapy, additional studies are needed in order to empirically examine this assertion further. What is important is that each patient is immersed to the extent necessary to fully emotionally engage in the environment in order to change his or her "fear structure" with or without an HMD. Botella and colleagues (2008) found that it was possible for VR scenarios to "activate the participants' anxiety during the exposure sessions, even without using an HMD" (p. 663). Therefore, an HMD does not necessarily translate into an immersive VE experience, nor is it a necessary requisite for a positive therapeutic outcome. Similarly, the extent to which multi-sensory stimulation aids in the efficacy of PTSD treatment has not yet been empirically established. The types of systems that currently exist utilizing such apparatuses and multi-sensory capabilities tend to be costly, as well as requiring extensive laboratory setup. In contrast, the approach described in this paper does not rely on extensive laboratory setup, so that service members in remote and rural areas can access a less stigmatizing form of treatment.

This latter approach is based partly on the works of those such as Blascovich (2002) who maintain that a highly realistic VE does not in and of itself lead to subsequent behavioral outcomes. In the context of immersive VE technology, Blascovich suggests that behavioral realism and social presence must "complement each other in order for social influence effects to occur." He finds that photorealism, an aspect of behavioral realism, is not always a necessary component of social influence. This may well be the case with PTSD treatment also. With respect to therapeutic applications of a VE, we suggest that there is likely a "good enough" level of rendering fidelity (Walshe et al., 2005) and sensory experience. Consequently, a key aspect of this approach is the creation of a VE that makes sense to the patient without needing to be hyper-realistic or multi-sensory. Additionally, when a factor, such as sound, is salient to the patient's trauma memory, then it should be incorporated into the VE. Indeed, notions such as "silence is absurd in a supermarket" (Galimberti & Belloni, 2003) highlight the salience of factors such as sound that are essential to a "good enough," one-size-does-not-fit-all rendering within a VE. A VE needs only allow the patient to emotionally engage in the trauma memory and, while the level of fidelity needed may vary between patients, it is possible to create a cost-effective, easily deployable VE that meets these requirements. Thus, this approach is based on the fact that in imaginal exposure treatment, the currently accepted efficacious treatment for PTSD, subjective ratings of vividness of the imagery are irrelevant (Rauch, Foa, Furr, & Filip, 2004) and thus only add cost and complexity to the technology package.

Several additional factors or "best practices" that contribute to an effective clinical VE could be leveraged. These factors include: (a) a safe experiential context with ecological validity; (b) an environment that helps increase an awareness of perception versus cognition, a necessary component of psychological and behavioral change (Riva et al., 2003); (c) empowering patients to create their own, self-relevant experiences that enable a sense of efficacy, thus furthering engagement in the therapeutic process; (d) the use of VR as a form of "supportive technique," with positive implications for the therapeutic relationship; (e) recognition of individual predisposing factors that play a role in the efficacy of therapy; and (f) a one-size-does-not-fit-all paradigm, such that a therapist can readily tailor "base" scenarios to the needs of each patient.

TECHNICAL CONSIDERATIONS

In order to create affordable, customizable trauma scenes within a VE, the clinician would need to have a Commercial Off-the-Shelf (COTS) tool. There are a number of COTS products available; however, none are currently designed for use by the medical and psychological community that are both combat-oriented and allow for rapid scenario generation without significant training or financial costs. Therefore, this technical discussion begins with an overview of COTS products that could serve as a platform for the development of a clinical gaming environment as has been previously described. We suggest a system be developed by creating what is commonly known as a wizard, along with a graphical user interface (GUI), which would be integrated and overlaid onto the COTS product. The goal is to create an integrated platform that allows clinicians, even those in remote or rural locations, to rapidly create PTSD scenarios that resonate with their patients. We will conclude our technical discussion with an overview of how such a system would function in a clinical setting.

Key Needs of Patient and Therapist

In order to assess the feasibility of creating an affordable and easily accessible clinical gaming environment for PTSD, we examined a number of commercially available software (SW) products. Precluded from this discussion are products that are not currently publicly available (DARPA RealWorld), those with restricted commercial usage (VBS2 Personal Edition), or those that are for military use only (VBS2 Lite and RealWorld). Included in this discussion is a currently available system known as Virtual Iraq, which is compared to the approach considered in this paper.

Table 1 summarizes commercially available game-based SW products that allow for the development and integration of a GUI and wizard. This table summarizes some advantages and disadvantages of the different platforms, and highlights relevant areas that would affect clinician adoption of this technology. For each of the three platforms, we compare the ease of scenario creation by a clinician, and the adaptability of the SW for integration into a combat-oriented scenario creation platform.

Table 1. Comparison of COTS Tools in the Context of VE Treatment of PTSD

Platform or Environ-ment	Ease of Use by a Clinician*	Adaptability for Combat Scenarios by Developer**
Most Relevant Approaches		
VBS2	**2 As Is** **4 To Be**	**5**
Unity Pro	**0 As Is** **4 To Be**	**3-4**
Also Considered		
"Virtual Iraq" Gamebryo Engine	3	4

* Ease of Use: 0 – No Ability; 1 – 2D Editor; 2 – 3D Editor; 3 – Requires some training; 4 – Similar to using MS Word; 5 – Anyone could use it with no training at all
** Adaptability: 3 – Needs additional imported and created assets and created SW scripts; 4 – Needs additional imported and created assets; 5 – Needs only very minor modifications to assets and scripts

Virtual Battle Space 2 (VBS2), by Bohemia Interactive Australia (BIA), is currently being used by the U.S. Army and Marine Corps, as well as militaries in various NATO countries for military exercise training (Atherton & Baxter, 2009). VBS2 has been used by the U.S. Army and the Marine Corps for years, with both organizations having free enterprise license agreements with BIA since August 2009 and August 2006 respectively. It is also possible that in the future BIA would extend its enterprise licensing agreement to cover VA hospitals. Even without this enterprise licensing agreement, however, VBS2 is a highly affordable option. Further, training or mission scenarios created by the Army and Marine Corps could be used by anyone with a VBS2 license and the permission of the creator. This versatility makes this COTS tool ideal, as scenarios could be imported from military training servers to VA hospital servers for use in PTSD treatment.

Unity Pro is a multi-platform game development tool used by the gaming industry for the creation of high-fidelity games, training, simulations, and visualizations. It is a low-cost, lightweight, agile platform with drag-and-drop functionality, an advanced physics engine, and an advanced, customizable, easy-to-use, and fully integrated level editor. These features not only make Unity Pro ideal for game development but can be adapted for creating PTSD treatment scenarios. Unity also has a very large user base, which means that there is a depth of graphical content (3D models), SW scripts, and graphics (maps, locations, and scenes) that can be purchased and integrated into a Unity-developed VE.

Finally, the Institute for Creative Technologies' (ICT) Virtual Iraq is a VR therapy application that was based on a U.S. Army-funded combat tactical simulation scenario game, Full Spectrum Warrior (Pair et al., 2006). It employs an HMD for visual stimuli and provides directional 3D audio, vibrotactile, and olfactory stimuli (Rizzo et al., 2008). In therapeutic settings, patients often hold realistic firearms as they are immersed in a sensory-rich experience that functions as a mood and memory aid within VRET. Costs of this system have been cited as being approximately $70,000 for a two-scenario package (Anderson, 2007). This is substantially higher than the estimated costs for a gaming based system using VBS2 or Unity such as we have been discussing.

In Table 1, the information in the "Ease of Use by a Clinician" column describes how easily a clinician could create a combat scenario that would meet the needs of a patient who is being treated for PTSD. For VBS2, with the current scenario editor, we rated it a 2 out of 5, with 5 being extremely easy and 0 meaning unable to effectively use it without extensive training and special gaming software skills. However, we postulate that after a wizard is created and a scenario creation GUI developed, the ease of use for a clinician would increase to a 4. This interface would be similar to using Microsoft Word for most users.

For Unity Pro, since the game has no scenario editor at all, it is unusable by a clinician in its current state. In order for Unity to be the basis of a clinical gaming environment, it would be necessary to develop additional SW (a fully integrated wizard and GUI) that would allow a clinician to create a PTSD scenario in session with a patient without extensive SW training.

Between the two, VBS2 has an advantage, with a vendor-provided (out-of-the-box) 3D scenario editor and its own GUI. However, the VBS2 GUI still requires a person to extensively read the manual or undergo training in order to learn how to operate it effectively. VBS2 also requires a practitioner to understand how to write software scripts. With Unity, SW scripts function as the artificial intelligence (AI) engine, whereas with the VBS2 approach, this COTS tool already has an integrated AI engine.

To be clear, it is not recommended that PTSD clinicians utilize VBS2 out of the box. This application would require far too much orientation and intensive training than would be possible in most VA hospitals, health care institutions, and specialty clinics. Therefore, both platforms need to be further developed and modified with a wizard and GUI to make it simple for a clinician to use in session with patients without extensive training. The "to be" state for both approaches would be the COTS platform, modified for clinical use.

Virtual Iraq is already deployed and in use, therefore the rating of a 3 is based on its use by clinicians at over 45 locations (Virtual Iraq, n.d.).

In the area of adaptability for combat scenarios, we rated VBS2 the highest because it comes with an extensive set of tailorable, military content. VBS2 is a highly capable out-of-the-box, military-oriented gaming environment. With VBS2, scenarios can be created from any number of vendor-supplied or user-developed locations. Scenarios can be created within vendor-supplied locations in urban or rural settings, European or Middle Eastern villages, towns, deserts or remote islands, the "Green Zone" in Baghdad, and other Iraqi or Afghani locations. Within any of these locations, there is the ability to add a variety of military personnel and civilians, military and civilian vehicles such as Humvees, cars, helicopters, fixed-wing planes, and tanks, as well as buildings and objects. Convoys, IED scenarios, checkpoints, artillery, snipers, building searches, and civilian interactions are all scenarios that can be developed. Patients also have the ability to use night vision or thermal vision (infrared) goggles within the game. Finally, the time of day, day of year and weather conditions can all be tailored for a scenario as well as modified as the scenario progresses.

We rated Unity Pro as a 3 or 4 once appropriate 3D assets have been added to the gaming platform's library. Unity Pro is rapidly gaining in popularity within the gaming, training, and simulation community, which means its functionality and versatility will continue to improve.

Between the two, VBS2 would be far easier for a developer to build upon, since Unity Pro has no existing scenario editor, requiring a developer to create one prior to beginning the development of an integrated scenario editor GUI.

Virtual Iraq has six scenario settings. "All scenarios can be adjusted for time of day, weather conditions and lighting" (Pair et al, 2006 p. 67). Additionally, Virtual Iraq has multi-sensory systems including olfactory and tactile stimuli. As previously noted, however, these features may not altogether be necessary to an effective treatment system for PTSD.

In conclusion, though not without limitations, Unity and VBS2 present viable options for use in a therapeutic setting. Both have the potential of becoming a basis of a clinical gaming environment without the cost, portability and training barriers of a lab-based VR systems approach.

Technical Considered Approach

Figure 1 describes the concept of operation for the creation of a clinical gaming environment after the COTS product (e.g., Unity or VBS2) has been combined with an initiation wizard and a scenario-generation GUI. In order to create the PTSD scenario, the clinician would work with the patient in a therapeutic setting and use the wizard SW to begin the scenario generation. The wizard would consist of several questions related to the combat scenario with multiple options available for each. At the end of the wizard, a baseline scenario is established to match the needs of the patient, with necessary people, buildings, vehicles, and objects placed within the scene, and saved locally to a file on the clinician's computer. Next, the clinician would retrieve the newly created PTSD baseline file and begin to review what has already been created within the wizard. As the patient begins to describe and elaborate on the particular sequence of events that were of significance, the clinician would utilize the scenario creation GUI to capture these events within the scenario file. This phase of the therapeutic process allows the patient to have some control over the creation of the VE to maximize the relevance of the VE for that particular patient.

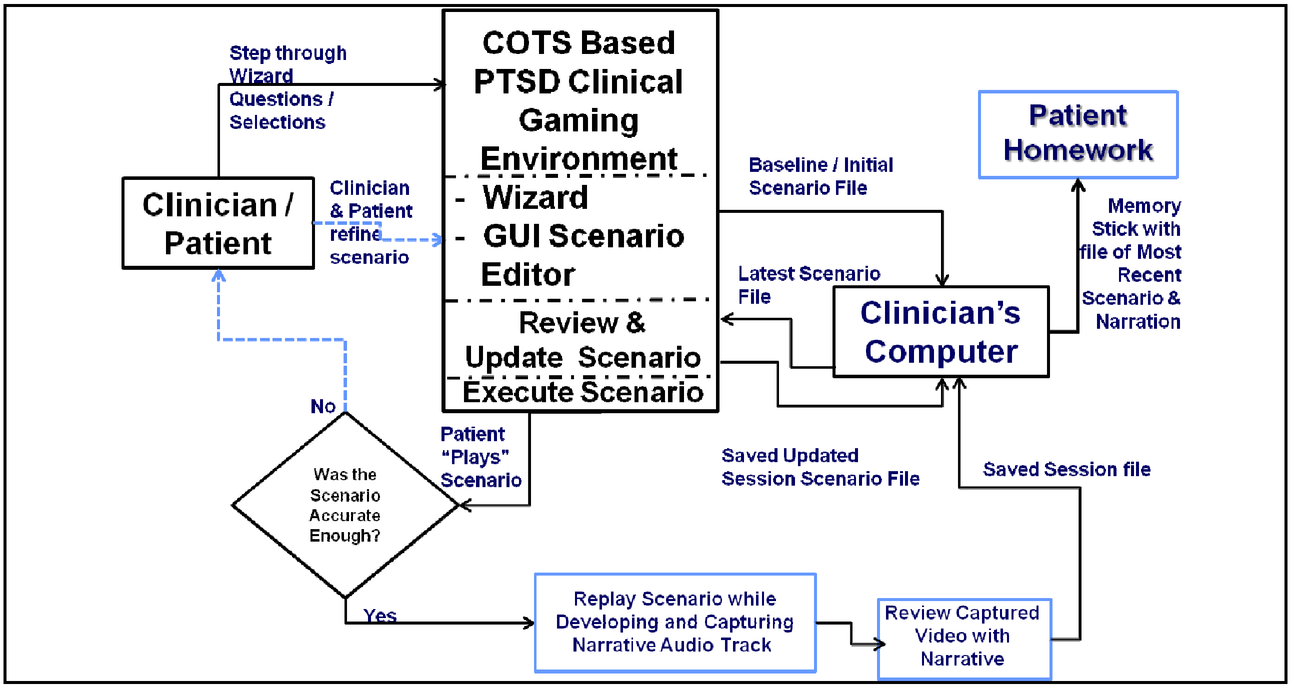

Figure 1. Concept of Operations

After the clinician and patient have used the GUI once, the patient will walk through the scenario. After the first time through, the scenario may need to be modified to make it accurate enough, from the patient's perspective, for effective treatment. After reviewing the scenario and updating it as necessary, the scenario will be accurate enough for the creation of the patient's exposure exercise. In the case that the platform is VBS2-based, the GUI automatically opens video capture software (such as FRAPS) and records the scenario as it is being played by the patient. Then the GUI opens Microsoft Windows Movie Maker, imports the video file, and prompts the patient to watch the captured video while providing his/her trauma narrative just as in traditional PE. This recording will be the second audio track recorded along with the initial VBS2-provided sound of the scenario. In the case of development based on Unity, no separate video capture is necessary. The game file can stand alone, since the Unity SW can be freely distributed with the game file to the patient. The narrative is to be created by the patient and captured as an audio file that is linked to the Unity-based scenario file. By utilizing SW that allows for audio capture, it creates the possibility of using a portable version of this file as a between-session exposure assignment similar to the audio recordings in traditional PE.

This file with the video capture and narration would be saved to the clinician's computer and on a memory stick or DVD and given to the patient to take home. The patient would be instructed to watch this video at home on his/her computer by simply opening up the .wmv file, in the case of the VBS2 -based platform. In the case of Unity 3D, the patient would receive a Unity data file along with a narrative audio file that would run concurrently, driven by the Unity SW loaded onto the memory stick or DVD. In both cases, watching the video file with narration replaces the audio file homework given in traditional PE.

CONCLUSIONS

Given the large number of returning military personnel that are affected by PTSD and the debilitating effects it can have on personal and professional quality of life, technology is increasingly being leveraged to enhance efficacy of existing treatment models as well as increase access to effective treatment for those in remote areas. The approach described in this paper is intended to address both of these areas in a way that increases access, efficacy, and ease of use while decreasing cost and stigma.

When treatment research using VR has been initiated for patients with PTSD, high-fidelity, multi-sensory environments were emphasized. These high-fidelity environments, while effective, often have a high cost associated with them and fewer customizations available than in the system we suggest for consideration. This customization is particularly important when considering a disorder such as PTSD, which must be a highly personalized treatment process. Engagement in the specifics of the trauma memory is particularly important for individuals in treatment for PTSD. The high level of customization possible within a gaming-based approach aims to increase engagement in the specific details that are salient for the individual patient, with the hope that this will lead to a more relevant treatment.

In this system, the patient would engage in simultaneous virtual and imaginal exposure rather than replacing imaginal exposure with a VE. The visual elements present in the VE assist in the engagement process, particularly for individuals who have trouble visualizing the trauma memory but do not require the feeling of vividness from a high-fidelity environment. In this way, the same experience of engagement in the memory is possible with a less expensive, more portable, and easier-to-use technology package.

Another significant benefit of the system versus a VR lab-based system is portability. This approach allows the patient to access the VE scenario between sessions as homework. This contrasts with current practices implemented by VR lab-based systems. Additionally, a system such as described in this paper is capable of being set up in a small office in an outpatient setting, which significantly increases the accessibility of this type of system to remotely located individuals. VA community access centers or other small-scale clinics that might not be able to afford the larger lab-based set-up would benefit greatly from having another game-based exposure therapy option. This would allow for more widespread access to this type of beneficial technology in remote or rural settings where treatment access has long been problematic.

Although on the surface this system does not represent a radical departure from traditional forms of therapy for PTSD, its new application of VE technology can have profound impacts on patient outcome. This approach should be considered a technological supplement to PE that is intended to increase the efficacy of the treatment model. By minimizing the changes to the existing forms of effective therapy, it is likely that this type of system has the potential to be more readily adopted by the psychological community.

Advantages of leveraging the types of COTS products we have described include portability, affordability, increased receptivity by patients to technology based treatment, likelihood of adoption. The use of the lighter weight technical approach allows therapists to create their patients' trauma scenarios with the capability for between session homework thus bolstering efficacy of treatment.

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