THESIS

VETERANS' BRAINS AND THE POSITIVE AND NEGATIVE PERCEPTIONS OF MENTAL HEALTH CARE; REALITIES VIRTUAL AND OTHERWISE

Submitted By

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ABSTRACT

VETERANS' BRAINS AND THE POSITIVE AND NEGATIVE PERCEPTIONS OF MENTAL HEALTH CARE; REALITIES VIRTUAL AND OTHERWISE

The purpose of this study is to identify the benefits of using virtual reality exposure therapy (VRET) to treat veterans who suffer from posttraumatic stress disorder (PTSD), and to ascertain the efficacy of the treatment. In order to evaluate VRET as an effective treatment, prior case studies utilizing VRET will be analyzed to answer the research questions through the method of content analysis.

Nine case studies were studied and coded for themes revolving around gender, age, education, definition of PTSD, the lapse of time between trauma and treatment, deployment length and location, and type of technology used.

Findings across the board indicate that this method of treatment is highly effective and should continue to be utilized by practitioners in the treatment of veterans with PTSD. Specific research questions did not all arrive at conclusive answers, as the amount of data available and studied is limited. Information on gender, age, and education level are not readily available, and this study suggests that further research be completed in these areas in order to better understand and cater to these specific populations.

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CHAPTER ONE, INTRODUCTION

Soldiers in war face innumerable struggles each day. They are burdened with anxieties about when they will get to eat next, when they are going to sleep next, if they will be attacked in the night, or if they will wake up in the morning. They struggle with all of this in order to serve their country. It is impossible to make war a stress-free experience, but returning home should be as painless as possible. The battle should not follow them home.

Unfortunately, many veterans return with invisible and unrelenting battle wounds. One example of this is chronic Posttraumatic Stress Disorder (PTSD). PTSD is one of the leading psychological disorders found in returning veterans, and is "characterized by re-experiencing, avoidance, and hyper-arousal symptoms" related to a traumatic experience (Rothbaum et al., 2010, p 126.).

Approximately 830,000 Vietnam Veterans have experienced chronic combat related PTSD symptoms (Wood et al., 2007). Since the onset of Operation Enduring Freedom and Operation Iraqi Freedom, 2.5 million troops have been deployed to Iraq and Afghanistan, and thirteen to twenty percent are expected to return with or develop PTSD (Rothbaum et al., 2014). Iraq and Afghanistan veterans who tested positive for a mental disorder are at a low treatment rate, with only 23 to 40 percent receiving mental health care (Rizzo et al., 2010).

Military personnel are more likely than civilians to develop PTSD due to their higher exposure rate to traumatic experiences, such as enemy raids, torture, explosions, losing a fellow soldier, and seeing human remains. In Afghanistan and Iraq veterans, 13.8 percent of

veterans suffer from PTSD (Seitz et al., 2014). These numbers are rising at alarming rates, requiring new methods of treating this illness.

Because of the stigma attached to mental illness, many veterans suffer in silence. Fifty percent of diagnosed veterans go untreated, and those who are brave enough to reach out for help only receive minimal treatment (Mclay, 2012). They fear that seeking help will cause them to appear weak and vulnerable, or worse, that their fellow soldiers will think that they are lying. "Many people question if unscrupulous individuals manufacture their symptoms to gain disability payments" says Mclay (2012, p.64). This, in turn, leads to a high rate of preventable suicides in returning soldiers and veterans. PBS reported that 22 military veterans commit suicide every day, and 1,000 veterans attempt suicide each month (PBS, 2014).

Is virtual reality exposure therapy an effective method of treating PTSD in veterans?

The hope is that, by using a virtual reality program, the stigma connected with PTSD will be reduced, as will the stigma attached to seeking help. If seeking help can be viewed as a respectable course of action instead of a shameful one, the number of veterans undergoing treatment, and ultimately recovery, should increase, and the rate of veteran suicides should decrease.

Virtual reality exposure therapy (VRET) aims to offer a new form of therapy for veterans who are suffering from PTSD, but are not finding relief in cognitive behavioral therapy or medication (Rizzo et al., 2010). This type of therapy combines three different elements: virtual reality goggles, exposure therapy (which is based on emotional processing theory), and cognitive behavioral therapy.

The process of exposure therapy stems from a psychological theory, emotional processing theory, which focuses on identifying how exposure to the feared situation can help people with anxiety disorders become habituated to their fear, and no longer be negatively impacted by it.

Exposure therapy "involves helping people to repeatedly confront safe but feared thoughts, sensations, situations, and activities in order to promote emotional processing" (Foa, 1986, p. 8). For example, if the patient has a fear of elevators, he or she will be asked to ride an elevator for increasingly longer periods of time, until he or she no longer fears riding an elevator. Exposure therapy should be well planned, carried out over a long period of time, and delivered in a progressive fashion (Rachman, 2001, p.166). When virtual reality therapy is implemented, the patient can experience a simulation of the feared experience, instead of experiencing it in *vivo* (in person).

CHAPTER TWO, LITERATURE REVIEW

Virtual reality exposure therapy (VRET) aims to offer a new form of therapy for veterans who are suffering from posttraumatic stress disorder (PTSD), but aren't finding relief in traditional talk therapy or medication (Rizzo et al., 2010). This type of therapy combines three different elements: virtual reality goggles, exposure therapy, and traditional talk therapy.

2.1 Virtual Reality and the Basics of VRET

VRET was first used after the Vietnam War with veterans in 1999 by Rothbaum et al. VRET works by virtually exposing the patient to their traumatic experience repeatedly, until habituation is acquired. "VR offers a human-computer interaction system in which users are no longer simply external observers of images on a screen but are active participants within a computer-generated three-dimensional virtual world" (Rothbaum et al., 2010, p.127). The goggles, which consist of two screens, one in front of each eye, are placed on the patients' heads. The graphics shown on the screens immediately immerse them in a world that is modeled after Afghanistan, Iraq, or Vietnam, depending on the background of the patient, and shuts out the "real-world," allowing the user to have a sense of telepresence, which is the overall sense of being immersed in another world (Rothbaum et al., 2010). The first operating systems were bulky and expensive, making their usability limited. The visuals also had substantial lag time, making total immersion difficult for the user. Programs and hardware being used now include Virtually Better, Oculus Rift and X-Box, which present the user with fluid visuals and sound.

Jonathan Steur defines virtual reality as "a real or simulated environment in which a perceiver experiences telepresence" (1993, p.7). The most important aspect of virtual reality is that of telepresence, which is feeling that you are fully immersed in the environment that you are viewing. There are numerous elements that can help increase the likelihood that the viewer will experience telepresence. Where telepresence is the umbrella term, it includes vividness and interactivity. Beneath vividness is breadth and depth. Beneath interactivity are speed, range, and mapping.

Steur explains the meaning and importance of each of these elements in his article. Vividness is the "representational richness of a mediated environment as defined by its formal features… the way in which an environment presents information to the senses" (1993, p. 11). Essentially, the more high-definition the media is, the more vivid it is. Contributing to vividness is sensory breadth, "the number of sensory dimensions simultaneously presented" and sensory depth, "the resolution within each of these perceptual channels" (1993, p.11). Breadth provides sensory inputs across multiple senses (sights, smell, and touch) while depth is the quality of those sensory inputs. Higher quality inputs have a greater depth than low quality inputs. Natural un-mediated perception of senses is far more in-depth than mediated perceptions, at this time. As technology continues to advance, it will more closely resemble our natural perceptions.

Interactivity is the "extent to which users can participate in modifying the form and content of a mediated environment in real time" (Steur, 1993, p. 14). This means that the user of the media is able to manipulate the content as they desire, in terms of surroundings and actions taken by characters in the medium. Contributing to this factor is speed, "the rate at which input can be assimilated into the mediated environment"; range, "the number

of possibilities for action at any given time"; and mapping, "the ability of a system to map its controls to changes in the mediated environment in a natural and predictable manner" (1993, p. 15) and is most successful when controllers are connected to the human body. If these three factors are poorly constructed, the user may feel disengaged from the experience, and may even suffer from motion sickness.

Another crucial aspect of telepresence is the feeling of engagement, and this stems from a willing suspension of disbelief. This requires the user to loosen their focus on the reality in which they live, and accept the one being experienced through a form of media. Once their reality is suspended, they can immerse themselves in a new one.

Steuer states that, "vividness and interactivity are both positively related to telepresence; that is, the more vivid and the more interactive a particular environment is, the greater the sense of presence evoked by that environment" (1993, p. 20). This creates an efficacious virtual reality environment and experience. The first piece of equipment to be considered virtual reality was the Sensorama, created by Morton Heilig in 1961. It engaged four senses, allowing the user to "see the Manhattan streets go by, hear the roar of the motorcycle and the sounds of the street, smell the exhaust of other cars and pizza cooking in roadside restaurants, and feel the vibration of the handlebars" (Steuer, 1993, p.12).

Since Heilig's invention, virtual reality has advanced. The most common forms are the Oculus Rift, the HoloLens, and games on consoles like the XBOX 360. Virtual reality can be used for a variety of tasks, such as gaming, gamification (turning work into play), helping people conquer trauma, and reducing phobias of snakes, spiders, flying, elevators, as well as many others.

Anders Gronstedt and Marc Ramos applied virtual reality worlds and gamification to training employees. In their article "Learning Through Transmedia Storytelling", they express the value that VR has in a transmedia teaching environment. Employees are able to create their own avatars, and transport them around a virtual world, which follows a story line. The employees communicate and interact with other players, or computer players that provide them with information. Gronstedt explained how "the sound and volume changes depending on where they are—it's sound and sight in 3-D. The immersive environment keeps participants completely focused on the task at hand… These 3D immersive environments allow learners to step into the characters and create their own stories" (2014, p.9).

At the University of Colorado Denver, Gronstedt and Ramos piloted a meta-analysis on the efficacy of virtual gaming as a teaching tool. They found "computer-based simulation games to be more effective than traditional approaches by any measure, including 20 percent more effective in task completion" (2014, p.8).

This article also discusses the possibility of using VR to help train medical professionals. Medical students would be able to master complex procedures without compromising the health of an actual patient. "Emergency response workers [would be] able to practice scenarios and see stories unfold while being completely immersed in the simulation," Gronstedt stated. "Learners can experience lasting and memorable stories through multiple senses" (2014, p.9).

The content included in these articles varies drastically. Steuer concentrated on the implications of using VR as a treatment, while Gronstedt and Ramos examined it from a teaching angle. These are both practical and efficient uses of an innovative technology, and

both applications should be researched further to ensure that they are being used as widely as possible.

2.2 Posttraumatic Stress Disorder (PTSD)

PTSD was added to the DSM-III in 1980 (Jones & Wessley, 2005, p.124). The DSM is the Diagnostic and Statistical Manual of Mental Disorders, in which is listed every mental disorder or illness found in the developed world and its classification and symptoms.

Modern day PTSD finds its roots in the Great War from 1914 to 1918 when "military doctors had begun to diagnose soldiers with 'exhaustion' following the stress of battle. This 'exhaustion' was often characterized by a mental shutdown as a result of trauma" (Chamberlin, 2012, p.360). At this time, the only prescriptions that soldiers were given was "rest" and were then carted back to the frontlines to continue fighting for their country. However, "military psychiatry did not originate with the First World War. Physicians had attempted to treat a range of unexplained somatic disorders during earlier conflicts, of which disordered action of the heart (DAH), effort syndrome, non-ulcer dyspepsia and psychogenic rheumatism have been the most prominent" (Jones & Wessley, 2005, p.126).

In 1876, Dr. Mendez DaCosta coined the term "Soldier's Heart" during the Civil War. Dr. Arthur Meyer took this idea and expanded it. Meyer "observed that combat soldiers serving in active war zones often exhibited distress characterized by arousal of the cardiovascular system. Symptoms of this disorder included extreme fatigue, dyspnea, heart palpitations, sweating, tremors, and loss of consciousness" (Chamberlin, 2012, p.360). These symptoms closely resemble the symptoms that are found in the DSM-IV for PTSD today.

Similar to many diseases, PTSD can be viewed as a culturally constructed ideology. At this point in the development of a clear understanding of PTSD, a stigma began to develop. This stigma was a gender-biased belief that male soldiers ought to be tough and immune to developing psychological disorders. “Soldiers suffering the effects of trauma show an inability to exhibit virtues of the ideal male, by failing to meet expected gender norms and fulfill male gender roles. Soldiers are still and have historically been expected to be strong and fearless, but trauma-related nervous disorders such as PTSD serve to expose the vulnerabilities and frailty of these men” (Chamberlin, 2012, p.359).

In an attempt to allow the men to retain their dignity and to avoid speaking about men acting in a way that did not conform to the script written for them by history, Soldier’s Heart was deemed to be caused by concussions suffered by the soldiers during battle.

As the validity of Soldier’s Heart faded, Charles Samuel Meyers created the term “Shell Shock” to take its place. This diagnosis was still based on a somatic response to an environment, and Dr. Meyers stated that Shell Shock was “caused by cerebral concussions and the rupture of small blood vessels resulting from proximity to exploding shells” (Chamberlin, 2012, p.361). This explanation did not hold true as soldiers who did not experience front-line combat began to develop similar symptoms.

Dr. Meyers then expanded the diagnosis and “distinguished the neurological condition of shell concussion from the psychological disorder of shell shock that could be caused by exposure to the intense and horrific conditions of war” (Chamberlin, 2012, p.361). Men suffering from shell shock were quickly diagnosed with shell concussion in order to conform to the masculine stereotype and expectation. This only strengthened the stigma surrounding the illness, and that stigma is still heavily prevalent today.

Following Shell Shock, the term "Combat Fatigue" was established. At this time, there was significant research and interest in the illness by researchers and citizens alike. The illness benefitted from this expansion to the public sphere in many ways, but it enhanced the stigma even further. During the Vietnam War, "there were very few combat stress casualties. Initially, it appeared that the Vietnam War had been a psychiatric success story" (Jones & Wessley, 2005, p.126). Between 1968 and 1975, this perception changed. A few studies examining small groups of veterans led to "the opinion that this conflict had been unusually potent in leading to psychiatric distress becom[ing] generally accepted" (Jones & Wessley, p.126).

After the Vietnam War left a record number of men suffering, the term PTSD was created and added to the latest version of the DSM; DSM III. PTSD was then diagnosed in individuals who were not in the military. It was defined as a "psychological condition experienced by a person who had faced a traumatic event, which caused catastrophic stressors outside the range of usual human experience" (Chamberlin, 2012, p.363).

The underlying illness of PTSD has remained the same, but has been operationalized differently. One aspect that has remained consistent is the culturally constructed aspect to it; men, soldiers especially, must not show mental weakness and may not be believed when they claim to be distraught even though "throughout the history of the war, men have been both mentally and physically broken by the battlefield" (Chamberlin, 2012, p.359).

Hapke et al. posited that, "pre-existing anxiety disorders, somatoform disorders and depressive disorders significantly increase the risk of PTSD" (2006, p.299).

Rachel Yehuda begins her article "Post-Traumatic Stress Disorder" by defining what qualifies as a traumatic event. She states that the "defining characteristic of a traumatic

event is its capacity to provoke fear, helplessness, or horror in response to the threat of injury or death" (2002, p.108). These types of feelings can be the result of military combat, violent personal assault, being kidnapped or taken hostage, terrorist attack, torture, incarceration as a POW or in a concentration camp, natural or manmade disasters, severe automobile accidents, or being diagnosed with a life-threatening illness" (Chamberlin, 2012, p.362).

In order to be diagnosed with PTSD, the sufferer must have experienced a traumatic event, and then "responded with fear, helplessness, or horror and to have three distinct types of symptoms consisting of re-experiencing the event, avoidance of reminders of the event, and hyper-arousal for at least one month" (Yehuda 2002, p.108).

Stanley Rachman (2001) defined PTSD as "abnormal… experiences and behavior such as unwanted intrusive thoughts, the return of fear, abnormal grief reactions, and so forth" (p.164), which occur after some sort of trauma. This re-experiencing can happen soon after the traumatic event, or months or years later, "sometimes to the considerable surprise of the person experiencing the return" (p. 165). Rachman goes on to identify the three main components of a diagnosis of PTSD as "heightened arousal, abnormal avoidance, and re-experiencing" (2001, p.165), just as Yehunda had.

Re-experiencing refers to nightmares or flashbacks; avoidance refers to avoiding people, places, or situations that remind the person of the trauma; hyper-arousal refers to an inability to sleep properly and an increase in irritability and startle reaction.

The development of PTSD after a traumatic event is more likely in someone who previously suffered from depression or anxiety disorders. It is also more likely to occur when the trauma is of an interpersonal nature. Yehuda found that, "PTSD developed in 55

percent of persons who reported being raped, as compared with 7.5 percent of those involved in accidents and 2 percent of those who learned of traumatic events" (2002, p.109). Statistics compiled by Yehuda show that women develop PTSD more frequently than men do, but this is a misleading correlation. Women are not necessarily more likely to develop PTSD due to biological constructs, but because they are "ten times as likely as men to be raped" (Yehuda, 2002, p.109). While women statistically more likely to be raped than men, PTSD following a rape trauma is more prevalent in men than women, and "these statistics argue against an increased vulnerability to the disorder in women and instead suggest that certain experiences may involve different degrees of actual threat and physical injury" (Yehuda, 2002, p.110).

The body and the mind play integral roles in the development of PTSD. Some people are able to experience a trauma and process it fully, thus not developing PTSD. Yehuda states that, "the psychological and biological response to a traumatic event is determined by the characteristics of both the event and the person involved" (2002, p.210). The primary response is biological, and is followed by a mental organization of the event. At this point, the brain can either process the event and begin recovery by "confronting human vulnerability in a way that promotes the development of resilience" or can become overwhelmed which "may perpetuate a state of fear that interferes with the restoration of feelings of safety" (Yehuda, 2002, p.210).

The result of the latter is the development of PTSD. This then leads to avoidance, which in turn "reduces opportunities to extinguish or diminish fear responses… and prevents the development of effective coping strategies, resulting in further social, interpersonal, or occupational disruption" (Yehuda, 2002, p.210). It is imperative that the

sufferer confronts the memory of the traumatic experience and reaches habituation, at which point the trauma will no longer disrupt his or her daily life.

There are biological differences between people with PTSD and people who have successfully processed the trauma. Those with PTSD have increased levels of norepinephrine and their adrenergic receptors are more reactive. It has also been discovered that there are "alterations in two major brain structures—the amygdala and hippocampus" (Yehuda, 2002, p.110), two areas that are involved in generating fear structures. The stimuli from the trauma is coded and stored in a destructive manner, causing the person to experience "intrusive recollections of the event, avoidance of reminders of the event, and symptoms of hyper-arousal" (Yehuda, 2002, p.112).

Yehuda suggests that the most effective methods of treatment are exposure therapy, cognitive behavior therapy, anxiety management, and medication.

Hapke et al. conducted a case study on the importance of gender on the development of PTSD. He found that, in a civilian setting, women are at a higher risk of being exposed to trauma and consequentially develop PTSD than men are. This did not hold true in military samples. Overall, "factors such as psychiatric history had a more uniform predictive effect than gender" (2006, p.300).

While Yehuda discussed the underlying framework of PTSD, Hapke provided a case study examining a possible correlation between gender and development of PTSD. Coupling these articles provides a baseline understanding of the disorder, itself, and then shows one way in which it can be assessed. Without a proper grasp on the causes of PTSD, the case study would be meaningless.

2.3 Exposure Therapy

Exposure therapy also finds its roots in assisting returning Vietnam veterans (Rothbaum et al., 1999). It is often used with people who have experienced something traumatic and are having residual negative emotional or physical consequences, and are having trouble working through the trauma. Exposure therapy forces the patients to face head-on the event that they are struggling to process. By having them confront the event repeatedly, they can work through exactly what happened and eventually reach habituation. Although there is no one method that is agreed upon as the most effective, "Exposure therapy shows some of the strongest empirical support for successfully treating PTSD and it is therefore currently considered the treatment of choice" (Seitz et al., 2014, p.24). An example of this is provided below in section 2.5. Therapy that involves exposure has been found to be more effective than other forms of therapy, and thus is utilized by a majority of mental health professionals (Rothbaum et al., 1999).

Successful habituation may be interrupted if the patient is under-engaged/under-activated or over-engaged/over-activated. Foa et al. (2006) explained how "an extreme level of activation (over-activation) may interfere with emotional processing… over-activation leads to a failure to incorporate new information…" (p.7). In this instance, the fear structure cannot be modified.

Under-engagement occurs when "the fear structure is not sufficiently activated" (Rauch, 2006, p.62). If the patient appears detached from the exposure and does not show signs of emotional engagement and some level of distress, his or her fear structure is not being activated. If the fear structure is not activated, it can't be restructured with new information.

Foa, Huppert, and Cahill dissected the exposure therapy approach to reducing anxiety, and thoroughly explained why it is effective. Simply put, it reduces symptoms of anxiety because it helps sufferers transform their fear structures through repeat exposure to the feared experience. The overarching framework for this transformation is based on the emotional processing theory.

Using this method of exposure therapy can access fear structures, and they can also easily be rewired with the repeat exposure. Foa et al. (2006) explains that, "through repeated imaginal exposure of the traumatic memory, the patient with PTSD learns the distinction between remembering the trauma and being re-traumatized, thus altering the association between the traumatic memory and threat meaning" (p.8). Foa and Kozak (1986) reiterate this by saying that, "repeated exposures over time allow a new representation of long-term consequences to replace elements of the preexisting fear memory" (p.28).

There are several methods to assist in this process. Kozak and Foa (1986) posit that, "evocative information can be delivered via a variety of audio or visual media. Verbal descriptions, visual displays, or lifelike enactments can contain the required information to access an existing fear structure" (p.25).

Foa et al. state that, "the fear structure of patients with PTSD is characterized by a pathological association between trauma reminders, which are essentially safe situations or images, and danger or a sense of incompetence" (2006, p.6). Due to a traumatic experience, individuals can begin to believe that something completely harmless actually presents danger to them and their wellbeing. Rauch and Foa state that "when something in

the environment matches one or more of the fear structure elements, it is activated and the activation spreads throughout the network" (2006, p.61).

In order to adjust fear structures and to process an experience in a healthy manner, two things are required: "(1) activation of the fear structure and (2) incorporation of new information that is incompatible with the pathological elements of the fear structure" (Foa et al., 2006, p.7). Activation of the fear structure involves recreating the feared behavior, causing the person to remember the trauma. The next step is to incorporate new information that is divergent from the feared information, showing that the feared result, pain, does not occur. This new information will overwrite the fear structure, rendering the feared stimuli no longer debilitating to the individual.

The primary reason that people suffer from PTSD is a failure to appropriately process a traumatic event, most often due to avoidance. Foa et al. describe how "avoidance of trauma memories and reminders appears to interfere with natural recovery, whereas talking about the experience with supportive others appears to facilitate natural recovery" (Foa et al., 2006, p.13). Foa explains that, "the persistence of a pathological fear structure is due to behavioral and cognitive avoidance" (p.5) and adds that "avoidance of trauma memories and reminders appears to interfere with natural recovery" (p.13).

Exposure therapy allows the sufferer to face the trauma gradually and in a safe environment, and eventually come to the realization "that the feared consequences did not occur" (Foa et al., 2006, p.17).

At the time of this article's publication, virtual reality was not widely used, but Foa at el. offer the idea that exposure therapy could be used in a variety of new ways, even going as far as to vaguely mention a technological administration of the therapy. Their

conclusion that "emotional processing theory appears to account quite well for natural recovery, as well as for the treatment of anxiety disorders, whether by exposure therapy, cognitive therapy, or other alternatives" (2006, p.18) leaves room for exposure therapy to be used in a virtual setting through VR headsets.

2.4 Emotional Processing Theory

Emotional processing theory is derived from the fear structures in one's mind, and attempting to redirect them away from irrational panic, and towards rational conceptualizations of an experience. This can be done through exposure therapy, of which there are various types, including in vivo, imaginal, and virtual reality.

The primary focus of emotional processing theory is identifying how exposure therapy can help people with anxiety disorders, such as obsessive compulsive disorder, social anxiety, phobias, and posttraumatic stress disorder, become habituated to their fear, and will no longer be negatively affected by it.

Foa et al "defined emotional processing as the modification of the fear structure in which pathological associations among stimuli, responses, and meaning are replaced with nonpathological associations… weakening erroneous associations and acquiring new associations" (2006, p. 6).

Rachman (2001) presents an article that focuses on emotional processing and posttraumatic stress disorder. This article aids in exploring the connection between general anxiety and PTSD. He gives a brief history of exposure therapy, explaining how "the connection between traumatic experiences and a form of re-experiencing was recognized a century ago" (p.164) by Freud, in 1910.

Emotional processing is "a process whereby emotional disturbances are absorbed, and decline to the extent that other experiences and behavior can proceed without disruption" (Rachman, 2001, p.165). When the person is unable to properly work through the experience, the negative feelings associated with the trauma take control and can potentially ruin a person's life through "unwanted intrusive thoughts, obsessions, phobia, the return of fear, abnormal avoidance, re-experiencing, elevated arousal, abnormal grief reactions, nightmares" (Rachman, 2001, p.165), all of which are symptoms of PTSD. Some factors that can make emotional processing difficult are state factors, maladaptive cognitions, personality factors, and stimulus factors (Rachman, 2001).

These symptoms occur after the person experiences some sort of trauma, and this re-experiencing can happen soon after the traumatic event, or months or years later, "sometimes to the considerable surprise of the person experiencing the return" (Rachman, 2001, p.165). Rachman defines the three main components of a diagnosis of PTSD as "heightened arousal, abnormal avoidance, and re-experiencing" (2001, p.165).

Rachman explains that exposure therapy will only change fear structures if the patient shows physical responses of distress, such as an increased heartbeat. He states that, "fear structures must be evoked if fear is to be modified" (2001, p.166). He also explains the factors most likely to help a patient achieve habituation: "engaged exposure to the disturbing material, habituation training, calm rehearsals, long presentations, repeated practice, proceeding from high to low provoking stimuli, the use of relaxation, the vivid presentation of stimuli, the formation of vivid images, presentation of stimuli, an emphasis on visual images" (2001,p.168).

Fear is “represented in memory structures that serve as blueprints for fear behavior” (Foa & Kozak, 1986, p.21). There are two kinds of these fear structures. One is normal and adaptive, while the other is pathological and maladaptive (Foa et al., 2006, p.5). A normal, adaptive fear structure is healthy to have. An example of this type of fear structure would be scalding water coming out of the sink. Touching hot water will hurt and is dangerous, so it is logical that one will adapt to the situation, and not put a hand in the water. Pathological fear structures are maladaptive, and resistant to change, and “contains associations among the stimulus, response, and meaning representations that distort reality and includes excessive response elements e.g. avoidance of safe situations” (Foa et al, 2006, p.5). An example of this is hearing fireworks and taking cover.

Kozak and Foa (1986) state that there are a number of meanings that characterize fear structures in people who suffer from anxiety disorders. “Firstly, there is the concept that anxiety will persist until escape is realized. Secondly, the fear stimuli and/or the fear responses are associated with unrealistically high probability for causing either psychological or physical harm. Thirdly, the threat has an extremely high negative valence for the individual” (p.28).

The final factor, “emphasis on visual images,” ties in directly with virtual reality exposure therapy. However, VRET creates a 4D environment by adding scents, noises, and vibrations, which accompany the visuals.

Proper emotional processing will be achieved when there is “evidence of a return to normal, undisrupted, routine behavior” (Rachman, 2001, p.167). Another method of assessing the efficiency and completeness of emotional processing is through test probes, which “offer the most direct and best way of determining the progress of emotional

processing" (Rachman, 2001, p.168). These test probes confront the patient with stimuli similar to their feared stimuli. If the test probe causes the patient to experience fear, emotional processing is not complete. If the patient is able to experience the test probe without any fear, emotional processing is complete.

Emotional processing theory and exposure therapy are an integral part of virtual reality exposure therapy. They are, in fact, the basis for it. Having a thorough understanding of how exposure therapy works is necessary in order to correctly utilize VRET. The notion of exposing someone to the situation or object that is feared most may sound like unnecessary and cruel torture, but once the science behind it is understood, it becomes clear that exposure therapy is an important, effective, and life-changing method.

Foa's and Rachman's articles complement one another, and provide a full map of the deep connection between emotional processing theory and exposure therapy. This theoretical framework provides the necessary explanation as to why exposure therapy is a successful method of rehabilitation for anxieties such as PTSD. These articles were placed into the same category because the theory validates the efficacy of the method.

2.5 Virtual Reality Exposure Therapy Case Studies

Rothbaum et al. conducted the first case study examining VRET in 1999. This study focused on a single male who served as a helicopter pilot in Vietnam, and subsequently suffered from PTSD. The subject was virtually immersed in an environment that closely resembled Vietnam by putting on the "Virtual Research V6 head mounted display equipped with a Polhemus InsideTrak position tracker and high-quality headphones" (Rothbaum et al., 1999, p.265). The display had two small screens, one in front of each eye, which showed graphics of his feared environment, and was fully immersive. The headphones permitted

the patient to communicate with the therapist, as well as hear sounds that would be typically heard in a war zone.

The patient was seated on a "Thunder Seat," an apparatus similar to the seminal works of Morton Heilig's Sensorama. This seat vibrated in a fashion akin to a helicopter's rumble when he was in a virtual helicopter. When the patient was standing, he was in a city-like virtual environment. His subjective units of discomfort (SUDS) were evaluated every five minutes while he was wearing the goggles to gauge how well he was coping with his virtual surroundings. SUDS are used to measure distress in a patient.

SUDS consist of data about skin conductance, heart rate, and self-reported anxiety levels. If the patient is feeling overly anxious, the therapist knows not to increase the intensity level. If the patient isn't experiencing anything mentally or physically, the therapist knows to increase the intensity. Without this assessment, the exposure could become either useless due to over or under stimulation, and either way would not be beneficial to the patient (Seitz et al., 2014). Each time that the patient has a session, the level of intensity is raised. In time, the patient should be able to navigate the entire memory without having a high level of anxiety or skin conductance.

The effectiveness of exposure therapy can be measured by subjective units of discomfort and with test probes, both of which measure physiological responses in the body. Physiological responses "include changes in heart rate, blushing, sweating, and trembling" (Foa et al., 2006, 15). These are all responses that occur when one is nervous, uncomfortable, embarrassed, or anxious. Along with these, other measurements can be taken such as restlessness, eye movement, and swallowing.

The end goal of VRET is a reduction in the SUDS ratings, which signals that the person is less affected by the exposure to their traumatic experience. A low SUDS level indicates that the patient has either reached or is nearing habituation. This means that they are comfortable with exposure, and are no longer categorized as having PTSD. This will signal successful habituation (Rothbaum et al., 1999)

Fourteen 90-minute sessions were administered over seven weeks. During each session, the patient was exposed to virtual environments in increasing intensity, which triggered memories of his time in Vietnam. He was evaluated at the end of treatment, as well as six months subsequent to the exposure. The results disclosed that "scores on all measures decreased from pre- to post-treatment and gains were generally maintained at follow-up" (Rothbaum et al., 1999, p.267).

This was the initial case study of this kind, and was vital in introducing the possibilities of VRET. Rothbaum's explanation of the procedure set a protocol for further study and piqued the interest of other researchers. The positive results opened up possibilities for mental health care that had yet to be considered.

Robert McLay advanced the world of VRET further when he took the system overseas and worked with soldiers serving in Iraq. His book, "At War With PTSD," is broken up into sections, each describing distinctive aspects of PTSD, VRET, and the experiences of soldiers in Iraq. He begins by explaining that PTSD occurs when a "person experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others"(McLay, 2012, p.12), and that it is made serious by the re-experiencing of the event.

People who suffer from PTSD have, on average, a smaller hippocampus in comparison to a healthy individual (McLay, 2012, p.33). However, it is unsure if the smaller hippocampus is a cause of the PTSD, or if the acquisition of PTSD causes the hippocampus to shrink. Are people with smaller hippocampi more prone to develop PTSD, or does the development of PTSD cause the hippocampus to shrink? There is still not a definitive conclusion. Another indicator for the development of PTSD is that "individuals with a history of childhood abuse have a higher likelihood of developing PTSD after combat" (McLay, 2012 p.63).

The concern of stigma in the military can cause soldiers and veterans to suffer silently, instead of seeking support. McLay found that "it wasn't just the troops in the field who jumped to the idea of malingering when an individual presented with symptoms of PTSD. Many individuals from all walks of life felt that PTSD was something that was made up to justify a paycheck, a trip home, or a failed life" (2012, p.64). High stigmatization of the disorder makes it nearly impossible for soldiers and veterans to ask for help. They fear that they will be seen as weak or liars in the eyes of their peers.

Once an adequate definition of PTSD was provided and stigma was addressed, McLay mentioned exposure therapy, and that the Institute of Medicine "reviewed more than two thousand eight hundred papers but… the only treatment they clearly endorsed was exposure therapy" (2012, p.52). He clarifies that exposure therapy works because fear is ultimately reduced. McLay states, "if you run through the same video sequence enough times without that link to real danger, you realize that the sights and sounds don't hurt you, and it becomes less scary" (2012, p.82). This statement led to the discussion of using virtual reality goggles to help patients experience exposure therapy.

The graphics in virtual reality exposure therapy can be manipulated to match that of the traumatic experience of the patient. There is a "collection of menus, allowing [the user] to pick everything from the time of day, to the weather, to the level of violence going on in the background or near the Humvee" (McLay 2012, p.117). Scents, sounds, and vibrations can be manipulated in order to match the lived experience as closely as possible.

While McLay used the VRET technology in Iraq on active duty members, his goal was to aid soldiers who were struggling with their deployment due to traumatic experiences on past or current deployments. He matched the VR surroundings to the actual surroundings, and the soldiers were able to work through the traumatic events.

Some soldiers at the camp in Fallujah, where McLay applied the technology, felt general anxiety and suffered from disordered sleep. It was clear that they had PTSD, but the soldier didn't know the exact trauma that caused the disorder. Here, VRET was still useful. The idea is "to allow you to recognize what does bother you, and to slowly make it more realistic and more stressful, so that you learn to deal with those anxiety-provoking situations once you know what they are" (p.167).

"At War With PTSD" provides a strong case for the effectiveness of VRET on veterans. Patients who did not drop out of treatment experienced a large reduction in PTSD symptoms, and were able to return to their families and live normal lives.

McLay's book provides a broad context in which to consider the use of VR with military personnel and veterans. He discusses its application for treating PTSD, but also the possibility of using it to prevent the development of PTSD. Exposing the soldiers to graphic violence that they may encounter in battle before it transpires may help the soldier cope

after the traumatic event. He used the VR system with active soldiers and veterans, showing the versatility of the technology.

None of his work would have been possible without the initial findings and reports by Rothbaum. Her initial case study provided researchers with the proper foundation to expand and elaborate on virtual reality exposure therapy.

Many other similar studies have been conducted and will be the focus of this paper's content analysis.

The concepts will be operationalized by gaining a second-hand understanding of how effective the use of VRET is at decreasing or extinguishing PTSD in veterans. This will be measured through a thorough content analysis of all qualifying case studies completed between the years 1999 and 2013.

Others researching the use of VRET on veterans with PTSD include Ready and colleagues in 2006, Wood et al. in 2007, Geradi et al. in 2008, Reger and Gahm in 2008, Rizzo, Difede, and colleagues in 2009, Ready, Geradi, Backscheider, Mascaro, and Rothbaum in 2010, and Reger and Colleagues in 2011.

CHAPTER 3, METHODS

The study being conducted is a content analysis of nine case studies focusing on the effect of virtual reality exposure therapy on veterans who are suffering from posttraumatic stress disorder. This method is being employed due to the fact that each of these studies is a comprehensive examination of VRET from different points of view. Some have a large sample size, while others have only one participant; some include only males or only females, while others are a mix of both. Another difference between these case studies is the level of technology being used. In the initial study, the technology was fairly new and underdeveloped. Technology has advanced greatly over the past 14 years, and now more recent studies are able to provide a more immersive experience for patients.

Articles were located based on the following key words: post-traumatic stress disorder, virtual reality exposure therapy, virtual reality, exposure therapy, emotional processing theory, veterans, Vietnam, Iraq, Afghanistan, OEF, OIF.

Once articles were located, they were read for disqualifying/qualifying aspects. Inclusion was based on the case study focusing only on veterans who suffered from PTSD and not other anxiety-based illnesses. The case study must not be comparative, and must only be examining the effectiveness of VRET. All methods of VRET technology were included, as were all different kinds of measurements used.

All articles used measured PTSD in either PCL-M or CAPS. PCL-M is an acronym for PTSD Checklist, Military version, and it was created by the VA's National Center for PTSD. It is comprised of 17 questions, each using a 1-5 Likert Scale, 1 indicating "Not At All" and 5 indicating "Extremely", to measure various symptoms of PTSD. The patient is asked how

perturbed they have been by specific issues during the previous month. Examples of instances are “Repeated, disturbing memories, thoughts, or images of a stressful military experience from the past?”, “Suddenly acting or feeling as if a stressful military experience were happening again (as if you were reliving it)?”, “Avoiding thinking about or talking about a stressful military experience from the past or avoiding having feelings related to it” and “Feeling irritable or having angry outbursts?” (Blanchard, 1996, p.1-4).

Often referred to as the ‘gold standard’ in PTSD assessment, CAPS is an acronym for Clinician Administered PTSD Scale. Created by the VA’s National Center for PTSD, this 30-question interview is used to determine the presence of PTSD, as well as “provide a measure of PTSD symptom severity” (National Center for PTSD) and has been utilized regularly since 1990. A sample question, provided by the U.S. Department of Veteran Affairs, is provided below:

> “In the past month, have you had upsetting thoughts, pictures or sounds of what happened come into your mind when you didn't want them to? Did this happen while you were awake, so not counting dreams?
> How did these upsetting thoughts, pictures or sounds of what happened come into your mind?
> [If not clear]: Do these unwanted thoughts, pictures or sounds just pop into your head, or do you think about what happened on purpose?
>
> How much do these thoughts, pictures or sounds bother you?
>
> Are you able to put these thoughts, pictures or sounds out of your mind and think about something else?
>
> How often have you had these thoughts, picture or sounds come into your mind in the past month?”

The answers are each ranked from a severity of 1-4, and are later culminated and calculated to provide an overall CAPS score.

Nine articles were chosen for inclusion. They can be found below at 6.3.

3.1 Research Questions

Three research questions have been formulated in order to understand one overarching question, which is: Is there a relationship between the definition of trauma, background demographics, and evolving VRET technology on the one hand, and PTSD treatment outcomes and success on the other? The research questions are:

1. How do changing definitions of trauma/PTSD influence the success of VRET?
2. Since no two patients are alike, are some patients prone to having a higher success rate due to their background?
3. Is there a relationship between evolving treatment and PTSD outcomes?

3.2 Hypotheses

Along with the research questions, three hypotheses were formed. These hypotheses are:

1. Success rates were higher in early studies.
2. Young individuals, females, and people with higher level of education will show higher success rates.
3. As the VRET technology has improved, patients have shown higher success rates.

The reasoning behind H1 is that the definition of PTSD was still in its early stages and had not yet become fully formed. This meant that it was not understood as it is today. When PTSD was referred to as “exhaustion” it was treated with rest, so time between trauma and treatment was a good night’s sleep. Since its acceptance into the DSM, treatment has become far more clinical. The definition and the technology used to treat it have changed significantly. Now, to qualify as rehabilitated and no longer suffering from PTSD, an individual must undergo a number of stringent tests and be assigned numerical results below certain levels on a variety of different scales.

I believe H2 to be factual due to a few important factors. The first is that women are more open to accepting therapeutic treatment. Gallegos et al. (2015) found in their case study that, "female participants were more likely to have attended treatment than male participants at both the 3- and 6-month follow-up interviews" (p.544).

Second, younger generations, many of whom are digital natives, are more comfortable with technology, and therefore will not be wary of trying a new technological treatment option.

Finally, people with higher education know the value of therapy and will work harder to find better treatment options. Steele et al. (2007) discovered that "For each additional level of education, individuals were 15% more likely to see a psychiatrist, 12% more likely to see a family doctor, 16% more likely to see a psychologist and 16% more likely to see a social worker" (p. 97).

The justification behind H3 is that, as the environments become more realistic and can more accurately portray the feared environment, they also become more immersive. This higher level of immersion will allow the patient to connect deeply with the traumatic memory and lead to habituation at a faster rate.

From these research questions and hypotheses, themes were identified which were used to code the nine articles. The themes are:

1. How has the definition of trauma (or PTSD) changed over time?
2. Is treatment more effective with a certain group of individuals?
    a. Gender?
    b. Education/Status?
    c. Age?

d. Deployments?

e. Time between trauma and treatment?

3. Have the outcomes of the treatment improved steadily as the technology has improved?

3.3 Codebook

A codebook was created and was used to evaluate each of these research questions in each of the nine articles. A second, third, and fourth party then coded the articles as well, in order to ensure that answers were consistent. Once all three coders collect data, hypotheses and research questions were tested, and conclusions were drawn. The codebook can be found in the appendix below.

CHAPTER FOUR, FINDINGS AND DISCUSSION

After the nine articles were read, the codebook created, and four individuals collected the data, findings were examined to reach conclusions on research questions and hypotheses. The answers reached by each individual were compiled in to an Excel spreadsheet, as well as in a Word document.

The Excel spreadsheet has all four sets of data on one page. The coders name is on the left, followed by thirteen columns, each stating what is being tested for. These include article number, gender, number of participants in the study, age of participants in the study, education level of participants in the study, number of deployments of each participant in the study, time between original trauma and initial VRET treatment, the definition of PTSD used in the study, the type of technology used for treatment, the pre-test, post-test, and three and six-month post-test follow ups. Rows on the left were labeled with the article name and number, and all appropriate information was filled in.

The Word document listed article name/number followed by each of the aforementioned 13 column names separately, and has each coder's entry side by side, instead of separate. Both of these documents can be found in the appendix section.

The research questions are:

1. **How do changing definitions of trauma/PTSD influence the success of VRET?**

In these articles, PTSD was demarcated by the definition found in the DSM-IV. In this study, the definition of PTSD did not vary greatly. All definitions were based on the DSM-IV standard of PTSD, the only difference being the way that it was measured. This was in CAPS or PCL-M, both of which are tests administered by clinicians. In all instances, post-test

levels of PTSD were lower than pre-test levels. If reported, 3-month and 6-month post-test levels were also significantly lower than the pre-test levels, showing long-lasting effects. While this is indicative that VRET has a high efficiency level, it does not assist in answering the research question. There was no change in the definition of trauma or PTSD over the course of this study.

The findings are still robust, even though they do not answer this specific question. They demonstrate that there is a consistent and reoccurring decrease in PTSD levels after patients are treated with VRET. The findings for this section can be found in the appendix.

2. **Since no two patients are alike, are some patients prone to having a higher success rate due to their background?**

For this research question, a number of variations were examined: age, gender, education level, number and location of deployments, and time between original trauma and initial treatment. Only a meager amount of data is available addressing the correlation between gender and the success of VRET. Another area where there is insufficient information available concerns the efficacy of VRET on varying education levels. Due to this, gender and education level were researched, but were not considered in the final analysis.

Examined closely were age, number and location of deployments, and time between trauma and treatment. When examining the CAPS sample, the younger the participant, the higher their initial PTSD levels were. Age has no bearing on decrease in PTSD after treatment. In measuring CAPS, the distribution appeared:

Table 4.1 Age X CAPS

Age	CAPS Pre-test Score	CAPS Post-test Score	Reduction
Early 20s	90	42	-48
26	83	57.78	-25.22
29	106	47	-59
50	68	25	-43
51	64	11	-53

As for measuring of PCL-M, age made no difference. These scales have widely different ranges, so it is difficult to discern if this opposition is due to actual patterns of suffering, or simply due to scale size. The scales for each of these testing methods can be found in the codebook in the appendices. The PCL-M distribution appeared:

Table 4.2 Age X PCL-M

Age	PCL-M Pre-test Score	PCL-M Post-test Score	Reduction in PTSD Score
28	54.4	35.6	-18.8
28	60.9	47.08	-13.82
30s	58	29	-29
32	55	45	-10

Number of deployments was not measured equally among all of the studies examined. Some specified the number of years that an individual was deployed for, while others mentioned the number of separate deployments the individual was sent on. All

mentioned the region where the individual served. Two patients served in Vietnam, while the remainder served in Iraq. By region, these were the results:

Table 4.3 Region X CAPS

Region	Pretest (CAPS)	Post-Test (CAPS)	Reduction (CAPS)
Vietnam	66 avg.	49.89 avg.	-16.11 avg.
Iraq	93 avg.	27.67 avg.	-65.33 avg.

Table 4.4 Region X PCL-M

Region	Pretest (PCL-M)	Post-Test (PCL-M)	Reduction (PCL-M)
Vietnam	N/A	N/A	N/A
Iraq	57.08 avg.	39.17 avg.	-17.91 avg.

By time spent deployed, the results were:

Table 4.5 Deployment Time X CAPS

Deployments	Pre-Test (CAPS)	Post-Test (CAPS)	Reduction
1+	66 avg.	49.89 avg.	-16.11 avg.
6 Years	86.5 avg.	18 avg.	-68.5 avg.
10 Years	106	47	-59

Table 4.6 Deployment Time X PCL-M

Deployments	Pre-Test (PCL-M)	Post-Test (PCL-M)	Reduction
1+	57.65 avg.	41.34 avg.	-16.31 avg.
9 Years	58	29	-29
12 Years	55	45	-10

At the intersection of region and CAPS, results showed that patients who had been deployed to Iraq had higher rates of PTSD initially, and had higher rates of reduction after their treatment than those deployed to Vietnam. This difference could be attributed to many factors, or a combination of those factors; the advancements in technology and the population being younger and more accustomed and responsive to technology. Region and PCL-M are impossible to explore because patients being measured by this method were only deployed to Iraq.

The main conclusion drawn from number of deployments was when the CAPS measurement was being used. As the deployment number/number of years deployed rose, so did the initial PTSD score. This proves that individuals who had a higher number of years exposed to war had more severe PTSD. Post-test rates all decreased from pre-test, but there was no identifiable pattern. Findings were not similar when examining PCL-M scores. Pre-test PTSD prevalence only varied by one or two points, and post-test scores had no significant range or pattern.

Time between trauma and treatment was not mentioned in each case study, and, when mentioned, was an averaged amount of time. Because of these discrepancies, there are not many values available. The included values are from case studies that deal with a single patient, and are not based on mean scores. Time between trauma and treatment is included in this summary:

Table 4.7 Time Between Trauma and Treatment X CAPS

Time	Pre-Test (CAPS)	Post-Test (CAPS)	Reduction
6 Months	106	47	-59
6 Years	83	11	-72
26 Years	64	42	-22
30 Years	68	57.78	-10.22

An analysis of these results indicates that patients have a higher level of PTSD symptoms closer to the time of the trauma. There is a 38-point difference in CAPS scores between the smallest amount of time passage and the largest amount of time passage. Post-test scores varied far less, and tended to fall closer to one another. Because of these similar post-test scores, reduction in symptoms had a similar progression, showing the most reduction when less time passed between trauma and treatment, and least reduction when more time had passed between trauma and treatment. While symptoms resulting from a traumatic experience can arise years after the trauma, it appears that symptoms are most pronounced shortly after the event, and abate to some extent as time passes.

This finding is in agreement with preliminary studies conducted on the development of PTSD symptoms over time. Though only a few studies have been completed, it has been found that substantial PTSD can be found in individuals many years after the trauma occurs, even if they tested negative for PTSD directly after the event. Gray et al. (2004) discovered that "Among trauma victims who develop chronic posttraumatic stress disorder (PTSD), the modal symptom course is immediate distress that persists over time. In contrast, following a period of relative quiescence, some trauma victims report

clinically significant posttraumatic distress at a later time" (p.909). Additionally, they found that "the delayed-onset group exhibited a significant increase in PTSD symptoms over time, whereas the remitters exhibited a significant symptom decrease over time" (p.911)

Patients who received treatment had high, observable rates of PTSD, while those who did not receive treatment until some period of time after the trauma may have not been showing signs directly after the traumatic event. These individuals may have developed PTSD years later, and finally were given treatment much longer after that. Veterans diagnosed with PTSD after a prolonged period of time where they did not present any symptoms, should be taken just as seriously and treated with the same care, especially since Grey et al. (2004) discovered that "combat is reported to be the traumatic event with the highest incidence of delayed-onset PTSD" (p. 910).

3. Is there a relationship between evolving treatment and PTSD outcomes?

Type of technology was broken down into seven different categories, which were labeled A-G. The long-hand version of these and explanations for each method can be found in the codebook. Technology used, pre-treatment, post-treatment, and reduction rates are summarized thus:

Table 4.8 Technology Types

Technology Used	Pre-Treatment Score	Post-Treatment Score	Reduction in PTSD Score
A	CAPS 54	CAPS 42	-12
A	CAPS 68	CAPS 57.78	-10.22
B	PCL-M 55	PCL-M 45	-10
B	CAPS 83	CAPS 11	-72
C	CAPS 106	CAPS 47	-59
D	PCL-M 58	PCL-M 29	-29
E	PCL-M 54.4	PCL-M 35.6	-18.8
F	CAPS 90	CAPS 25	-65
G	PCL-M 60.9	PCL-M 47.08	-13.82

Many of the treatment methods were similar in technology and execution, and varied only in the minor details.

Since treatment methods varied from case study to case study, it is difficult to draw conclusions on the efficacy of individual methods. Only treatment method A and method B were used in more than one case study included in the sample. Similarities and differences can be examined, but it is noteworthy that every single technology proved successful in lowering, often highly significantly, the PTSD symptoms and values.

Differences between technologies used, as mentioned, are minimal. Technologies labeled C, D, and G use the eMagin Z800 Head Mounted Display (HMD) to immerse the

patient visually in the virtual environment. Other HMDs used were the VRV6, Dell Processors with standard HMD, and the Firsthand Tech.

Technologies labeled B, C, D, and E all immersed the patient in an environment meant to represent Iraq, called Virtual Iraq or Virtual Baghdad. The largest number of patients used this technology because the majority of patients represented in this population were deployed in and experienced their trauma in Iraq. Technology A visually represented Vietnam, and F was a more generic setting, simply called Virtual Middle East.

Technologies C, E, and G all delivered olfactory stimulation to the patients, and allowed them to decide which scents should be present. If their trauma took place in a market, the smell of spice and gasoline may have been in the air, so spice and gasoline smells are delivered to the patient. If they were amid a battlefield, the smell of rotting corpses and gunpowder could be used instead.

Each of the technologies provided the patient with headphones. Some allowed them to hear virtual surroundings, such as screams and explosions, and also enabled the therapist to communicate with them through the headphones. In instances where the therapist was not able to communicate with the patient through the headphones, hand signals based on amount of pressure applied by the patient's hand to the therapist's hand were set up in order to assist in communication between patient and therapist.

The technologies labeled A, C, E, D, and G all utilized a Thunderseat, or vibrating platform to make the patient feel as though they were traveling in a HUMVEE or in a helicopter, depending on their location trauma. The Thunderseat also allowed the patient to relive the feeling of explosions.

All except for the oldest of the technologies, A, provided the patient with a handheld controller or joystick so that they could navigate within their virtual environments. This control allows the patient to become more immersed in the technology, and as a result, connect more deeply with the memory and work towards habituation.

Another attribute that A is lacking is a control panel for the therapist. Each of the other forms, since they are more advanced, include some form of controller, which is utilized by the therapist, allowing him or her to manipulate the immersive environment. They can change the time of day and weather to match the traumatic experience, and can raise or lower intensity of the session to ensure that the patient is not being over or under-stimulated.

All of these elements in combination aid the therapist in walking the patient through the exposure therapy session.

Along with the research questions, three hypotheses were formed. These hypotheses are:

H1. Success rates were higher in early studies.

This hypothesis was proven null. Earlier studies had a lower reduction rate in both the CAPS and PCL-M measurements. This proves that more recent studies have a higher success rate and, on average, a larger reduction in PTSD symptoms after treatment.

Table 4.9 Year Published X CAPS

Year Published	Pre-Test (CAPS)	Post-Test (CAPS)	Reduction
’99 -‘07	66 avg.	49.89 avg.	-16.31 avg.
’08 - ‘11	93 avg.	27.67 avg.	-65.33 avg.

Table 4.10 Year Published X PCL-M

Year Published	Pre-Test (PCL-M)	Post-Test (PCL-M)	Reduction
’99 – ‘07	55	45	-10
’08 – ‘11	57.77 avg.	37.23 avg.	-20.54 avg.

H2. Young females with a higher level of education will show higher success rates.

Education and gender are two of the most understudied aspects of this therapeutic method. More research needs to be completed before a conclusion can be reached on this hypothesis. This area is a true limitation to this study. Only three case studies involved females, and only one focused solely on a female. This low number can be attributed to the fact that “3,800 women accounted for 14% of a total 27,000 recent veterans treated for PTSD in 2006” (Wood et al,. 2009, p.1215).

Similarly, only one case study gave information on education level of the participant. The study mentioned that the patient was college educated, but did not go further in depth about his education, or whether they believed it had any bearing on the outcome of his treatment.

H3. As the VRET technology has improved, patients have shown higher success rates.

Results on this can be found above in Research Question Three.

These findings demonstrate that this therapy is a highly effective way to treat PTSD. In each instance of PTSD in these case studies, there were positive improvements in symptomology. The varying forms of technology seem to have little to no impact on the

patients' outcome. Irrespective of these varying technologies, it is clear that there are improvements across the board on patient PTSD levels. Since the first use of this technology, the basis for it has remained the same. The theoretical framework of exposure therapy has been continuously effective. At its inception, when the graphics were not as fluid, clear, or easy to manipulate, it was already proving its worth.

Data were most easily and functionally analyzed when examining age and time between trauma and treatment. In terms of age, younger participants had higher initial PTSD levels. While this was helpful in analyzing who might be most susceptible to contracting PTSD, the post-treatment numbers did not follow any pattern, making it difficult to determine if age is a factor in analyzing post-treatment results. For this study, age was found to have no effect on post-treatment values and outcomes.

In analyzing the effect of time between trauma and treatment, results showed that an individual is likely to have a higher level of reported PTSD symptoms if their trauma was more recent. A significant 38-point increase was found in CAPS score between individuals who had suffered their trauma 30 years ago, versus six months ago. There can be a latent onset of PTSD symptoms and "findings indicated that, although low initially, rates of PTSD increased substantially over time" (Wolfe, 1999, p.520), so individuals who may not have sought treatment directly after their trauma were still harboring anxieties months and years after the traumatic event took place. Post-test scores, again, showed little variation between participant types and tended to fall in similar ranges.

Although the other areas of this analysis were not necessarily conclusive based on limited information provided by the article's authors, it is still clear that this treatment method creates a statistically significant decrease on the PTSD rating on all individuals who

participated and completed the treatment. The consistent reduction in PTSD levels demonstrates the efficacy of this treatment.

Exposure therapy has been a proven method of reducing PTSD symptoms for many decades. The introduction of a VR aspect eliminates barriers that were present in a typical exposure therapy session, which is especially useful for veterans. It would be difficult to recreate a war-like environment for a veteran to re-experience their trauma, without actually taking them back to Vietnam, Afghanistan, or Iraq. This would be expensive, time consuming, and perhaps dangerous. Allowing them to experience their trauma in the safety of a therapist's office is a safe and realistic option, which has demonstrated immediate and long-lasting effects.

4.1 Limitations

As mentioned above, major limitations to this study are a small sample size, incompatible measurement methods, and the limited number of variables examined. Only nine articles met all inclusion requirements, which makes it difficult to draw and form concrete conclusions, when in reality the sample size of veterans using this therapeutic method is much higher. Pre-test and post-test scores were measured in CAPS or PCL-M, for which no standard conversion could be found. Identifying which range of numbers were considered "No Symptoms", "Moderate", and "Severe" in each measurement scale between studies made comparisons difficult.

The majority of the case studies examined did little to describe the patient past their gender, age, deployment type/time and time intervals between trauma and treatment. These aspects were not described in great detail, appearing more as an afterthought, and females were under-represented across the board. Education level was described in even

less detail, being mentioned briefly in only a single article analyzed. The present study suggests that in-depth research be conducted on each of these variables, separately, in order to gain a more refined understanding of which aspects of therapeutic method are most effective with specific veteran groups.

The Veteran's Association (VA) should be taking greater steps to make this treatment widely available to veterans who are suffering from PTSD. It is their responsibility to ensure the safety of returning veteran's, and currently, they are doing an underwhelming job at this. Researchers should be hired by the VA to examine each of the specifications laid out in this study to determine when this method is most useful. Next, they should begin to implement the treatment in a large number of their facilities across the United States. This will help drastically in cutting down the number of veteran suicides that occur each year.

Although it was not reflected in this study, PTSD definitions have changed over time. Qualification, treatments, and names have all morphed. It is difficult to say definitively that PTSD has remained the same over the past 200 years, as it is a culturally constructed illness and was viewed differently by the individuals and medical professionals over time. This does allow PTSD to then be considered a transient illness, meaning that there has not been a singular, permanent definition for it throughout time. The root issue has remained the same, some sort of emotional trauma, but everything surrounding it, symptomology included, has not remained constant.

Also of importance to consider is how PTSD is thought of and treated in other countries. Some countries believe that it is best to repress difficult memories; therefore VRET would not fit the societal norms. Talking about depression or trauma is frowned

upon in countries that somaticize mental illness, so this method of treatment would not be useful. Here in the United States, people are encouraged to seek help for mental illness and to talk about their problems, which is why VRET works for such a large number of individuals.

CHAPTER FIVE, CONCLUSION

Veterans are an undervalued, understudied, and undertreated population in the United States. Programs should be promoted to make treatment more accessible to these men and women who put their lives on the line to save others. According to Chamberlin (2012), "PTSD is reaching epidemic proportions in the modern military. In fact, of the 1.64 million soldiers who have been deployed for Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) approximately 300,000 individuals are currently suffering from PTSD or major depression, placing the disease prevalence at 23%, meaning that PTSD rates in the military are four times higher than that of the average American male (5%) and twice that of the national data for women (10.4%)" (2012, p.363).

A significant issue that this population faces when attempting to seek counseling is the stigma attached to claiming mental incapacities. Admitting to suffering from mental illness can be difficult in a civilian population, but is even more difficult for the men and women who are seen as the nation's most fit. These individuals are taught in their military training to believe that they are physically invincible, and thus do not know how to cope with their emotional struggles. They fear being looked down upon, or that others will believe they are lying for financial gain. In addition, males fear feeling emasculated, as if they are not living up to the imagined standards that the military culture and society expects them to live up to.

A proven therapeutic option to assist in reducing the stigma is VRET. If a new method of treating PTSD will pique the interest of a larger number of veterans, and save

more lives by reducing the number of PTSD-related suicides, it should be fully explored as a proven theoretical treatment option for all veterans who served in war zones.

The most significant data that was discovered in this analysis was the difference in CAPS scores prior to treatment according to the amount of time that lapsed between trauma and treatment. Veterans who had experienced the trauma most recently had much higher CAPS scores than veterans who suffered their trauma years ago.

Other results were not as definitive. It was difficult to find correlations between pre and post-tests, because not as many patterns were formed as were expected. Each study presents highly conclusive evidence of the efficacy of VRET on treating chronic PTSD. All patients who completed the treatment emerged with decreased CAPS or PCL-M levels, indicating a reduction in symptoms.

When the case studies are analyzed together and examined with intersectionality, it becomes difficult to draw distinctive conclusions due to the limitations mentioned above. However, these findings are still of the upmost importance because multiple studies consistently show the success of VRET as a treatment method for combat veterans suffering from PTSD. It is an effective treatment for individuals who developed PTSD directly after the trauma, as well as for others who had a delayed onset of symptoms. It aided individuals after a few sessions, as well as had long-lasting sustaining effects. This technology needs to be further researched by the VA and civilian researchers and utilized in order to help minimize the burgeoning problem that is our under-valued veteran population.

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APPENDIX

6.1 Code Book

Please read each of the nine case studies provided and code for the following:

1. Date of publication?

2. Journal of publication?

3. How has the definition of trauma/PTSD changed over time? What factors are used to decide if someone qualifies to be included in the study? What characteristics?

The Diagnostic and Statistical Manual of Mental Disorders 4th Edition was used to diagnose PTSD in many of these studies. Sufferers must meet a base level standard in order to be diagnosed. This includes "intense fear, helplessness, or horror… persistent reexperiencing of the traumatic event (Criterion B), persistent avoidance of stimuli associated with the trauma and numbing of general responsiveness (Criterion C), and persistent symptoms of increased arousal (Criterion D). The full symptom picture must be present for more than 1 month (Criterion E), and the disturbance must cause clinically significant distress or impairment in social, occupational, or other important areas of functioning (Criterion F)."

A method of determining the presence and reduction of PTSD is the Clinician Administered PTSD Scale, referred to as CAPS.

A method of determining the presence and reduction of PTSD is the PTSD Checklist, Military Version. It includes 17 self-reporting items that measure possible symptoms of PTSD as a response to a military situation. It is referred to as PCL-M(3).

What is being measured **before** treatment to show level of PTSD?

SUDS or CAPS?

What is being measured **during** treatment to show level of PTSD?

SUDS or CAPS?

What is being measured **after** treatment to show level of PTSD?

SUDS or CAPS?

Please denote which is used in each study, what the levels (numeral) are at each testing interval (pre, post, 3-month post, 6-month), and what that equates to using the table below.

CAPS

0-19	Asymptomatic
20-39	Mild
40-59	Moderate
60-79	Severe
80+	Extreme

PCL-M

Below 50	No PTSD Diagnosis (military standard)
Above 50	PTSD Diagnosis (military standard)

4. Is treatment more effective on a certain group of individuals? Gender? Age? Education? Deployments? Time between trauma and treatment?

Due to the fact that females were not seeing combat until 2013, there are fewer women included in the case studies. Between 1994 and 2013, it was illegal for women to fight in combat, however they could still be active military members, and this led to many cases of PTSD. Combat is not the sole way to develop PTSD in a military setting. Only two studies in the present study included women. Compared to men, did women have higher levels of a reduction in PTSD symptoms (1) equal levels of reduction in PTSD symptoms (2) or a lower level of reduction of symptoms (3)?

Specific ages were not given for individuals in each study. Therefore, information here is quite limited. Further research should be completed on this subject. Was the age listed of each participant? List the age of the individual, or the mean age of all individuals.

Education level of each participant was not given in each study. Therefore, information here is quite limited. Was the education level listed of each participant? Please list the level of education, if provided in the article.

The higher number of deployments, the more likely an individual is to acquire PTSD, due to repeat exposure to high-stress environments. Was the number of deployments listed? If so, please list the number of deployments for each individual.

Time between traumatic event and proper treatment may have an effect on the outcome of the treatment. Did the article indicated how much time passed between trauma and treatment? If yes, please list the amount of time.

5. Has treatment outcome improved as the technology used in VRET has advanced?

What equipment is used in this study?

What percent of participants no longer met the standards for PTSD after treatment with each type of equipment?

A brief summation of these treatments can be found in the table below:

Treatment Modes

A	VRV6 Polhemus Inside Trak/ headphones/ thunderseat/ raised platform/ virtual Vietnam
B	Joystick/ 3PCs/ 1 Goggles visual & auditory measured on Intel Pentium Core Duo Processor/ 1 Control panel for therapist/ 1 PC J&J measured on Intel Centrino Processor/ Hand signals&pressure/ 360 degree chair/ Virtual Baghdad/ Drive humvee/ walk/ fire rifle
C	eMagin Z800 HMD/ Headphones/ Virtual Iraq/ handheld controller/ olfactory stimuli/ raised floor/ control panel for therapist/ drive humvee in desert/ walk in city/ PC linked to PC
D	Humvee convoy/ patrol in Iraqi city/ 2 Dell XPS notebooks/ 1 for HMD/ 1 for therapist/ USB game pad/ eMagin z800 HMD/ SVGA res/ 40 deg FOV/raised platform/ Virtual Iraq
E	Virtual Iraq/ 3D audio/ vibrotactile/ olfactory/ clinicial interface (Oz)/ look at citation 12
F	Middle East VR/ Firsthand Tech/ 3D VR sterioscopic HMD/ high-res microdisplays/ 60 degree FOV/ HR/ skin conductance/ temp/ respiration/ HW in between
G	2 Dell XPS comps/ eMagin z800 HMD/ raised platform/ olfactory with Enviroscent Scent Palette/ joystick on mock M4 rifle/ joystick on Logitech

These categories are a suggestion. If other patterns arise or seem more fluid, feel free to change it at your discretion.

Once you have completed gathering this information, please use it to draw conclusions on the efficacy of VRET on the treatment of PTSD. Take each variable into account separately and determine what impact it has on the success rate of the technology on the illness.

THANKS.

6.2 Findings

Article 1

Journal of Traumatic Stress, Vol. 12 NO. 2, 1999

"Virtual Reality Exposure Therapy for PTSD Vietnam Veterans: A Case Study" by Rothbaum et el.

Gender

Chelsea	Chuck	Cody	Jessa
M	M	M	M

Number of Participants

Chelsea	Chuck	Cody	Jessa
1	1	1	1

Age of Participants

Chelsea	Chuck	Cody	Jessa
50	50	50	50

Education Level of Participants

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A Heli Pilot School	N/A

Number of Deployments

Chelsea	Chuck	Cody	Jessa
1, Vietnam	1	1+	1, Vietnam

Time Between Trauma and Treatment

Chelsea	Chuck	Cody	Jessa
26 Years	26 Years	26 Years	26 Years

Definition of PTSD

Chelsea	Chuck	Cody	Jessa
DSM-IV	CAPS & DSM-IV	CAPS & DSM-IV	DSM-IV & CAPS

Type of Technology Used

Chelsea	Chuck	Cody	Jessa
A	A	A	A

Pre Test

Chelsea	Chuck	Cody	Jessa
CAPS 64 (Severe)	CAPS 64 (Severe)	CAPS 64 (Severe)	CAPS 64 (Severe)

Post Tests

Chelsea	Chuck	Cody	Jessa
CAPS 42(Moderate)	CAPS 42(Moderate)	CAPS 42(Moderate)	CAPS 42(Moderate)
CAPS 54 (Moderate)	CAPS 54 (Moderate)	CAPS 54 (Moderate)	CAPS 54 (Moderate)
CAPS 47 (Moderate)	CAPS 47 (Moderate)	CAPS 47 (Moderate)	CAPS 47 (Moderate)

Article 2
Journal of Clinical Psychiatry, Vol. 62, Issue 8, 2001
"Virtual Reality Exposure Therapy for Vietnam Veterans With Posttraumatic Stress Disorder " by Rothbaum et al.

Gender

Chelsea	Chuck	Cody	Jessa
M	M	M	M

Number of Participants

Chelsea	Chuck	Cody	Jessa
9	16	16	16

Age of Participants

Chelsea	Chuck	Cody	Jessa
51 (AVG)	51 (AVG)	N/A	51 +/- 3.16

Education Level of Participants

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A	N/A

Number of Deployments

Chelsea	Chuck	Cody	Jessa

Vietnam	1	1+	1, Vietnam

Time Between Trauma and Treatment

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A	N/A

Definition of PTSD

Chelsea	Chuck	Cody	Jessa
DSM-IV	CAPS	DSM-IV & CAPS	DSM-IV & CAPS

Type of Technology Used

Chelsea	Chuck	Cody	Jessa
A	E	A&B	A

Pre Test

Chelsea	Chuck	Cody	Jessa
CAPS 68 (Severe)	CAPS 68 (Severe)	CAPS 68 (Severe)	CAPS 68 (Severe)

Post Tests

Chelsea	Chuck	Cody	Jessa
CAPS 57.78 (Severe)	CAPS 57.78 (Severe)	CAPS 57.78 (Severe)	CAPS 57.78 (Severe)
CAPS 54.6 (Moderate)	CAPS 54.6 (Moderate)	CAPS 54.6 (Moderate)	CAPS 54.6 (Moderate)
CAPS 47.12 (Moderate)	CAPS 47.12 (Moderate)	CAPS 47.12 (Moderate)	CAPS 47.12 (Moderate)

Article 6

CyberPsychology& Behavior, Vol. 10, No. 2, 2007

"Combat-Related Post-Traumatic Stress Disorder: A Case Report Using Virtual Reality Exposure Therapy With Physiological Monitoring" by Wood et al.

Gender

Chelsea	Chuck	Cody	Jessa
M	M	M	M

Number of Participants

Chelsea	Chuck	Cody	Jessa

1	1	1	1

Age of Participants

Chelsea	Chuck	Cody	Jessa
32	32	N/A	32

Education Level of Participants

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A 2nd Class Petty Officer	N/A

Number of Deployments

Chelsea	Chuck	Cody	Jessa
12 Years, Iraq	12 Years	1+	1, Iraq

Time Between Trauma and Treatment

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A	N/A

Definition of PTSD

Chelsea	Chuck	Cody	Jessa
DSM-IV	PCL	DSM-IV	DSM-IV

Type of Technology Used

Chelsea	Chuck	Cody	Jessa
B	C	B	B

Pre Test

Chelsea	Chuck	Cody	Jessa
PCL-M 55	PCL-M 55	SUDS 55	PCL-M 55

Post Tests

Chelsea	Chuck	Cody	Jessa
PCL-M 45	PCL-M 45	SUDS 45	PCL-M 45
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

Article 7
Journal of Traumatic Stress, Vol. 21, No. 2, 2008
"Virtual Reality Exposure Therapy Using a Virtual Iraq: Case Report" by Gerardi et al.

Gender

Chelsea	Chuck	Cody	Jessa
M	M	M	M

Number of Participants

Chelsea	Chuck	Cody	Jessa
1	1	1	1

Age of Participants

Chelsea	Chuck	Cody	Jessa
29	29	29	29

Education Level of Participants

Chelsea	Chuck	Cody	Jessa
College	College	College	College

Number of Deployments

Chelsea	Chuck	Cody	Jessa
10 Years, Iraq	10 Years	10 Years, Iraq	1, Iraq

Time Between Trauma and Treatment

Chelsea	Chuck	Cody	Jessa
6 Months	6 Months	28 Y.O. vs. 29 Y.O.	6 Months

Definition of PTSD

Chelsea	Chuck	Cody	Jessa
DSM-IV	CAPS	DSM-IV	DSM-IV

Type of Technology Used

Chelsea	Chuck	Cody	Jessa
C	C	C	C

Pre Test

Chelsea	Chuck	Cody	Jessa
CAPS 106 (Extreme)	CAPS 106 (Extreme)	CAPS 106 (Extreme)	CAPS 106 (Extreme)

Post Tests

Chelsea	Chuck	Cody	Jessa
CAPS 47 (Moderate)	CAPS 47 (Moderate)	CAPS 47 (Moderate)	CAPS 47 (Moderate)
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

Article 8
Journal of Clinical Psychology: In Session, Vol. 64(8), 2008
"Virtual Reality Exposure Therapy for Active Duty Soldiers" by Reger et al.

Gender

Chelsea	Chuck	Cody	Jessa
M	M	M	M

Number of Participants

Chelsea	Chuck	Cody	Jessa
1	1	1	1

Age of Participants

Chelsea	Chuck	Cody	Jessa
30s	30s	30s	30s

Education Level of Participants

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A	N/A

Number of Deployments

Chelsea	Chuck	Cody	Jessa
9 Years, OIF	9 Years	9 Years, OIF	1, Iraq

Time Between Trauma and Treatment

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A	N/A

Definition of PTSD

Chelsea	Chuck	Cody	Jessa
DSM-IV	PCL-M	DSM-IV	DSM-IV

Type of Technology Used

Chelsea	Chuck	Cody	Jessa
D	D	D	D

Pre Test

Chelsea	Chuck	Cody	Jessa
PCL-M 58 (YES)	PCL-M 58 (YES)	PCL-M 58 (YES)	PCL-M 58 (YES)

Post Tests

Chelsea	Chuck	Cody	Jessa
PCL-M 29 (NO)	PCL-M 29 (NO)	PCL-M 29 (NO)	PCL-M 29 (NO)
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

Article 9

Medicine Meets Virtual Reality 17 J.D. Westwood et al. (Eds) IOS Press 2009

"VR PTSD Exposure Therapy Results with Active Duty OIF/OEF Combatants" by Rizzo et al.

Gender

Chelsea	Chuck	Cody	Jessa
M/F	M/F	M/F	M/F

Number of Participants

Chelsea	Chuck	Cody	Jessa
19/1	20	19/1	19/1

Age of Participants

Chelsea	Chuck	Cody	Jessa
28 (Mean) 21-51	21-51 (Range)	21-51 (Range)	21-51; 28 Avg

(Range)			

Education Level of Participants

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A	N/A

Number of Deployments

Chelsea	Chuck	Cody	Jessa
Iraq	N/A	1+	1

Time Between Trauma and Treatment

Chelsea	Chuck	Cody	Jessa
N/A	N/A	3Mo & 1Wk Prior	3Mo & 1 Wk

Definition of PTSD

Chelsea	Chuck	Cody	Jessa
DSM-IV	CAPS	DSM-IV	DSM-IV

Type of Technology Used

Chelsea	Chuck	Cody	Jessa
E	A	E	E

Pre Test

Chelsea	Chuck	Cody	Jessa
PCL-M 54.4	PCL-M 54.4	PCL-M 54.4	PCL-M 54.4

Post Tests

Chelsea	Chuck	Cody	Jessa
PCL-M 35.6	PCL-M 35.6	PCL-M 35.6	PCL-M 35.6
PCL-M 29.5	PCL-M 11.9	N/A	N/A
N/A	N/A	N/A	N/A

Article 10
Annual Review of Cybertherapy and Telemedicine 2010 B.K. Wiederhold et al. (Eds.) Ios Press, 2010
"VR PTSD Exposure Therapy Results with Active Duty OIF/OEF Combatants" by Rizzo et al.

Gender

Chelsea	Chuck	Cody	Jessa
M	M	M	M

Number of Participants

Chelsea	Chuck	Cody	Jessa
1	1	1	1

Age of Participants

Chelsea	Chuck	Cody	Jessa
Mid- 20s	Mid-20s	Mid-20s	Mid-20s

Education Level of Participants

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A	N/A

Number of Deployments

Chelsea	Chuck	Cody	Jessa
6 Years, 2 Deploys, Iraq	6 Years, 2 Deploys, Iraq	6 Years, 2 Deploys, Iraq	2, Iraq, 18 Mo

Time Between Trauma and Treatment

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A	N/A

Definition of PTSD

Chelsea	Chuck	Cody	Jessa
CAPS, DSM-IV	CAPS, DSM-IV	CAPS, DSM-IV	CAPS, DSM-IV

Type of Technology Used

Chelsea	Chuck	Cody	Jessa
F	F	F	F

Pre Test

Chelsea	Chuck	Cody	Jessa
CAPS 90 (Extreme)	CAPS 90 (Extreme)	CAPS 90 (Extreme)	CAPS 90 (Extreme)

Post Tests

Chelsea	Chuck	Cody	Jessa
CAPS 25 (Mild)	CAPS 25 (Mild)	CAPS 25 (Mild)	CAPS 25 (Mild)
CAPS 16 (Asymptomatic)	CAPS 16 (Asymptomatic)	CAPS 16 (Asymptomatic)	CAPS 16 (Asymptomatic)
N/A	N/A	N/A	N/A

Article 11

Military Medicine, 174, 11: 1215, 2009

"Combat-Related Post-Traumatic Stress Disorder: A Case Report Using Virtual Reality Graded Exposure Therapy With Physiological Monitoring With a Female Seabee" by Wood et al.

Gender

Chelsea	Chuck	Cody	Jessa
F	F	F	F

Number of Participants

Chelsea	Chuck	Cody	Jessa
1	1	1	1

Age of Participants

Chelsea	Chuck	Cody	Jessa
26	26	26	26

Education Level of Participants

Chelsea	Chuck	Cody	Jessa
N/A	N/A	Second Class Petty Officer Seabee	N/A

Number of Deployments

Chelsea	Chuck	Cody	Jessa
6 Year, 3 Deploy, Iraq	6 Year, 3 Deploy, Iraq	6 Year, 3 Deploy, Iraq	6 Year, 3 Deploy, Iraq

Time Between Trauma and Treatment

Chelsea	Chuck	Cody	Jessa
2003-2009; 6 yrs.	N/A	N/A	N/A

Definition of PTSD

Chelsea	Chuck	Cody	Jessa
DSM-IV	CAPS, DSM-IV	DSM-IV, CAPS	DSM-IV, CAPS

Type of Technology Used

Chelsea	Chuck	Cody	Jessa
B	B	B	B

Pre Test

Chelsea	Chuck	Cody	Jessa
CAPS 83 (Extreme)	CAPS 83 (Extreme)	CAPS 83 (Extreme)	CAPS 83 (Extreme)

Post Tests

Chelsea	Chuck	Cody	Jessa
CAPS 11 (Asymptomatic)	CAPS 11 (Asymptomatic)	CAPS 11 (Asymptomatic)	CAPS 11 (Asymptomatic)
CAPS 12 (Asymptomatic)	CAPS 12 (Asymptomatic)	CAPS 12 (Asymptomatic)	N/A
N/A	N/A	N/A	N/A

Article 12
Journal of Traumatic Stress, Vol. 24, No. 1, 2011
"Effectiveness of Virtual Reality Exposure Therapy for Active Duty Soldiers in a Military Mental Health Clinic" by Reger et al.

Gender

Chelsea	Chuck	Cody	Jessa
M/F	M/F	M/F	M/F

Number of Participants

Chelsea	Chuck	Cody	Jessa
17/1	31	24	24

Age of Participants

Chelsea	Chuck	Cody	Jessa
28.8 (Mean)	28	28.8 (Mean)	28.8 (Mean)

Education Level of Participants

Chelsea	Chuck	Cody	Jessa
N/A	N/A	N/A	N/A

Number of Deployments

Chelsea	Chuck	Cody	Jessa
At least one	At least one	2+	1+ OIF/OEF

Time Between Trauma and Treatment

Chelsea	Chuck	Cody	Jessa
27.8 Mo (Mean)	N/A	N/A	27.8 Mo (Mean)

Definition of PTSD

Chelsea	Chuck	Cody	Jessa
PCL-M	PCL-M	PCL-M	PCL-M

Type of Technology Used

Chelsea	Chuck	Cody	Jessa
G	G	G	G

Pre Test

Chelsea	Chuck	Cody	Jessa
PCL-M 64.06 (Mean)	PCL-M 60.92	PCL-M 60.92	PCL-M 60.92

Post Tests

Chelsea	Chuck	Cody	Jessa
PCL-M 49.72	PCL-M 47.08	PCL-M 49.72	PCL-M 47.08

Chuck's Findings

Chuck															
Article Author		Trauma to Treat	Gender	Participants	Age	Education	Treatment	# of Depolyments	Definition of PTSD/Trauma	Tech used	Pre test	Post test	3 month post	6 month post	
Rothbaum pt 2	1	26 years	M	1	50	N/A	VRE	1	CAPS and DSM	A	64	42	Y, 54	Y, 47	
Rothbaum	2	?	M	16	Avg-51	N/A	VRE	1	CAPS	A	68	57.78	Y, 54.6	Y, 47.12	
Wood	6	?	M	1	32	N/A	VRGET	12 Years	PCL	B	55	45	?	?	
Gerardi	7	6 Months	M	1	29	College	VRE	10 Years	CAPS and PSSR(not in code)	C	106	47	?	?	
Reger	8	?	M	1	30	N/A	VRE	9 Years	DSM	D	58	29	N	N	
Rizzo	9	?	M/F	20	Range-21-51	N/A	VRET	N/A	CAPS	A	54.4	35.6	Y, 11.9	N	
Miyahira	10	?	M	1	Mid-20s	N/A	VRE	2 Depoly, 6 Years	CAPS	F	90	25	Y, 16	N	
Wood pt 2	11	?	F	1	26	N/A	VRGET	3 Depoly, 6 Years	DSM(CAPS)	B	83	11	Y, 12	N	
Reger pt 2	12	27.8 Mo	M/F	31	Avg-28	N/A	VRE	At least 1	PCL	G	60.92	47.08	?	?	

Chelsea's Findings

Chelsea													
Article Number		Gender	Number	Age	Education	Deployments	Trauma to Treatm	Definition of PTSD/Trauma	Type of Technology Used	Pre Test	Post Test	3 Month Post Test	6 Month Post Test
1		M	1	50	N/A	1, Vietnam	26 yrs	CAPS; DSM-IV	A	CAPS 64 (severe); IES 33	CAPS 42 (moderate); IES 18	CAPS 54 (moderate	CAPS 47 (moderate); IES 0
2		M	16	51+/-3.16 (mean)	N/A	Vietnam	30 years?	DSM-IV	A	CAPS 68 (severe); IES 42	CAPS 57.78 (severe); 36.11+/	CAPS 54.6+/-17.5 (	CAPS 47.12+/-17.04 (moderate); IES 29.88+/-19.39
6		M	1	32	N/A	12 years, Iraq	N/A	DSM-IV	B	PCL-M 55 (formal PTSD s	PCL-M 45 (below PTSD score	N/A	N/A
7		M	1	29	College	10 years, Iraq	6 months	DSM-IV	C	CAPS 106 (extreme)	CAPS 47 (moderate) (-56%)	N/A	N/A
8		M	1	30s	N/A	9 years, OIF	N/A	DSM-IV	D	PCL-M 58 (formal PTSD s	PCL-M 29 (below PTSD score)	7 month- "maintainance of treatment gains"	
9		M/F	19/1	28 (mean) 21-51 (range)	N/A	Iraq	N/A	DSM-IV	E	PCL-M 54.4 (mean)	PCL-M 35.6(mean) (below PT	N/A	N/A
10		M	1	mid 20s	N/A	6 years, 2 deploy (18 mo), Iraq	N/A	CAPS; DSM-IV	F	CAPS 90 (extreme)	CAPS 25 (mild)	CAPS 16 (asympton	N/A
11		F	1	26	N/A	6 years, 3 deploy, Iraq	2003-2009; 6 yrs	DSM-IV-R	B	CAPS 83 (extreme); PCL-	CAPS 11 (asymptomptic); PCI	CAPS 12 (asympton	N/A
12		M/F	24	28.8 (mean)	N/A	At least 1; 63% 2+; Iraq	27.8 mo (mean)	PCL-M	G	PCL-M 60.92 (mean)	PCL-M 47.08 (mean)	N/A	N/A

Cody's Findings

Cody													
Date & Journal		Article	Gender	#Participants	Age	Education	Deployments	Trauma to Treatment	Definition of PTSD/Trauma	Type of Technology Used	Pre Test	Post Test	3 Months	6 Months
Journal of Traumatic Stress, Vol. 12 NO. 2, 1999		1	M	1	50	N/A Helicopter Pilot School	1+	26 yrs old VS. 50 yrs old	DSM-IV and CAPS	A	CAPS 64 "Severe"	CAPS 42 "Moderate"	CAPS 54	CAPS 47
Journal of Clinical Psychiatry, Vol 62, Issue 8, 2001		2	M	16	N/A	N/A	1+	N/A	DSM-IV, CAPS, CES, SCID, BDI, CGI-I, and PGI-I	A and B	CAPS 68 "Severe" BDI ±25 IES±43	CAPS 57.78 "Moderate" BDI ±20 IES±35	CAPS 54.6 BDI ±25 IES±20	CAPS 47.12 BDI ±20 IES±30
CyberPsychology& Behavior, Vol. 10, No. 2, 2007		6	M	1	N/A	N/A 2nd Class Petty Officer	1+	N/A	DSM-IV	B	PCL-M 55	PCL-M 45	N/A	N/A
Journal of Traumatic Stress, Vol. 21, No. 2, 2008		7	M	1	29	Prior College, Combat Engineer	10 years active 1 year-long tour Iraq	28 yrs old VS. 29 yrs old	DSM-IV	C	CAPS 106 "Extreme"	CAPS 47 "Moderate"	N/A	N/A
Journal of Clinical Psychology: In Session, Vol. 64(8), 2008		8	M	1	30(s)	N/A Infantryman	9 years active 1 year OIF for HMWVV	N/A	DSM-IV	D	CAPS 58 "Moderate"	CAPS 29 "Mild"	N/A	N/A
Medicine Meets Virtual Reality 17 J.D. Westwood et al. (Eds) IOS Press 2009		9	19M/1F	20	21-51	N/A	1+	1 Wk and 3 Mo. Prior	DSM-IV	E	PCL-M 54.4 PTSD Positive	PCL-M 35.6 PTSD Negative	N/A	N/A
Annual Review of Cybertherapy and Telemedicine 2010 B.K. Wiederhold et al. (Eds.) Ios Press: 2010		10	M	1	Mid-20s	N/A OIF Soldier	6 years exp 18 months 2 tours in Iraq	N/A	DSM-IV, CAPS, PDS, BDI	F	CAPS 90 "Extreme" PDS 59 "Severe" BDI 32	CAPS 25 "Mild" PDS 15 "Mild" BDI 18	CAPS 16 PDS 15 BDI 15	N/A
Military Medicine, 174, 11: 1215, 2009		11	F	1	26	N/A Second Class Petty Officer Seabee	6 years continuous active duty 3 tours in Iraq OIF soldier	N/A	DSM-IV, CAPS, PCL-M	B	CAPS 83 "Extreme" PCL-M 65	CAPS 11 "Mild" PCL-M 27	CAPS 12 PCL-M 24	N/A
Journal of Traumatic Stress, Vol. 24, No. 1, 2011		12	23M/1F	24	Average 28.8	N/A	2+ OIF soldier	N/A	PCL-M	G	PCL-M 60.92	PCL-M 47.08	N/A	N/A

Jess's Findings

Jessa											
Article Number	Gender	Number	Age	Education	Deployments	Trauma to Treatment	Definition of PTSD/Trauma	Type of Technology Used	Pre Test	Post Test	3 Month Post Test	6 Month Post Test
1	M	1	50	n/a	1, Vietnam	26 years	DSM-IV and CAPS	A	CAPS 64 (severe)	CAPS 42 (moderate/threshold)	CAPS 54 (moderate/threshold)	47 (moderate/thresh old)
2	M	16	51 +/-3.16 years	n/a	1, Vietnam	not mentioned	CAPS, CES, SCID for DSM-IV, IES, BDI, CGI-I, PGI-I	A	68 +/- 15.26	57.78 +/-20.61	54.6 +/-17.5	47.12 +/-17.04
6	M	1	32	n/a	1, Iraq	not mentioned	DSM-IV	B	10 (PHQ-9), 55 (PCL-M), 26 (BAI)	8 (PHQ-9), 45 (PCL-M), 24 (BAI)	n/a	n/a
7	M	1	29	college-educated	1, Iraq	6 months	DSM-IV	C	CAPS 106 (extreme)	CAPS 47 (moderate/threshold)	n/a	n/a
8	M	1	30's	n/a	1, Iraq	n/a	DSM-IV	D	CAPS 58 (moderate)	CAPS 29 (mild)	n/a	n/a
9	19 M, 1 F	20 (19 M, 1 F)	21-51 (ave. age: 28)	n/a	1	3 months, 1 week	DSM-IV	E	PCL-M 54.4	PCL-M 35.6	n/a	n/a
10	M	1	mid-20's	n/a	2, Iraq (18 months)	n/a	DSM-IV, CAPS, PDS, BDI	F	CAPS 90 (severe)	CAPS 25	CAPS 16 (mild)	n/a
11	F	1	26	n/a	3, Iraq (6 years)	n/a	DSM-IV, CAPS, PCL-M	B	14 (PHQ-9), 28 (BAI), 65 (PCL-M), 83 (CAPS)	2 (PHQ-9), 3 (BAI), 27 (PCL-M), 11 (CAPS)	n/a	n/a
12	23 M, 1 F	24	ave. age: 28.8	n/a	1+ OIF or OEF	ave. of 27.8 months	PCL-M	G	M=60.92	M=47.08	n/a	n/a

6.3 Articles Used for Coding

1. “Virtual Reality Exposure Therapy for PTSD Vietnam Veterans: A Case Study” by Rothbaum et el.

2. “Virtual Reality Exposure Therapy for Vietnam Veterans With Posttraumatic Stress Disorder “ by Rothbaum et al.

3. (6). “Combat-Related Post-Traumatic Stress Disorder: A Case Report Using Virtual Reality Exposure Therapy With Physiological Monitoring” by Wood et al.

4. (7). “Virtual Reality Exposure Therapy Using a Virtual Iraq: Case Report” by Gerardi et al.

5. (8). “Virtual Reality Exposure Therapy for Active Duty Soldiers” by Reger et al.

6. (9). “VR PTSD Exposure Therapy Results with Active Duty OIF/OEF Combatants” by Rizzo et al.

7. (10). 7. “VR PTSD Exposure Therapy Results with Active Duty OIF/OEF Combatants” by Rizzo et al.

8. (11). “Combat-Related Post-Traumatic Stress Disorder: A Case Report Using Virtual Reality Graded Exposure Therapy With Physiological Monitoring With a Female Seabee” by Wood et al.

9. (12) “Effectiveness of Virtual Reality Exposure Therapy for Active Duty Soldiers in a Military Mental Health Clinic” by Reger et al.