Chapter 16
Update and Expansion of the Virtual Iraq/ Afghanistan PTSD Exposure Therapy System

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Introduction

War is perhaps one of the most challenging situations that a human being can experience. The physical, emotional, cognitive, and psychological demands of a combat environment place enormous stress on even the best-prepared military personnel. Thus, it is no surprise that the stressful experiences that have been characteristic of the Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) combat theaters have produced significant numbers of returning service members (SMs) at risk for developing posttraumatic stress disorder (PTSD) and other psychosocial/behavioral health conditions. For example, as of December 2012, the

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Defense Medical Surveillance System reported that 131,341 active duty SMs have been diagnosed with PTSD (Fischer, 2013). As well, Hoge (2013) reported that 13.2 % of OEF/OIF operational infantry units met criteria for PTSD in a meta-analysis across studies since 2001 (Kok, Herrell, Thomas, & Hoge, 2012) with the PTSD incidence rising dramatically, ranging from 25 to 30 %, in infantry units with the highest levels of direct combat (Kok et al., 2012; Thomas et al., 2010). During this same time period, the prevalence of PTSD among discharged Veterans receiving treatment at Veteran Health Affairs clinics has been reported to be 29 % (Fischer, 2013). These findings make a compelling case for a continued focus on developing and enhancing the availability of diverse evidence-based treatment options to address this military behavioral healthcare challenge.

This chapter will describe a set of projects that are developing content for inclusion in a newly updated “Virtual Iraq/Afghanistan” virtual reality (VR) system for the delivery of VR exposure therapy (VRET). The chapter presupposes that the reader has read and understands the history and rationale for VRET use with Anxiety Disorders and PTSD as presented by Garcia-Palacios, Botella, Baños, Guillén, and Navarro (2014) and the early development and dissemination of the initial treatment version of the Virtual Iraq/Afghanistan system presented in Reger et al. (2014), earlier in this volume. The present chapter will start with a brief detailing of the factors that led to the initial development of Virtual Iraq/Afghanistan VRET system and the clinical outcomes that have been reported with its use. We will then discuss the current efforts to update the VRET system with more advanced software to expand the VR content and features based on input from clinical users of the previous 2007 version of the system. Following a description of this new Virtual Iraq/Afghanistan application (now referred to as “BRAVEMIND”), we will then focus on a general overview of two new projects that aim to provide relevant and customizable options for conducting VRET with users having a wider range of military trauma experiences, combat medics/corpsmen, and victims of military sexual assault. The chapter will conclude with a description of the further expansion of the system to create a VR tool for use to prevent the incidence of combat-related PTSD via pre-deployment resilience training.

Context and Rationale for Military Adoption of VRET for Combat-Related PTSD

It was during the “computer revolution” in the 1990s that promising technologically driven innovations in behavioral healthcare had begun to be considered and prototyped. Primordial efforts from this period can be seen in research and development (R&D) that aimed to use computers to enhance productivity in patient documentation and record-keeping, to deliver “drill and practice” cognitive rehabilitation, to improve access to care via internet-based teletherapy, and in the use of virtual reality simulations to deliver exposure therapy for specific phobias. These and other computer and internet driven behavioral health applications gradually evolved as the technology got faster, better, and cheaper moving into the twenty-first century. However, it was the onset of OEF/OIF and the subsequent need to provide optimal care for the significant numbers of U.S. SMs returning from the battlefront with traumatic injuries that really drove an intensive focus (and significant funding) on how technology could be marshaled to enhance, expand, and extend the reach of behavioral healthcare. Thus, the urgency of war essentially led to increased U.S. government funding levels that has substantially driven innovative R&D in behavioral healthcare technology. Primarily supported through the U.S. Department of Defense (DoD) and the Department of Veteran Affairs (VA), this increased focus and support has been most dramatically seen in research efforts to enhance the treatment of PTSD and comorbid health conditions. It is within this historical context that the DoD/VA have driven advances in behavioral healthcare technology by supporting R&D to (1) advance the development and delivery of evidence-based treatments for behavioral health conditions and (2) reduce "barriers to care" by investigating ways to improve the awareness, availability, access, appeal, acceptance, and adherence of/to evidence-based treatments and services (IOM, 2012).

This R&D funding supported a range of technology-based efforts at advancing behavioral healthcare including: teletherapy, online informational and self-help Web sites, mobile smartphone apps, virtual reality and online virtual worlds, intelligent healthcare agents, and interactive clinical training systems. However, one would be mistaken to assume that this level of DoD/VA support emerged from a naïve view or belief that technology, in and of itself, could actually "fix" anyone. In spite of the pressure at the time to address a growing behavioral healthcare challenge, funding agencies in the USA took a measured approach to funding some of the many novel systems that were being proposed at the time. Consequently, one can observe that the most promising first efforts at applying technology to address the psychological "wounds of war" were typically seen to meet two criteria: (1). They did not require the imposition of a new theoretical model of clinical care—technology-based approaches were best seen as tools to support and advance the delivery of already known and evidence-based clinical methods (e.g., Virtual Reality delivery of Prolonged Exposure), and (2). each technologic approach needed to clearly specify its rationale for targeting some recognized barrier to care. For example, most technology-based systems that were initially supported during this time also made the case that some element of the care *process* would also be enhanced to: Promote *Awareness* of care options (e.g., online resources/Web sites, Social Media), improve *Access* to care (e.g., teletherapy), support treatment *Appeal* and *Acceptability* to reduce stigma (e.g., VRET and other approaches that leverage compelling game technologies), increase the *Availability* of well-trained providers (e.g., Online training, virtual patient training), and to support *Adherence* to treatment (e.g., mobile phone apps, teletherapy). By making this secondary case, the complexity and cost of new technology-based systems could be more easily justified for support by these agencies.

The use of VR to deliver exposure-based interventions for PTSD clearly met these criteria, and consequently within this wartime zeitgeist, the DoD/VA significantly supported R&D to develop and evaluate VRET applications. The rationale for this was clear and compelling. Prolonged exposure (PE) (Foa, Hembree, &

Rothbaum, 2007) had been documented to be an effective “evidence-based” treatment for PTSD across a spectrum of trauma experiences due to combat, terrorist attacks, sexual assault, and motor vehicle accidents (IOM, 2007, 2012). However, while the efficacy of imaginal PE was established in multiple studies with diverse trauma populations, many patients were observed to be unable or unwilling to effectively visualize traumatic events and memories. In fact, avoidance of trauma reminders is inherent in PTSD and is one of the cardinal symptoms of the condition. To address this challenge, the VR delivery of an evidence-based PE protocol was seen as a way to immerse users in simulations of trauma-relevant environments in which the emotional intensity of the scenes could be precisely controlled by the clinician to personalize the exposure for the individual patient. In this fashion, VRET offered a way to circumvent the natural avoidance tendency by directly delivering multisensory and context-relevant cues that aided in the confrontation and processing of traumatic memories. Previous success in similarly using VR to deliver exposure therapy for persons with anxiety disorders such as specific phobias had been documented in at least three independent meta-analyses of the literature (Powers and Emmelkamp, 2008; Parsons & Rizzo, 2008; Opris et al., 2012) and this literature is extensively detailed in Garcia-Palacios et al. (2014). As well, three publications reported positive outcomes with non-OEF/OIF PTSD using VRET with patients who were unresponsive to a previous course of *imaginal-only* PE treatment (Difede et al., 2007; Difede & Hoffman, 2002; Rothbaum, Hodges, Ready, Graap, & Alarcon, 2001).

Moreover, the use of VR as a PE delivery system may also have potential advantages for breaking down barriers to care by improving treatment appeal, acceptability, and adherence by SMs and Veterans in need of care. The current generation of young military SMs, many having grown up with digital gaming technology, may actually be more attracted to and comfortable with participation in a VR therapy application approach and this could lead to increased access of care by those in need (Reger, Gahm, Rizzo, Swanson, and Duma, 2009; Wilson, Onorati, Mishkind, Reger, & Gahm, 2008). Additionally, in spite of DoD and VA efforts to foster adoption of PE as a first-line treatment, challenges have been noted in the dissemination of PE in part due to clinician hesitancy to adopt and use it (Becker, Zayfert, & Anderson, 2004; IOM, 2012). This challenge might be reduced with a VR system that allows a care provider to more easily create customized simulated scenarios to support patient trauma narratives with a computer control interface and thus support PE adoption by empowering clinicians with a VR tool that is readily learnable. VR also provides an objective and consistent format for documenting the sensory stimuli that the patient is exposed to that is not possible when operating exclusively within the unseen world of the patient’s imagination. However, these speculations on VRET attraction and adoption still require controlled research to determine how and to what extent a VR approach may break down barriers to care and enhance dissemination.

Development and Research Outcomes from the Initial Virtual Iraq/Afghanistan VRET System

In view of the military behavioral health needs at the time and supported by a clear theoretical rationale and the extant literature, the USC Institute for Creative Technologies developed an initial prototype Virtual Iraq system in 2004 to run user tests to determine feasibility (*Video 1–2004 Virtual Iraq Prototype:* http://www.youtube.com/watch?v=zTtaK6mK3_c). A full Virtual Iraq/Afghanistan VRET simulation for PTSD treatment was developed and evaluated during 2005–2007, funded by the U.S. Office of Naval Research (cf. Fig. 15.3 in Reger et al., 2014). The 2007 system consisted of four customizable scenarios designed to represent relevant contexts for VRET: three Humvee driving scenarios within Iraq, Afghanistan, and USA-themed settings (*Video 2–2007 Virtual Iraq Humvee Driving with Attack Stimuli*: http://youtu.be/cdtqHxdjPnM) and a 24-block middle-eastern city (*Video 3–2007 Virtual Middle Eastern City Zones:* http://youtu.be/oT1iyT63au0) that was navigable in a dismounted patrol format (*Video 4–2007 Virtual Middle Eastern City Dismounted Patrol*: http://www.youtube.com/watch?v=s9MXM9RllWo). The creation of these VRET scenarios was the product of both theory-driven design and iterative user-centered feedback cycles with OEF/OIF service members to maximize the content-relevance for these clinical users (cf. Reger et al., 2014). Since that time, the system was disseminated to over 50 "early-adopter" clinical sites for use as a tool to deliver PE and to collect outcome data on its effectiveness. A detailed description of this Virtual Iraq/Afghanistan system and the methodology for a standard VRET clinical protocol can be found elsewhere (Rothbaum, Difede, & Rizzo, 2008).

Initial clinical tests of the system produced encouraging results. Three case study reports initially documented its feasibility and safety, and produced positive clinical outcomes with use of the system (Gerardi, Rothbaum, Ressler, Heekin, & Rizzo, 2008; Reger & Gahm, 2008; Rizzo et al., 2007). These were followed by an open clinical trial with 20 active duty treatment completers (19 male, 1 female, Mean Age = 28, Age Range: 21–51) which also reported positive clinical outcomes (Rizzo, Difede, Rothbaum, & Reger, 2010). Results reported from this open trial indicated that mean pre/post PCL-M (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996) scores decreased in a statistical and clinically meaningful fashion from 54.4 (SD = 9.7) to 35.6 (SD = 17.4). Paired pre/post t-test analysis showed these differences to be significant ($t = 5.99$, $df = 19$, $p < 0.001$) with 16 of the 20 completers no longer meeting PCL-M criteria for PTSD at posttreatment (see Fig. 16.1) and an average 50 % decrease in symptoms. Five participants in this group with PTSD diagnoses had pretreatment baseline scores below the conservative cutoff value of 50 (prescores = 49, 46, 42, 36, 38) and reported decreased values at posttreatment (post-scores = 23, 19, 22, 22, 24, respectively) suggesting improvements for sub-threshold PTSD users as well. Beck Anxiety Inventory (BAI) (Beck, Epstein, Brown, & Steer, 1988) scores significantly decreased 33 % from 18.6 ($SD = 9.5$) to 11.9 ($SD = 13.6$), ($t = 3.37$, $df = 19$, $p < 0.003$) and mean PHQ-9 (Kroenke & Spitzer, 2002) depression scores decreased 49 % from 13.3 ($SD = 5.4$) to 7.1 ($SD = 6.7$),

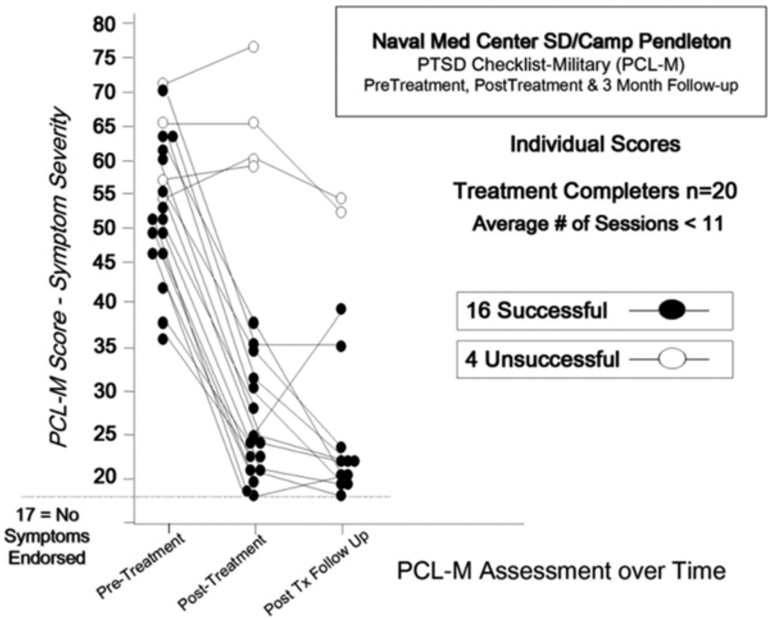

Fig. 16.1 PCL-M scores across treatment

($t=3.68$, $df=19$, $p<0.002$) (see Fig. 16.2). Treatment gains were maintained at 3-month posttreatment follow-up and anecdotal patient reports suggested that they saw improvements in everyday life functioning. The average number of sessions for this study was just under 11.

Another open clinical trial with active duty soldiers ($n=24$) produced significant pre-/post-reductions in PCL-M scores and a large treatment effect size (Cohen's $d=1.17$) (Reger et al., 2011a). After an average of 7 sessions, 45 % of those treated no longer screened positive for PTSD and 62 % had reliably improved. In a small preliminary quasi-randomized controlled trial (McLay et al., 2011), 7 of 10 participants with PTSD showed a 30 % or greater improvement with VR, while only 1 of 9 participants in a "treatment as usual" group showed similar improvement. While the results of this study are limited by its small sample size, lack of blinding, a single therapist, and treatment comparison with a relatively uncontrolled care as usual condition, these results do add to the incremental evidence suggesting VR to be a safe and effective approach for delivering PE for combat-related PTSD. Finally, at the 2012 American Psychiatric Association Convention, McLay (2012) presented data from an ongoing comparison of VRET with the traditional, evidence-based PE approach in active duty SMs. The results showed significantly better maintenance of positive treatment outcomes at 3-month follow-up for VRET compared to traditional PE (McLay 2012). The overall trend of these positive findings (in the absence of any reports of negative findings) is encouraging for the view that VRET is safe

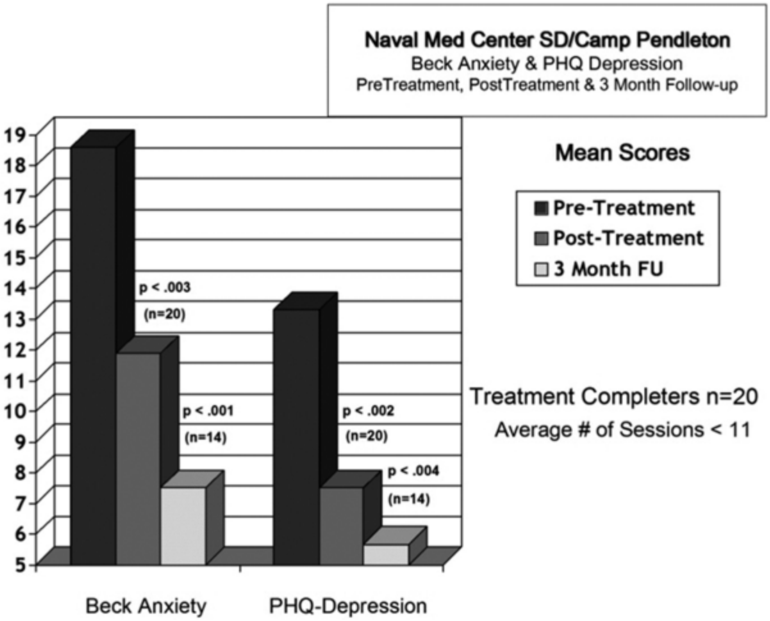

Fig. 16.2 BAI and PHQ-9 depression scores

and may be an effective approach for delivering an evidence-based treatment (PE) for PTSD.

Currently, five randomized controlled trials (RCTs) are ongoing using the Virtual Iraq/Afghanistan system with active duty SM and Veteran populations. Two RCTs are focusing on comparisons of treatment efficacy between VRET and prolonged imaginal exposure (PE) (Reger & Gahm, 2010, 2011b) and another is testing VRET compared with VRET + a supplemental care approach (Beidel, Frueh, & Uhde, 2010). Two more RCTs (Difede, Rothbaum, & Rizzo, 2010; Rothbaum et al., 2008) are investigating the additive value of supplementing VRET and imaginal PE with a cognitive enhancer called D-Cycloserine (DCS). DCS, an N-methyl-d-aspartate partial agonist, has been shown to facilitate extinction learning in laboratory animals when infused bilaterally within the amygdala prior to extinction training (Walker, Ressler, Lu, & Davis, 2002). The first clinical test in humans combined orally administered DCS with VRET (Ressler et al., 2004) with participants diagnosed with acrophobia ($n = 28$). Participants who received DCS + VRET experienced significant decreases in fear within the virtual environment 1 week and 3 months posttreatment, and reported significantly more improvement than the placebo group in their overall acrophobic symptoms at 3-month follow-up. The DCS group achieved lower scores on a psychophysiological measure of anxiety than the placebo group. Further evidence of both VRET and DCS effectiveness has recently been reported by Difede et al. (2013) in a clinical trial with World Trade Center

PTSD patients. In a double-blinded controlled comparison between VRET+DCS and VRET+Placebo, both groups had clinically meaningful and statistically significant positive outcomes with the DCS group achieving equivalent gains with fewer sessions. Finally, a current multisite PTSD RCT (NICoE, Weill-Cornell, and the Long Beach VAMC) (Difede et al., 2010) is testing the effect of DCS vs. placebo when added to VRET and PE with active duty and veteran samples ($n = 300$). Further details on DCS and PTSD can be found in the Burton, Youngner, McCarthy, Rothbaum, and Rothbaum (2014).

Significant funding support for these RCTs underscore the interest that the DOD/VA has in exploring this innovative approach for delivering PE using VR. However, while RCTs are the gold standard for gaining acceptance by the scientific and clinical communities for the use of emerging treatment approaches, it should be noted that at its core, the therapeutic model/principle that underlies VRET (CBT with exposure) is in fact evidence-based (IOM, 2007, 2012). VRET is simply the delivery of this evidence-based treatment in a format that may serve to engage a wider range of patients in the necessary confrontation and processing of traumatic memories or "fear-structures" (cf. Foa, Davidson, & Frances, 1999) needed for positive clinical outcomes. Thus, even equivalent "non-inferior" positive results with PE in these RCTs would validate the use of VRET as another safe and evidence-based treatment option. Moreover, the VRET approach could serve to draw SMs and Veterans into treatment, many of whom have grown up "digital" and may be more likely to seek care in this format compared to what they perceive as traditional talk therapy.

Project BRAVEMIND: Updating and Expanding the Virtual Iraq/Afghanistan VRET System

Based on the initial encouraging outcomes to date using VRET to treat combat-related PTSD and the urgency of the need for diverse evidence-based treatment options for the growing numbers of those reporting PTSD symptoms, the U.S. Army has funded the development of an updated and expanded version of Virtual Iraq/Afghanistan system, now referred to as BRAVEMIND. One of the primary goals for this project was to update and expand the diversity of the VR scenario content and functionality to improve the customizability of stimulus delivery to meet the needs of users having had a diverse range of trauma experiences. These aims were supported by drawing on patient and clinician feedback that has now come from a large number of SM and Veterans who were treated with the previous version of the VRET system. The system has been updated using the Unity Game Engine, an advanced state-of-the art VR development software platform that supports full 3D graphic rendering, physics, and a wide variety of interaction device options.

The current BRAVEMIND system now consists of 14 diverse scenarios. The original system contained four: a foot patrol navigable 18-block middle eastern city and 3 Humvee driving scenarios within Iraq, Afghanistan, and USA-themed settings (cf. Reger et al., 2014). The four original 2007 environments have been completely rebuilt

(*Video 5–2013 Bravemind Humvee Turret Attack Mix Scenes*: https://www.youtube.com/watch?v=8ZQjrfTqvDs&feature=youtu.be) and 10 additional scenarios have been added for a total of 14 (*Videos 6 and 7–2013 Bravemind Collected Scenes*: https://www.youtube.com/watch?v=iMeEuSdJ7EU&list=UUQrbzaW3x9wWoZPl4-l4GSA&index=1 and https://www.youtube.com/watch?v=_XO4nq4XUcA), including: separate Iraq and Afghanistan cities, a rural Afghan village, an industrial zone, a roadway checkpoint, slum and high-end residential areas, a mountainous forward operating base, and a Bagram Air Force Base setting (see Fig. 16.1). New features include selectable Humvee/MRAP/Helicopter vehicles, vehicle-to-foot patrol transitioning, expanded weather and time of day controls, customizable sound trigger profiles, and an updated clinical interface designed with clinician feedback to enhance usability. The Unity Game Engine and higher fidelity graphic art/animation have been used to enhance the realism and credibility of the stimulus content while presenting an experience that is uniquely designed to differentiate it from a commercial video game. The system was also designed to use off the shelf components (e.g., standard laptop, head mounted display, tracking/interface technology, etc.) that require only one computer with the aim to reduce equipment costs to well under $5,000. The BRAVEMIND VRET system is currently undergoing beta testing and has been designed to provide a flexible software architecture that will support the efficient addition of new content for the expansion and diversification of the system as new clinical needs are specified. More information on the BRAVEMIND system components is available in a detailed equipment/software manual available from the first author and an 18-min media story with new BRAVEMIND content and a former patient can be seen here (*Video 8*): https://www.youtube.com/watch?v=glIxXwT0cK4&list=UUQrbzaW3x9wWoZPl4-l4GSA. More videos of various PTSD system content, media pieces, and patient interviews can be accessed here: https://www.youtube.com/playlist?feature=edit_ok&list=PLMuMO5eoYy_BDmAfZrFSLBLlniAtvAdad.

The rebuilding of this VRET system has now provided the architecture to support the flexible and efficient expansion of the system's content and functionality to support new customizable and relevant options for conducting VRET with a wider range of relevant trauma experiences. The BRAVEMIND VRET system is now being further evolved to address the unique therapeutic needs of combat medics/corpsmen and in persons who have experienced military sexual trauma (MST) with PTSD. As well, the software has now been reconfigured to provide a VR tool that is being tested for its use for providing psychological resilience training prior to a combat deployment (Buckwalter & Rizzo, 2011; Rizzo et al., 2013) (Figs. 16.3, 16.4, 16.5, 16.6, 16.7, and 16.8).

Combat Medics/Corpsman VRET Project

Observations from our existing clinical work and from reports by medics (Cannady, 2012) indicate that there is a growing need to address PTSD in combat medics & corpsman. This will require specialized VR content that is more relevant to their

Fig. 16.3 Afghanistan city market

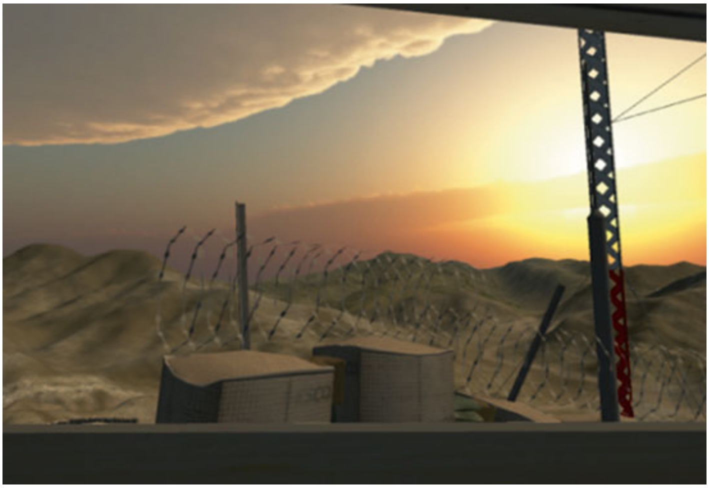

Fig. 16.4 Afghanistan FOB

Fig. 16.5 Afghanistan rural village

Fig. 16.6 Iraq Alley patrol

Fig. 16.7 Checkpoint zone

Fig. 16.8 Clinician control panel

experiences with emotionally challenging situations that are fundamentally different from what has been effective with other SMs. The primary role of the combat medic (Army and Air Force) and corpsmen (Navy and Marines) is to provide medical treatment to the wounded in a combat environment. Often they are assigned one to platoon or equivalent unit and this is mandatory due to their importance to the success of the unit's mission (Cabrera, Figley, & Yarvis, 2012). Combat medics/corpsmen are a unique population within the ranks of deployed SMs. They serve double duty, both professionally and psychologically. In addition to bearing all the responsibilities of soldiering, medics must calmly treat the devastating wounds of modern warfare: legs and arms mangled by roadside bombs, bodies peppered with shrapnel, arteries severed by high-velocity bullets. They are more exposed than other soldiers to seriously wounded or dead fellow SMs. Unlike hospital doctors or nurses, who rarely know their patients, medics have the added pressure of being close to the soldiers they are trying to keep alive. And when one dies, medics often face self-doubt—an emotion they must hide or risk losing the platoon's confidence.

While very preliminary findings have suggested that medics might be more resilient and less likely than other soldiers to have symptoms of PTSD, a small survey study looked at medics only 3 and 12 months after their deployments and reported PTSD symptoms that were seen to develop over time (Chapman, 2011). Cabrera et al. (2012) are currently studying this issue longitudinally in more detail. However, regardless of the limitations of the extant data on relative comparative rates of PTSD, there is no doubt that there is a clinical need for optimal treatment for this group and it has been the aim of this project to create the content required to meet that need.

This effort has required the tailoring of the existing scenarios to include more wounded virtual humans that can display a range of wounds/burns and manifest realistic injury behaviors. Helicopter insertion and extraction scenarios and a Bagram Air Force Base hospital setting for medic "first receivers" have been developed (see Figs. 16.9, 16.10, and 16.11). This effort has required the creation of significant new graphic art, motion capture animation, airborne vehicle integration, and a library of virtual human content that emulates the wounds and injuries common to the combat environment in order to offer relevant VRET for combat medics/corpsmen with PTSD. This system is currently nearing completion and will be available for use in early 2014.

Military Sexual Trauma

PTSD can result from exposure to actual or threatened death, serious injury, or sexual violation (APA, 2013). New to the APA DSM-5 is the explicit reference to a sexual violation as a possible source of trauma. This is of particular relevance for SMs who may face trauma from both the threat that is naturally inherent in the combat theater, as well as from the possible additive occurrence of sexual violations from within the ranks. Thus, military sexual trauma (MST) that is experienced as a result of an occurrence (or threat of an occurrence) of a sexual violation or assault within a military context can produce additional risk for the development of PTSD in a population that is already at high risk due to the existing occupational hazards present in the combat environment.

Fig. 16.9 Combat injury site

Fig. 16.10 Helicopter evacuation

In a recent report issued by the Joint Chiefs and Commandant of the Coast Guard, together with the DoD Sexual Assault Prevention and Response Program (SAPR) (DoD, 2012a), sexual assault has been defined “as intentional sexual contact, characterized by the use of force, threats, intimidation, abuse of authority, or

Fig. 16.11 Bagram first receiver area

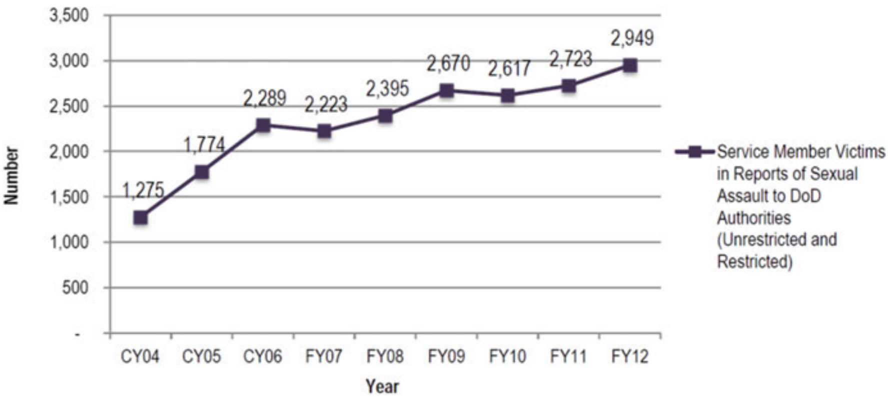

Fig. 16.12 Service member victims in DoD sexual assault reports, CY04–FY12 (from DoD2012c)

when the victim does not or cannot consent. Sexual assault includes rape, forcible sodomy, and other unwanted sexual contact that is aggravated, abusive, or wrongful (to include unwanted and inappropriate sexual contact), or attempts to commit these acts." (p. 5). The report further specifies the need for improvements in, "…advocacy coordination, medical services, legal support and [**behavioral health**] **counseling for the victim**" (p. 13). This has become an issue of grave concern within the military, as reports of sexual violations and assaults have not only been on the rise over the last 10 years (see Fig. 16.12), but have also garnered significant popular media attention (Kime, 2013; Valencia, 2013). Overall, 6.1 % of women and 1.2 % of men (active duty SMs) indicated they experienced unwanted sexual contact in 2012. For women, this rate is statistically significantly higher in 2012 than in 2010 (6.1 vs. 4.4 %) (DoD, 2012b).

A bleaker picture of the problem emerges when reports from post-discharge Veteran surveys are considered. Underreporting of MST by SMs while on active duty may occur due to fear of reprisal, concern for military careers, shame, or because they didn't want anyone to know while in the service and this additional threat may be lessened once the person transitions to Veteran status. For example, retrospective reports of sexual assault and harassment during active duty—by female Veterans following discharge—have suggested higher MST incidence than what has been reported in active duty samples. In a nationwide randomly selected sample of women seeking care through VA medical centers, approximately 1 out of 4 reported experiencing a sexual trauma while on active duty (Skinner et al., 2000). The reported prevalence rates of MST in women were 20–25 % for sexual assault and 24–60 % for sexual harassment and more recent indicators suggest that this problem is expected to grow exponentially in the future (Department of Veterans Affairs, 2007). The implication that MST can be a primary factor for the development of PTSD has also been supported by multiple studies that indicate that many women who report experiencing a MST also experience mental health problems, with the most frequently reported being PTSD (Kimerling et al., 2010; Street, Gradus, Stafford, & Kelly, 2007; Street, Stafford, Mahan, & Hendricks, 2008). For example, within a sample of women seeking PTSD-related services within the VA system, 71 % reported MST experiences (Murdoch, Polusny, Hodges, & O'Brien, 2004). Moreover, as with PTSD, MST is associated with a variety of comorbid mental and physical health disorders (Brewin, Andrews, & Valentine, 2000; Sadler, Booth, Nielson, & Doebbeling, 2000; Zinzow, Grubaugh, Monnier, Suffoletta-Maierle, & Frueh, 2007) as well as impairments in both social functioning and quality of life (Rheingold, Acierno, & Resnick, 2004; Surıs, Lind, Kaashner, & Borman, 2007). Thus, while the DoD is mobilizing to reduce the incidence of MST with novel education and prevention programs (DoD 2012a, 2012b, 2012c), a significant effort is also required to develop and disseminate effective treatment approaches to address the existing problem of PTSD due to MST.

The current project is developing content for inclusion in BRAVEMIND that will provide new customizable options for conducting VRET with persons who have experienced MST. The novel component of the current project involves the creation of new content that will be embedded within the existing BRAVEMIND scenarios such as barracks, tents, other living and work quarters, latrines, and other contexts that have been reported by MST victims as locations where their sexual assault occurred. This system will ***not*** attempt to recreate the sexual assault, but rather set up the contexts surrounding the assault, in which users can be supported in the therapeutic confrontation and processing of MST memories in accordance with the protocol that has been used previously that implements PE within the simulations (Rothbaum et al., 2008). When the new content is complete (summer 2014) a pilot waitlist RCT will commence with 34 male and female participants. This has not been attempted previously with immersive VRET and the unique challenges for creating such unique and sensitive content are significant. While both men and women can experience MST, the urgent need for this work is underscored by the growing role of women transitioning into full combat roles in the combat theater, an area that up to now has been primarily the domain of men.

Virtual Reality Resilience Training

Resilience is the dynamic process by which individuals exhibit positive adaptation when they encounter significant adversity, trauma, tragedy, threats, or other sources of stress (McEwen & Stellar, 1993). The core aim of resilience training is to promote psychological fitness through self-awareness, self-esteem, emotional regulation, and social support. This multidimensional approach to resilience training is designed to better prepare SMs for the psychological stressors that they may experience during a combat deployment and to provide them with the tools needed to resolve the inevitable reactivity they experience after trauma/stress. There is a powerful rationale for developing methods that promote SM resilience and psychological fitness prior to a combat deployment. The current urgency in efforts to address the psychological wounds of war in SMs and Veterans has also driven an emerging focus within the military on emphasizing a proactive approach for better preparing SMs for the emotional challenges they may face during a combat deployment to reduce the potential for later adverse psychological reactions such as PTSD, suicidality, and depression. This focus on resilience training prior to deployment represents no less than a quantum shift in military culture and can now be seen emanating from the highest levels of command in the military. For example, in an American Psychologist article, Army General George Casey (2011) stated that "…soldiers can "be" better before deploying to combat so they will not have to "get" better after they return." (p. 1), and he then calls for a shift in the military "…to a culture in which psychological fitness is recognized as every bit as important as physical fitness." (p. 2).

This level of endorsement can be seen in practice by way of the significant funding and resources applied to a variety of resilience training programs across all branches of the U.S. Military (Cornum, Matthews, & Seligman, 2011; Hovar, 2010; Luthar, Cicchetti, & Becker, 2000). Perhaps the program that is attempting to influence the largest number of SMs is the Comprehensive Soldier Fitness (CSF) program (Cornum et al., 2011). This project has created and disseminated training that aims to improve emotional coping skills and ultimate resilience across all Army SMs. One element of this program draws input from principles of cognitive-behavioral science, which generally advances the view that it is not the *event* that causes an emotion, but rather how a person *appraises* the event (based on how they think about the event) that leads to the emotion (Ortony, Clore, & Collins, 1988). From this theoretical base, it then follows that internal thinking or appraisals about combat events can be "taught" in a way that leads to more healthy and resilient reactions to stress. This approach does not imply that people with effective coping skills do not feel some level of "rational" emotional pain when confronted with a challenging event that would normally be stressful to any individual. Instead, the aim is to teach skills that may assist soldiers in an effort to cope with traumatic stressors more successfully.

The core motive with such efforts is to provide resilience training that would serve to promote psychological fitness and reduce the later incidence of PTSD and other psychological health conditions upon redeployment home (e.g., depression, suicide, substance abuse). A recent study on the Comprehensive Soldier Fitness program reported results from a longitudinal study over 18 months with 22,000 soldiers indicating positive outcomes (Lester, Harms, Herian, Krasikova, & Beal, 2011), but this report has been criticized for its exclusive reliance on self-report data and on other methodological grounds (PBS, 2012). Regardless of those academic "battles," the post-deployment psychological health statistics are alarming and provide a compelling justification for continued efforts to better prepare SMs for the onslaught of emotional challenges that they may face during a combat deployment.

Recently, the USC Institute for Creative Technologies has begun development of the STress Resilience In Virtual Environments (STRIVE) project which expands on the Virtual Iraq/Afghanistan simulations developed for VRET. The STRIVE project aims to foster psychological resilience by creating a set of combat simulations that can be used as contexts for SMs to experientially learn stress reduction tactics and cognitive-behavioral emotional coping strategies prior to deployment. This approach involves immersing and engaging SMs within a variety of virtual "mission" episodes where they are confronted with emotionally challenging situations that are inherent to the OEF/OIF combat environment. Interaction by SMs within such emotionally challenging scenarios aims to provide a more meaningful context in which to engage with psychoeducational information and to learn and practice stress reduction tactics and cognitive coping strategies that are believed to better prepare a SM for the psychological challenges that may occur during a combat deployment.

To accomplish this, STRIVE is being designed as a 30-episode interactive narrative in VR, akin to being immersed within a "Band of Brothers" type storyline that spans a typical deployment cycle. Within these episodes, SMs will get to know the distinct personalities of the virtual human characters in their squad and interact within an immersive digital narrative that employs cinematic strategies for enhancing engagement with the evolving storyline (e.g., strategic use of narration, montage shots, and dynamic camera direction). At the end of each of the graded 10-min episodes, an emotionally challenging event occurs, designed in part from feedback provided by SMs undergoing PTSD treatment (e.g., seeing/handling human remains, death/injury of a squad member, killing someone, the death/injury of a civilian child). At that point in the episode, the virtual world "freezes in place" and a virtual human "mentor" character emerges from the midst of the chaotic VR scenario to guide the user through stress-reduction tactics. These include psychoeducational animations, affect awareness and regulation strategies, moral appraisal discussions, "positive psychology"-based self-management tactics, as well as rational restructuring exercises for appraising and processing the virtual experience. The resilience training component is drawing on evidence-based content that has been endorsed as part of standard classroom-delivered DoD stress resilience training programs, as well as content that has been successfully applied in nonmilitary contexts (e.g., humanitarian aid worker training, sports psychology).

In this fashion, STRIVE provides a digital "emotional obstacle course" that can be used as a tool for providing context-relevant learning of emotional coping strategies under very tightly controlled and scripted simulated conditions. Training in this format is hypothesized to improve generalization to real world situations via a state dependent learning component (Godden & Baddeley, 1980) and further support resilience by leveraging the learning theory process of latent inhibition. Latent inhibition refers to the delayed learning that occurs as a result of pre-exposure to a stimulus without a consequence (Feldner, Monson, & Friedman, 2007; Lubow & Moore, 1959). Thus, the exposure to a simulated combat context is believed to decrease the likelihood of fear conditioning during the real event (Sones, Thorp, & Raskind, 2011).

Six episodes have been created thus far that expose SMs to the following stressors/trauma: the moral quandaries implicit in being a warrior in a less developed society, threat to self via an IED, the need to respect vastly different, even immoral, cultural actions through an episode where the patrolling squad comes upon a civilian woman is being beaten by men enforcing a local code of punishment, the death of an innocent child in which some unintentional, indirect responsibility can be in inferred to one of the members of your squad, the death of an inspirational Unit Leader, and an episode that reveals the varied stages in the grieving responses of individual squad members in the aftermath of the death of the leader. Several of these issues were selected given the frequency with which they are reported to be pivotal events in the development of PTSD (and on common themes that appeared in the narratives of patients previously treated with our VRET system). For example, the death of a local civilian child that a squad member had a relationship with is an event that resonates time and again as the service member tries to reengage in civilian life. Moral relativistic challenges are also presented in the episodes. This occurs specifically in a horrific event (the beating of a civilian woman by locals) where the culturally based systems of morality that one must accept to live resiliently as a warrior are presented in a way designed to challenge the psychological underpinnings of even the most resolute person. These moral issues are not part of the usual training that SMs receive and these episodes are designed to prepare SMs to consider such "what if" questions in advance of their possible occurrence during actual missions. Similarly, the act of killing is one that many soldiers never truly contemplate until it has occurred. And while we do not yet fully know how we can best train SMs to be psychologically resilient warriors on the battlefield and concerned civilians off, we do know from the increasing numbers of SMs returning from combat with "moral injuries," or psychological distress experienced from transgressing some moral value, that we need to acknowledge the need to study and improve the process of resilience training for the entire range of psychological challenges we find associated with the hellish demands of modern warfare.

The STRIVE project also incorporates a novel basic science protocol. While other stress resilience research efforts typically incorporate one or two biomarkers of stress and or resilience, the STRIVE projects will measure what we refer to as the "physiological fingerprint of stress," commonly called Allostatic Load (AL). The theoretical construct of AL, initially developed by one of the STRIVE collaborators, Bruce McEwen, is a measure of cumulative wear and tear on physiological symptoms due to chronic stress (McEwen & Stellar, 1993). As a theoretical construct, it is a preliminary attempt to formulate the relationship between environmental stressors and disease, by hypothesizing mechanisms whereby multiple kinds of stressors confer risk simultaneously in multiple physiological systems.

The construct of AL is based on the widely accepted response called allostasis. Sterling and Eyer (1988) defined allostasis as the body's set points for various physiological mechanisms, such as blood pressure or heart rate, which vary to meet specific external demands, e.g., emotional stress. McEwen and Stellar (1993) furthered our understanding of allostasis by broadening its scope. Rather than discuss allostasis in terms of a single set point that changed in response to a stressor, they described allostasis as the combination of all physiological coping mechanisms that are required to maintain equilibrium of the entire system. Thus, allostasis is the reaction and adaptation to stressors by multiple physiological systems that brings the system back to equilibrium. The related concept of homeostasis refers specifically to system parameters essential for survival (McEwen, 2002). To place AL into the context of allostasis, requires the view that allostasis does not always proceed in a normal manner. Any of the major physiological systems (e.g., inflammatory, metabolic, immune, neuroendocrine, cardiovascular, respiratory) in the process of responding to stress can exact a cost, or an allostatic load that can result in some form of physiological or psychological disturbance. McEwen (2000) identified four types of AL. The first is frequent activation of allostatic systems; second is a prolonged failure to shut off allostatic activity after stress; third is a lack of adaptation to stress, and fourth is an inadequate response of allostatic systems leading to elevated activity of other, normally counter-regulated allostatic systems after stress (e.g., inadequate secretion of glucocorticoid resulting in increased cytokines normally countered by glucocorticoids). Any of these types of AL intervene with the normal stress response of allostasis thus increasing the negative health impact from stress. This will increase one's risk for disease in the long term and may preclude the short-term development of physical hardiness and psychological resilience.

The STRIVE system will be empirically tested to determine if AL can predict acute response to stress (e.g., EEG, GSR, ECG, pupil dilation, etc.), when participants are exposed to the stressful simulated VR missions. Further analyses will determine if AL can predict participants' responses to virtual mentor instructions on how the participants can cope with stress through resilience training. Pilot research on this project will commence in January 2014 with a National Guard Special Operations Unit that will be deployed to Afghanistan in March 2014. We have the rare opportunity with this unit to have them participate in a 6-episode STRIVE experience and to follow their mental health status immediately upon the return home and at 6-month follow-up. If we find that AL is capable of predicting either short-term response to stress or the ability to learn stress resilience, there would be numerous implications for the future use of AL, including identification of leadership profiles and for informing the development of appropriate training systems for all SMs. This project is noteworthy in that it represents the direct application of a novel VR development effort (psychological resilience training) with a system that also serves as an "ultimate Skinner-Box" for the scientific study of stress reactions using objective physiological assessment measures.

Conclusions

This chapter has detailed the history and rationale for the updating of the Virtual Iraq/Afghanistan VRET system with the aim to expand the system's content and functionality to more widely address the range of possible trauma experiences that may occur during a military deployment. Previous research with this VRET system to address combat-related PTSD has produced positive results, yet the absence of relevant content that uniquely addresses the needs of combat medics/corpsmen and those who have experienced MST was seen as a gap in the provision of evidence-based PTSD care. Upon completion of this content, the system will immediately undergo tests within an existing clinical trial with medics/corpsmen and a new trial with male and female SMs and Veterans who have experienced MST. If these new applications produce positive clinical outcomes similar to what has emerged thus far with the existing Virtual Iraq/Afghanistan system, then support for a broader general use of VRET could also potentially drive increased adoption of this method of PE delivery within the civilian sector.

The BRAVEMIND VRET project has been updated with the use of an advanced VR software development platform (the Unity Game Engine). The capabilities of this state-of-the-art software have also driven the reconfiguration of VRET assets to create a tool designed to prevent the incidence of combat-related PTSD via pre-deployment psychological resilience/coping training. The STRIVE program is designed to both create a VR application for enhancing SM resilience and to provide a highly controllable laboratory test bed for investigating stress responding in provocative simulated contexts. Success in this area could have significant impact on the nature of military training as well as for the prevention of combat stress-related disorders.

Another option for use of the STRIVE system could involve its application as a tool for emotional assessment at the time of recruitment into the military. The larger question regarding such an application involves whether it would be possible (and ethical) to assess prospective SMs in a series of challenging combat-relevant emotional environments delivered in the STRIVE system to predict their potential risk for developing PTSD or other mental health difficulties based on their verbal, behavioral, and physiological/hormonal reactions recorded during these virtual engagements. To use such information for recruitment decisions would require a change from current military thinking, where doctrine dictates that anyone can be made into an infantryman. However, practical implementation of such an approach could advise that those who display reactions that were found to predict higher risk for a negative stress reaction post-combat, could either be assigned non-combat duties, not accepted into the services, or more preferably, presented with the opportunity to participate in a personally tailored psychological resilience training program that could minimize their identified risk to post-trauma dysfunction. This is not a new concept. Since the early days of the Army Alpha/Beta, assessments have been routinely conducted that are designed to predict what role is best suited to the unique characteristics and talent of a given recruit. Moreover, potential recruits are not accepted into the military for many reasons that are more easily measurable (e.g., having a criminal record, poor physical fitness, significant health conditions).

If one reviews the history of the impact of war on advances in clinical care, it could be suggested that Clinical VR may be an idea whose time has come. For example, during WW I, the Army Alpha/Beta Classification Test emerged from the need for better cognitive ability assessment; that development later set the stage for the civilian psychometric testing movement during the mid-twentieth century. As well, the birth of clinical psychology as a treatment-oriented profession was borne from the need to provide care to the many Veterans returning from WW II with "shell shock" or "battle fatigue." The Vietnam War then drove the recognition of PTSD as a definable and treatable clinical disorder. In similar fashion, one of the clinical "game changing" outcomes of the OIF/OEF conflicts could derive from the military's support for research and development that has advanced clinical systems that leverage new interactive and immersive technologies such as VR. If the positive findings seen in the early research is borne out in larger controlled trials, those results could potentially drive increased recognition and adoption within the civilian sector. As we have seen throughout history, innovations that emerge in military health care, driven by the urgency of war, typically have a lasting influence on civilian health care long after the last shot is fired.

References

APA. (2013). *Diagnostic and statistical manual of mental disorders*. Washington, DC: American Psychiatric Association (DSM-5).

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology, 56*, 893–897.

Becker, C. B., Zayfert, C., & Anderson, E. (2004). A survey of psychologists' attitudes towards and utilization of exposure therapy for PTSD. *Behaviour Research and Therapy, 42*, 277–292.

Beidel, D. C., Frueh, B. C., & Uhde, T. W. (2010). *Trauma management therapy for OIF/OEF veterans*. Department of Defense United States Army Military Operational Medical Research Program: http://www.psych.ucf.edu/faculty_beidel.php

Blanchard, E. B., Jones-Alexander, J., Buckley, T. C., & Forneris, C. A. (1996). Psychometric properties of the PTSD checklist (PCL). *Behaviour Research and Therapy, 34*(8), 669–673.

Brewin, C. R., Andrews, B., & Valentine, J. D. (2000). Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Journal of Consulting and Clinical Psychology, 68*, 748–766.

Buckwalter, J. G., & Rizzo, A. A. (2011). Stress resilience, virtual environments and allostatic load. *Proceedings of the Interservice/Industry Training, Simulation and Education Conference.*

Burton, M. S., Youngner, C. G., McCarthy, A. J., Rothbaum, A. O., & Rothbaum, B. O. (2014). Enhancing exposure therapy for PTSD using D-cycloserine. In M. Safir, H. Wallach, & A. A. Rizzo (Eds.), *Future directions in posttraumatic stress disorder: Prevention, diagnosis and treatment*. New York, NY: Springer.

Cabrera, D., Figley, C. R., & Yarvis, J. S. (2012). Helping the combat medic and corpsman: Adapting to both primary and secondary traumatic stress down range and beyond. In J. Beder (Ed.), *Advances in social work practice with the military* (pp. 112–118). New York, NY: Routledge.

Cannady, V. (2012, June 1). *Combat medics suffer from a high rate of PTSD*. Retrieved from: http://voices.yahoo.com/combat-medics-suffer-high-rate-ptsd-11398322.html?cat=31

Casey, G. W. (2011). Comprehensive soldier fitness: A vision for psychological resilience in the U.S. army. *American Psychologist, 66*(1), 1–3.

Chapman, P. (2011, September 16). *Study looks at psychological effects suffered by combat medics*. Retrieved from: http://www.stripes.com/news/study-looks-at-psychological-effects-suffered-by-combat-medics-1.155272)

Cornum, R., Matthews, M. D., & Seligman, M. E. P. (2011). Comprehensive soldier fitness: Building resilience in a challenging institutional context. *American Psychologist, 66*(1), 4–9.

Department of Veterans Affairs. (2007). *Women veterans: Past, present and future: Office of policy and planning*. Washington, DC: Government Printing Office.

Difede, J., Cukor, J., Jayasinghe, N., Patt, I., Jedel, S., Spielman, L., et al. (2007). Virtual reality exposure therapy for the treatment of posttraumatic stress disorder following September 11, 2001. *Journal of Clinical Psychiatry, 68*, 1639–1647.

Difede, J., Cukor, J., Wyka, K., Olden, M., Hoffman, H., Lee, F. S. & Altemus, M. (2013 November, 12). D-cycloserine augmentation of exposure therapy for posttraumatic stress disorder: A pilot randomized clinical trial. *Neuropsychopharmacology.* doi: 10.1038/npp.2013.317

Difede, J., & Hoffman, H. G. (2002). Virtual reality exposure therapy for world trade center post-traumatic stress disorder: A case report. *Cyberpsychology and Behavior, 5*, 529–535.

Difede, J., Rothbaum, B. O. & Rizzo, A. (2010–2013). Enhancing exposure therapy for PTSD: Virtual reality and imaginal exposure with a cognitive enhancer. *Randomized Controlled Trial*. http://clinicaltrials.gov/ct2/show/NCT01352637

DoD. (2012a). *Strategic direction to the joint force on sexual assault prevention and response*. Downloaded from: http://www.jcs.mil/content/files/2012-05/050812085404_Joint_Strategic_Direction_on_Sexual_Assault_(7_May_12).pdf

DoD. (2012b). *DoD FY12 annual report on sexual assault in the military, Vol. 2*. Downloaded from: http://www.sapr.mil/public/docs/reports/FY12_DoD_SAPRO_Annual_Report_on_Sexual_Assault-VOLUME_TWO.pdf

DoD. (2012c). *DoD FY12 annual report on sexual assault in the military, Vol. 1*. Downloaded from: http://www.sapr.mil/public/docs/reports/FY12_DoD_SAPRO_Annual_Report_on_Sexual_Assault-VOLUME_ONE.pdf

Feldner, M. T., Monson, C. M., & Friedman, M. J. (2007). A critical analysis of approaches to targeted PTSD prevention: Current status and theoretically derived future directions. *Behavior Modification, 31*, 80–116.

Fischer, H. (2013, February 5). United States military casualty statistics: Operation New Dawn, operation Iraqi freedom, and operation enduring freedom. *Congressional Research Service 7–5700*, RS22452. Retrieved from: http://www.fas.org/sgp/crs/natsec/RS22452.pdf

Foa, E. B., Davidson, R. T., & Frances, A. (1999). Expert consensus guideline series: Treatment of posttraumatic stress disorder. *American Journal of Clinical Psychiatry, 60*, 5–76.

Foa, E. B., Hembree, E., & Rothbaum, B. O. (2007). *Prolonged exposure therapy for PTSD: Emotional processing of traumatic experiences, therapist guide*. New York: Oxford University Press.

Garcia-Palacios, A., Botella, C., Baños, R., Guillén, V., & Navarro, M. V. (2014). Modifications of PTSD treatment. Inclusion of virtual reality A rationale for the use of VR in the treatment of PTSD. In M. Safir, H. Wallach, & A. A. Rizzo (Eds.), *Future directions in posttraumatic stress disorder: Prevention, diagnosis and treatment*. New York, NY: Springer.

Gerardi, M., Rothbaum, B. O., Ressler, K., Heekin, M., & Rizzo, A. A. (2008). Virtual reality exposure therapy using a virtual Iraq: Case report. *Journal of Traumatic Stress, 21*(2), 209–213.

Godden, D. R., & Baddeley, A. D. (1980). When does context influence recognition memory? *British Journal of Psychology, 71*, 99–104.

Hoge, C. W. (2013). Risks associated with untreated PTSD in veterans: Implications for improving mental health care engagement and treatment. *Federal Practitioner* (June), 5S–9S.

Hovar, C. (2010, December 10). *The military operational medicine research program for the US army*. Retrieved from: http://www.donhcs.com/hsr/21_march/doc/presentations/Carl%20Hover%20MRMC%20MOMRP%208%20slides.pdf

Institute of Medicine (IOM). (2007). *Treatment of posttraumatic stress disorder: An assessment of the evidence*. Washington, DC: The National Academies Press, 200 p. ISBN: 0-309-10925-6. Downloaded from: http://www.nap.edu/catalog/11955.html

Institute of Medicine (IOM). (2012). *Treatment for posttraumatic stress disorder in military and veteran populations: Initial assessment.* Washington, DC: The National Academies Press, 396 p. ISBN: 978-0-309-25421-2. Downloaded from: http://www.nap.edu/catalog.php?record_id=13364

Kime, P. (2013). *DoD, VA failing to treat military sexual trauma, veterans testify*. Army Times. Accessed on July 20, 2013 at: http://www.armytimes.com/article/20130719/NEWS05/307190039/DoD-VA-failing-treat-military-sexual-trauma-veterans-testify

Kimerling, R., Street, A., Pavao, J., Smith, M. W., Cronkite, R. C., Holmes, T. H., et al. (2010). Military-related sexual trauma among Veterans health administration patients returning from Afghanistan and Iraq. *American Journal of Public Health, 100*, 1409–1412.

Kok, B. C., Herrell, R. K., Thomas, J. L., & Hoge, C. W. (2012). Posttraumatic stress disorder associated with combat service in Iraq or Afghanistan: Reconciling prevalence difference between studies. *The Journal of Nervous and Mental Disease, 200*(5), 444–450.

Kroenke, K., & Spitzer, R. L. (2002). The PHQ-9: A new depression and diagnostic severity measure. *Psychiatric Annals, 32*, 509–521.

Lester, P. B., Harms, P. D., Herian, M. N., Krasikova, D. V. & Beal, S. J. (2011). *The comprehensive soldier fitness program evaluation*. Report #3: Longitudinal Analysis of the Impact of Master Resilience Training on Self-Reported Resilience and Psychological Health Data. Retrieved August 14, 2012, from: http://dma.wi.gov/dma/news/2012news/csf-tech-report.pdf

Lubow, R. E., & Moore, A. U. (1959). Latent inhibition: The effect of non-reinforced exposure to the conditioned stimulus. *Journal of Comparative and Physiological Psychology, 52*, 415–419.

Luthar, S. S., Cicchetti, D., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development, 71*, 543–562.

McEwen, B. S. (2000). Allostasis and allostatic load: Implications for neuropsychopharmacology. *Neuropsychopharmacology, 22*, 108–124. doi:10.1016/S0893-133X(99)00129-3.

McEwen, B. S. (2002). Sex, stress and the hippocampus: Allostasis, allostatic load and the aging process. *Neurology of Aging, 23*, 921–939.

McEwen, B. S., & Stellar, E. (1993). Stress and the individual: Mechanism leading to disease. *Archives of Internal Medicine, 153*, 2093–2101.

McLay , R. N. (2012). *New technology to treat post traumatic stress disorder*. Paper presented at the American Psychiatric Association Convention. May 8, 2012. Philadelphia, PA.

McLay, R. N., Wood, D. P., Webb-Murphy, J. A., Spira, J. L., Weiderhold, M. D., Pyne, J. M., & Weiderhold, B. K. (2011). A randomized, controlled trial of virtual reality exposure therapy for post-traumatic stress disorder in active duty service members with combat-related post-traumatic stress disorder. *Cyberpsychology, Behavior and Social Networking, 14*, 223–229.

Murdoch, M., Polusny, M. A., Hodges, J., & O'Brien, N. (2004). Prevalence of in-service and postservice sexual assault among combat and noncombat veterans applying for Department of Veterans Affairs posttraumatic stress disorder disability benefits. *Military Medicine, 169*, 392–395.

Opris, D., et al. (2012). Virtual reality exposure therapy in anxiety disorders: A quantitative meta-analysis. *Depression and Anxiety, 29*(2), 85–93.

Ortony, A., Clore, G., & Collins, A. (1988). *The cognitive structure of emotions*. Cambridge: Cambridge University Press.

Parsons, T., & Rizzo, A. A. (2008). Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: A meta-analysis. *Journal of Behavior Therapy and Experimental Psychiatry, 39*, 250–261.

Powers, M & Emmelkamp, P. M. G. (2008). Virtual reality exposure therapy for anxiety disorders: A meta-analysis. *Journal of Anxiety Disorders, 22*, 561–569.

Public Broadcasting System (PBS). (2012). *Health experts question army report on psychological training*. Retrieved August 14, 2012, from: http://www.pbs.org/newshour/updates/military/jan-june12/csf_training_01-02.html

Reger, G., & Gahm, G. (2008). Virtual reality exposure therapy for active duty soldiers. *Journal of Clinical Psychology, 64*, 940–946.

Reger, G. & Gahm, G. (2010). Comparing virtual reality exposure therapy to prolonged exposure (VRPE extension).*Randomized Controlled Trial*: http://clinicaltrials.gov/ct2/show/NCT01193725?term=Reger&rank=2

Reger, G. & Gahm, G. (2011b). Comparing virtual reality exposure therapy to prolonged exposure (VRPE extension). *Randomized Controlled Trial*: http://clinicaltrials.gov/ct2/show/NCT01352637

Reger, G. M., Gahm, G. A., Rizzo, A. A., Swanson, R.A., & Duma, S. (2009). Soldier evaluation of the virtual reality Iraq. *Telemedicine and e-Health Journal, 15*, 100–103.

Reger, G. M., Holloway, K. M., Rothbaum, B. O., Difede, J., Rizzo, A. A., & Gahm, G. A. (2011). Effectiveness of virtual reality exposure therapy for active duty soldiers in a military mental health clinic. *Journal of Traumatic Stress, 24*(1), 93–96.

Reger, G. M., Rizzo, A. A., & Gahm, G. A. (2014). Development and dissemination of virtual reality exposure therapy for combat related PTSD. In M. Safir, H. Wallach, & A. A. Rizzo (Eds.), *Future directions in posttraumatic stress disorder: Prevention, diagnosis and treatment*. New York, NY: Springer.

Ressler, K. J., Rothbaum, B. O., Tannenbaum, L., Anderson, P., Zimand, E., Hodges, L., et al. (2004). Facilitation of psychotherapy with D-cycloserine, a putative cognitive enhancer. *Archives of General Psychiatry, 61*, 1136–1144.

Rheingold, A. A., Acierno, R., & Resnick, H. (2004). Trauma, post-traumatic stress disorder, and health risk behaviors. In P. P. Schnurr & B. L. Green (Eds.), *Trauma and health: Physical health consequences of exposure to extreme stress* (pp. 217–243). Washington, DC: American Psychological Association.

Rizzo, A. A., Buckwalter, J. G., Forbell, E., Difede, J., Rothbaum, B. O., Lange, B., et al. (2013). Virtual reality applications to address the wounds of war. *Psychiatric Annals, 43*(3), 123–138.

Rizzo, A., Difede, J., Rothbaum, B. O., & Reger, G. (2010). Virtual Iraq/Afghanistan: Development and early evaluation of a virtual reality exposure therapy system for combat-related PTSD. *Annals of the New York Academy of Sciences, 1208*, 114–125.

Rizzo, A. A., Graap, K., Mclay, R. N., Perlman, K., Rothbaum, B., Reger, G., et al. (2007). Initial case reports from a VR exposure therapy application for combat-related post traumatic stress disorder. *IEEE XPlore Virtual Rehabilitation International Conference*, 2007, pp. 124–130.

Rothbaum, B., Difede, J., & Rizzo, A. (2008). *Therapist treatment manual for virtual reality exposure therapy: Posttraumatic stress disorder in Iraq combat veterans*. Atlanta: Virtually Better.

Rothbaum, B. O., Hodges, L., Ready, D., Graap, K., & Alarcon, R. (2001). Virtual reality exposure therapy for Vietnam veterans with posttraumatic stress disorder. *Journal of Clinical Psychiatry, 62*, 617–622.

Rothbaum, B.O., & Ressler, K.J. (2008). *D-cycloserine and virtual reality exposure to treat Iraq war veterans with TSD*: http://clinicaltrials.gov/ct2/show/NCT00356278?term=Barbara+Rothbaum&rank=4

Sadler, A. G., Booth, B. M., Nielson, D., & Doebbeling, B. N. (2000). Health-related consequences of physical and sexual violence: Women in the military. *Obstetrics & Gynecology, 96*, 473–480.

Skinner, K. M., Kressin, N., Frayne, S., Tripp, T. J., Hankin, C. S., Miller, D. R., et al. (2000). The prevalence of military sexual assault among female Veterans' Administration outpatients. *Journal of Interpersonal Violence, 15*, 291–310.

Sones, H. M., Thorp, S. R., & Raskind, M. (2011). Prevention of posttraumatic stress disorder. *Psychiatric Clinics of North America, 34*, 79–94.

Sterling, P., & Eyer, J. (1988). Allostasis: A new paradigm to explain arousal pathology. In S. Fisher & J. Reason (Eds.), *Handbook of life stress, cognition and health* (pp. 629–639). New York, NY: Wiley.

Street, A. E., Gradus, J. L., Stafford, J., & Kelly, K. (2007). Gender differences in experiences of sexual harassment: Data from a male-dominated environment. *Journal of Consulting and Clinical Psychology, 75*, 464–474.

Street, A. E., Stafford, J., Mahan, C. M., & Hendricks, A. (2008). Sexual harassment and assault experienced by reservists during military service: Prevalence and health correlates. *Journal of Rehabilitation Research and Development, 45*, 409–419.

Surıs, A., Lind, L., Kaashner, T. M., & Borman, P. D. (2007). Mental health, quality of life, and health functioning in women veterans: Differential outcomes associated with military and civilian sexual assault. *Journal of Interpersonal Violence, 22*, 179–197.

Thomas, J. L., Wilk, J. E., Riviere, L. A., McGurk, D., Castro, C. A., & Hoge, C. W. (2010). Prevalence of mental health problems and functional impairment among active component and National Guard soldiers 3 and 12 months following combat in Iraq. *Archives of General Psychiatry, 67*(6), 614–623.

Valencia, O. (2013). Veterans seek resources to treat military sexual trauma. *Talk Radio News Service*. Accessed on July 20, 2013 at: http://www.talkradionews.com/pentagon/2013/07/19/veterans-seek-resources-to-treat-military-sexual-trauma.html#.UerSFfPn9ow

Walker, D. L., Ressler, K. J., Lu, K. T., & Davis, M. (2002). Facilitation of conditioned fear extinction by systemic administration or intra-amygdala infusions of D-cycloserine as assessed with fear-potentiated startle in rats. *Journal of Neuroscience, 22*, 2343–2351.

Wilson, J., Onorati, K., Mishkind, M., Reger, M., & Gahm, G. A. (2008). Soldier attitudes about technology-based approaches to mental healthcare. *Cyberpsychology and Behavior, 11*, 767–769.

Zinzow, H. M., Grubaugh, A. L., Monnier, J., Suffoletta-Maierle, S., & Frueh, B. C. (2007). Trauma among female veterans: A critical review. *Trauma, Violence & Abuse, 8*, 384–400.