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Virtual Healing: Designing Reality

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From SIT to PTSD: Developing a Continuum of Care for the Warfighter

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BACKGROUND

The Virtual Reality Medical Center (VRMC) is currently conducting Stress Inoculation Training (SIT) and Posttraumatic Stress Disorder (PTSD) treatment for the United States Navy and Marine Corps, the combined result being a program that supports a continuum of care for troops.

PTSD affects an estimated 5.2 million Americans in any given year (NIH), often resulting in a diminished quality of life and considerable emotional suffering. The current rate of PTSD among Army and Marine Corps combatants returning from duty in Iraq is about 19%. Military experts believe the rate is following historical patterns for sustained ground combat and is still increasing. A continuing upward trend seems especially likely given the unique nature of the Iraq theater. According to recent reports, the number of Iraq War soldiers who will experience PTSD is higher than the Gulf War due to such factors as ground combat and long deployments (Litz, 2004). A recent survey of Soldiers and Marines deployed in Iraq describes a very high level of combat experience, with more than 90% of respondents reporting having been shot at (Hoge et al., 2004).

Clearly, PTSD is a serious health threat for military personnel. Learning to treat—or better still, prevent—this disorder is of paramount importance. It is our hope that SIT will help prevent or reduce rates of PTSD in returning troops. We at the VRMC have been working for the past 10 years to apply our clinical VR expertise to a full range of troop support, with the goal of providing effective tools for both pre- and post-deployment.

In regard to pre-deployment tools, we have developed stress inoculation training (SIT) and virtual environment tactical training to effectively teach personnel tactical and trauma care skills, enable them to practice stress management techniques, and to improve performance during real-life combat situations. Situations with very high stress and a cognitive load not often encountered in real life can be created in the simulation environment. These scenarios, combined with physiological monitoring, allow military personnel to train themselves to better process stress through techniques such as breath retraining and relaxation. In this way, cognitive skill hardening can be achieved.

For those personnel who require PTSD treatment post-deployment, we are developing and testing VR therapy environments. By placing a patient in a virtual Iraqi war setting, and then having him or her slowly experience that situation in a controlled way, the patient should begin to habituate to his or her specific PTSD symptoms and come to reappraise the situation, allowing emotional processing to fully occur. With the goal of allowing for the earliest possible intervention and treatment of PTSD, we have deployed a VR system to Iraq under a program funded by the United States Army's Telemedicine and Advanced Technology Research Center (TATRC). The sections below describe this and other VRMC projects in line with developing a comprehensive protocol to address an array of needs for military personnel, including SIT training for pre-deployment, tactical training for in-theater support, and follow-up mental health care for affected returning personnel.

PRE-DEPLOYMENT TOOLS: VR FOR SIT AND TACTICAL TRAINING

Stress Inoculation Training (SIT)

SIT is a technique to help "inoculate" individuals to future potentially traumatizing stressors. Deployed personnel must often perform in extremely stressful environments, and optimum performance under such conditions requires the
management of physiological, psychological, and emotional responses to stressful stimuli. An acute stress reaction (ASR) or combat and operational stress reaction (COSR) can occur during exposure to exceptionally stressful events, resulting in extreme sympathetic nervous system arousal and impaired performance. Longer-term reactions can include acute stress disorder, and acute and chronic PTSD. During preventative SIT, military personnel “experience” highly stressful situations in a virtual environment while being physiologically monitored. Repeated exposure enables performers to gradually become desensitized to stimuli that may initially elicit such strong physiologic arousal that performance is impeded (i.e., “freezing in the line of fire”) and psychological trauma is more likely.

SIT is intended to help prevent or reduce rates of PTSD in returning troops. There is some existing evidence that SIT can reduce PTSD. A group of 106 male British soldiers preparing for a 6-month tour of duty in Bosnia received a combination of pre-deployment stress training with psychological debriefing. They demonstrated a drastically reduced incidence of PTSD and other psychopathology, approximately 10 times less than figures reported from other military samples (Deahl et al., 2000). In fact, the level was too low to demonstrate any possible debriefing effect.

Besides decreasing stress, SIT for military personnel is designed to improve performance. Training under stressful conditions pre-deployment improves performance by training personnel to recognize and control their stress levels. In our ongoing SIT studies, we train military personnel in virtual environments such as an Iraqi village, a shoot house, and a ship. Simulations can be viewed on desktops, laptops, through a head-mounted display (HMD), or as a 3-wall CAVE (computer automatic virtual environment) projection system, depending on the needs of the specific population to be trained. The training is then transferred to real-world exercises in structures designed specifically for tactical training.

**Tactical Training**
VR allows stimuli to be presented in a systematic, controlled fashion, and physiology provides objective evidence of when the stimuli are eliciting appropriate responses in the trainee. This enables treatment and training to be individualized, focusing on those specific parts of the experience that cause the individual the most difficulty. By combining such measures as subjective ratings, physiological data, personality type, and self-report questionnaire scores with expert clinical observations, it is possible to further refine and improve clinical and research-based protocols.

By understanding the state of the student during training, the simulated training can then be modified to add or subtract stressors as would be most appropriate to the situation (Wiederhold, Bullinger, & Wiederhold, 2006). For example, quick mastery of a scenario could be supplemented by a more challenging mission, and physiological indicators that the participant is too overwhelmed to learn could be responded to by a “backing-off” of stressors until the trainee is again prepared to move forward.

VRMC’s Student State Report was a three-year study (completed in July 2005) sponsored by the Defense Advanced Research Projects Agency (DARPA), which proved the effectiveness of a low-fidelity laptop simulator to train military personnel. The 970 participants were a combination of elite units of the U.S. Navy, U.S. Marine Corps, and U.S. Coast Guard. The objectives of the investigation were to examine the effectiveness of virtual reality training simulators in their ability to teach personnel tactical and trauma care skills, enable them to practice stress management techniques, and to improve performance during real-life combat situations. The test group first received training in a virtual combat scenario while their stress and arousal levels were monitored through non-invasive physiological means. The control group did not receive virtual training. Afterward, all participants were tested in a real-world version of this same combat scenario to determine the effectiveness of training in a virtual environment. Significant transfer of skills from virtual to real world exercises was demonstrated through standard, objective performance measures and after-action analysis of video. The study proved virtual reality training to be an extremely effective and efficient method of preparing military personnel for combat situations.
Currently, the VRMC is conducting a study, funded by the U.S. Army’s Telemedicine and Advanced Technology Research Center (TATRC), to test the efficacy of virtual reality video game (VRVG) training in preparing combat medics for real-life combative medical scenarios. The purpose of the VRVG is to provide an inexpensive training tool that will allow medics to experience situations outside of their everyday training. The game will test the medics’ knowledge of medicine, combat training skills, and ability to function under the pressure of a battlefield situation. The VRVG will contain virtual scenarios of terrain that the medics are not able to experience in their current real-world training. The game will also allow medics to learn from their mistakes and repeat scenarios until they successfully complete the task.

In addition, the VRMC is currently providing SIT training for the U.S. Army’s Aeromedical personnel at Fort Rucker, AL. Data will be collected during the training, and trainees will be tracked after returning from deployment. Uses for the data may include: 1) studying the relationship between physiologic arousal and performance outcomes; 2) evaluating adjunctive training techniques (such as relaxation training) to manage physiologic arousal and enhance performance; and 3) longitudinal tracking of personnel physiological levels during training to determine the fidelity of the relationship between blood pressure/heart rate and combat operational stress reactions (COSRs) and PTSD, which could eventually act as a predictive tool.

**POST-DEPLOYMENT TOOLS: VR THERAPY FOR PTSD**

Deployment stress is a very serious problem. PTSD has a negative impact upon return to duty rates and health care costs. It is a disabling, often chronic problem, which frequently results in poor treatment outcomes and disability payments to PTSD-diagnosed veterans that may continue for years, if not decades. Front-line antidepressant medications for the disorder—such as selective serotonin reuptake inhibitors—rarely yield better than a 40% reduction in Clinician Administered PTSD Scale (CAPS) scores, and most patients will still meet criteria for PTSD at the end of an adequate treatment trial (Hamner, Robert, & Frueh, 2004). Regarding psychotherapy, only 44% of all those who enter treatment—based on a meta-analysis published early this year—will be classified at the end of the treatment period as improved (Bradley et al., 2005).

The DSM-IV classifies PTSD as a heterogeneous disorder that develops following exposure to traumatic events such as a serious injury or threat of injury or death to the self or others. Symptoms of PTSD, which must persist for at least one month, include increased anxiety or arousal, dissociation, avoidance of stimuli associated with the trauma, numbing of general responsiveness, and flashbacks to the traumatic experience (APA, 2000). Both anxiety-reducing medication as well as cognitive behavioral therapy (CBT) can help in recovery.

Prior to the availability of VR therapy applications, the existing standard of care for PTSD was imaginal exposure therapy, in which patients “relive” the traumatic event in a graded and repeated process (Rizzo et al., 2006). Exposure therapy is based on emotional processing theory (EPT). Applying EPT to PTSD, fear memories are stored as a “fear structure” and include psychological and physiological information about stimuli, meaning, and responses (Foa & Kozak, 1986). Once accessed and emotionally engaged, the structure is open to modification through CBT and, over time, will result in extinction of the fear response.

Although exposure therapy has been shown to be effective (Laor et al., 1998; Wiederhold & Wiederhold, 2004), many patients are unable or unwilling to effectively visualize the traumatic event. Ironically (in terms of exposure therapy), avoiding reminders of the trauma is one of the defining symptoms of the disorder (Difede & Hoffman, 2002). In studies that address treatment non-responders, failure to engage emotionally or visualize well enough to elicit an emotional response are cited as most predictive of non-response, since the fear structure is not accessed and therefore not open to change (Jaycox, Foa, & Morral, 1998; Kosslyn et al., 1984; Van Etten & Taylor, 1998).

This is where virtual reality graded exposure therapy (VRGET) may provide an excellent middle ground. In recent years, VR has been
shown to improve treatment efficacy for PTSD in survivors of motor vehicle accidents (MVA), war veterans, and those involved in the 9/11 World Trade Center attacks, as well as in other areas (Difede & Hoffman, 2002; Rothbaum et al., 1999; Walshe et al., 2003; Wiederhold & Wiederhold, 2000; 2004; Wiederhold et al., 2001; 2002). By placing the patients in a virtual Iraqi setting, or other environment where a trauma has occurred, and then having them slowly experience that situation in a controlled way, the patient may begin to habituate to their PTSD symptoms and come to reappraise the situation, allowing emotional processing to fully occur and thus free them from the past.

VRGET overcomes many of the shortcomings of imaginal exposure by providing external visual and auditory stimuli for the patient, thus eliminating the need for intense imagination skills. And, unlike in vivo therapy, which takes the patient into real-world scenarios (which is not practical or often even possible with war veterans), VR permits the patient to interact with anxiety-inducing scenarios in the safety and confidentiality of the therapy room. The ability of patients to feel they exert some measure of initial control over the situation also seems a safer, more tolerable starting point for many. In addition, the therapist and patient, in their therapeutic alliance, can determine and control the exact “dosage” (in terms of duration and intensity) of the exposure exercise. Multiple exposures can also be done during a single therapy session, making for more efficient time usage (Wiederhold & Wiederhold, 2004). Rizzo et al. suggest that a VR system for PTSD treatment could serve as a component within a reconceptualized approach to how treatment is accessed by veterans returning from combat, especially in regard to hesitancy to seek treatment (Rizzo et al., 2006).

In research funded by the Office of Naval Research (ONR), we are exploring whether exposure therapy for PTSD-diagnosed non-combatants using a cognitive behavioral therapy (CBT) approach is more effective when facilitated by VR tools. VRMC graphic designers and software developers created a Virtual Baghdad environment (see below) as a clinical therapy aid for military personnel with PTSD. This fully immersive environment can be viewed on a laptop computer or with a head-mounted display (HMD) and features a market, a battalion aid station, and houses, all of which can be freely navigated. The environment is comprised of sights and sounds such as Arabic prayer from a temple, helicopters thundering overhead, distant explosions, vehicles burning, terrorists running and firing guns, and the voices of Iraqi civilians. Based on interviews with a population of Marine and Navy personnel recently diagnosed with combat-related PTSD and receiving treatment, these are some of the most salient memories they associate with recurring, intrusive thoughts (Spira, Pyne, & Wiederhold, 2006).

Figure 1. Scenes from VRMC’s Virtual Baghdad, an immersive, highly realistic environment comprised of both sight and sound, which is used in combination with CBT to treat PTSD. (The combination is known as virtual reality graded exposure therapy, or VRGET.) Users can freely navigate the environment and its structures and interact with virtual people.
Participants will include 136 US Navy Seabees and medical personnel who have acute PTSD stemming from combat exposure. Outcome measures will focus on the general symptom categories targeted by exposure therapy, such as re-experiencing, avoidance, and arousal. The systems will be tested at Balboa Naval Hospital and Camp Pendleton. Initial pilot testing of the system indicates that VR therapy produces both subjective (self-report) and objective (physiological) arousal in individuals suffering from PTSD. In a second study funded by ONR, Stress Inoculation Training (SIT) protocols are being tested to determine if providing stress-hardening skills prior to deployment can decrease incidence of PTSD.

A separate project, funded by the Telemedicine and Technology Research Center (TATRC), allowed us the opportunity to ship a VR system to Iraq in August 2005. The tool is being used by psychiatrists and psychologists in Iraq, where mental health professionals are now forward. In-country clinicians appreciate use of the VR PTSD tool as part of an early intervention protocol, and provide VRMC clinicians with valuable feedback on ways to improve the tool. This information from troops in-theater on how the software might need to be adjusted to better meet their needs is crucial for our system. Having the end user in the development loop has been an important attribute we have encouraged over the past decade and provides for quicker iterations in the development cycle and a more useful end product.

CONCLUSION

Decades after the first simulators were used to train fighter pilots, advanced technologies and simulations are now impacting military medicine. The VRMC is committed to developing, testing, validating, and delivering innovative technology integrated with medical science to successfully train, prepare, and provide follow-up care for troops. Over the past decade, we have developed a variety of evaluation and assessment protocols based on both subjective and objective measures in our clinic, particularly by pioneering the use of physiological measures while trainees perform exercises in virtual reality and other simulation environments. We are greatly encouraged and motivated by the promising advances made so far and the new technologies yet to come.

REFERENCES


NIH. A real illness: Post-traumatic stress disorder (PTSD).


