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Virtual Reality Exposure Therapy for PTSD Vietnam Veterans: A Case Study

Barbara Olasov Rothbaum,[1,5] Larry Hodges,[2] Renato Alarcon,[3] David Ready,[3] Fran Shahar,[1] Ken Graap,[4] Jarrel Pair,[2] Philip Hebert,[2] Dave Gotz,[2] Brian Wills,[2] and David Baltzell[3]

Virtual reality (VR) integrates real-time computer graphics, body tracking devices, visual displays, and other sensory input devices to immerse a participant in a computer-generated virtual environment that changes in a natural way with head and body motion. VR exposure (VRE) is proposed as an alternative to typical imaginal exposure treatment for Vietnam combat veterans with posttraumatic stress disorder (PTSD). This report presents the results of the first Vietnam combat veteran with PTSD to have been treated with VRE. The patient was exposed to two virtual environments, a virtual Huey helicopter flying over a virtual Vietnam and a clearing surrounded by jungle. The patient experienced a 34% decrease on clinician-rated PTSD and a 45% decrease on self-rated PTSD. Treatment gains were maintained at 6-month follow-up.

KEY WORDS: PTSD; Vietnam; virtual reality; exposure therapy.

Posttraumatic stress disorder (PTSD) is one of the most disabling psychopathological conditions affecting the veteran population. Weiss et al. (1992) estimated 830,000 veterans suffered from chronic combat-related PTSD. Exposure treatments for PTSD involve repeated reliving of the trauma with the aim of facilitating its processing, a mechanism presumably impaired in victims with chronic PTSD (Foa, Steketee, & Rothbaum, 1989). Three controlled studies demonstrated statistically significant yet relatively small effects utilizing imaginal exposure (IE) for reducing PTSD and related pathology in male Vietnam veterans (Boudewyns

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[1]Department of Psychiatry, Emory University School of Medicine, Atlanta, Georgia 30322.
[2]College of Computing, Georgia Institute of Technology, Atlanta, Georgia 30332.
[3]Department of Psychiatry, Atlanta VAMC, Atlanta, Georgia 30322.
[4]Department of Psychology, Emory University, Atlanta, Georgia 30322.
[5]To whom correspondence should be addressed.

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& Hyer, 1990; Cooper & Clum, 1989; Keane, Fairbank, Caddell, & Zimering, 1989).

One of the most common complaints of Vietnam Veterans with PTSD is a strong emotional response to the sound of helicopters. The American Lake VAMC PTSD program used "helicopter ride therapy" for several years as a regular part of their treatment (Fontana, Rosenheck, & Spencer, 1993). More than 400 Vietnam veteran patients had the opportunity to ride in Huey helicopters as part of their treatment. The authors reported that this type of exposure treatment was very helpful to their patients, although no data was reported. However, it is not practical to use actual Huey helicopters for the thousands of veterans with PTSD, and the benefits of standard imaginal exposure in this population are modest, at best. Therefore, virtual reality exposure (VRE) therapy is proposed as a new medium of exposure therapy for veterans with PTSD.

Advantages of VRE include conducting exposure therapy without leaving the therapist's office, exactly controlling exposure stimuli, and exposing the patient to less risk of harm or embarrassment. In a controlled treatment study of acrophobia, VRE significantly reduced fear and avoidance of heights and improved attitudes toward heights (Rothbaum et al., 1995a). Repeated exposures to virtual foot bridges, outdoor balconies, and a glass elevator that ascended 50 floors produced physical symptoms of anxiety including sweating, butterflies, heart palpitations, shaking, weakness in the knees, tightness in the chest, and tension (Hodges et al., 1995). Case studies of VRE have demonstrated reduced fears of heights (Rothbaum, Hodges, Kooper, Opdyke, & Williford, 1995b), flying (Rothbaum, Hodges, Watson, Kessler, & Opdyke, 1996), and spiders (Carlin, Hoffman, & Weghorst, 1996).

What distinguishes virtual reality from a mere multimedia system or an interactive computer graphics display is a sense of presence. A sense of presence is also essential to conducting exposure therapy. As mentioned before, exposure therapy is aimed at facilitating emotional processing (Foa & Kozak, 1986). For this to occur, it has been proposed that the fear structure must be activated and modified. Exposure therapy is historically effective at activating the fear structure via confrontation with the feared stimuli, which elicits the fearful responses. The processes of habituation and extinction, in which the feared stimuli cease to elicit anxiety, aid modification of the fear structure, making its meaning less threatening. Any method capable of activating the fear structure and modifying it would be predicted to improve symptoms of anxiety. Thus, VRE has been proposed to aid the emotional processing of fears (Rothbaum et al., 1995).

In summary, no therapeutic approach has proven to be consistently effective in the management of combat-related PTSD. Behavioral therapies with an exposure element have proven more effective than most other types of treatment (Van Etten & Taylor, in press), but a significant number of patients do not seem to benefit from them, possibly due to difficulties imagining, visualizing or describing their

traumatic experiences. An uncontrolled treatment development study is currently underway to evaluate the therapeutic effectiveness of VRE for Vietnam veterans with combat-related PTSD. The present report is a case study of the first patient to complete this treatment.

Method

Participant

The subject of this report is a middle class, married, 50-year-old, Caucasian male, who served as a helicopter pilot in Vietnam approximately 26 years prior to this study. He met DSM-IV (APA, 1994) criteria for current PTSD, current major depressive disorder (recurrent, with melancholic features), and past alcohol abuse. He had recently completed a group based treatment at the Atlanta VAMC and yet still suffered with significant PTSD and depressive symptoms which were being managed with medication including Prozac (40 mg), Buspar (20 mg) and Doxipin (150 mg). He had never received exposure therapy prior to the current study. He was unemployed and was receiving 100% VA disability compensation.

Procedure

Informed consent was obtained and a preliminary screening interview conducted at Emory University. A pre-treatment evaluation was conducted by an independent assessor who reviewed the inclusion (currently meet PTSD diagnostic criteria, manageable suicidal ideation) and exclusion criteria (current substance abuse, mania, suicidal intent, unstable mediation in 3 months) and explained the procedures of the project in detail and scheduled the initial treatment session.

Apparatus

During VRE the patient wore a Virtual Research V6 head mounted display equipped with a Polhemus InsideTrak position tracker and high-quality headphones. This head mounted display contains two mini television screens, one in front of each eye, and ear phones over each ear. The head mounted display is worn on the head with T-straps holding it on the head, with a cable connected to the computer. Computer graphics images and spatial audio consistent with the orientation and position of the patient's head were computed in real time as the patient experienced and explored each environment. All environments were immersive, i.e., the patient experienced only the computer-generated audio and visual stimuli while "real-world" stimuli were shut out. Therapist communications were via a microphone connected to the headphones. During the helicopter virtual

environment, the patient sat in a "Thunder Seat," that included an integrated woofer under the seat which allowed the vibrations from the helicopter to be experienced. For the clearing environment, the patient stood on a raised (eight inches) platform (3.5 ft × 3.5 ft) surrounded by hand-rails. The patient "walked" in the environment by pushing a button on a hand-held joystick. Audio, headtracking, and real-time graphics were computed on a PC with a 233 MHZ Intel Pentium II Processor, 64 MB of ram, and an Evans & Sutherland 3D graphics card. The Virtual Vietnam software and environment models were custom-built at Georgia Tech and Virtually Better, Inc. using the Simple Virtual Environment (SVE) tools.

Treatment

Treatment was delivered in fourteen, 90-min individual sessions conducted twice weekly over 7 weeks. Session 1 was devoted to information gathering, explaining the therapy from an emotional processing viewpoint, teaching a brief breathing relaxation method, and familiarizing the patient with the virtual reality equipment using a neutral environment.

During sessions 2 and 3 the participant was exposed to the two virtual environments (VEs). In the virtual jungle clearing, the audio effects included recordings of jungle sounds (i.e., crickets), gunfire, helicopters, mine explosions, and men yelling "Move out! Move out!" which could be increased in intensity. Visual effects included muzzle flashes from the jungle, helicopters flying overhead, landing and taking off, and fog. In the virtual helicopter, audio effects included the sound of the rotors, gunfire, bombs, B52s, engine sounds, radio chatter, and men yelling "Move out! Move out!" Visual effects included the interior of a Huey helicopter in which the backs of the pilot's and copilot's heads with patches were visible, instruments, controls, as well as the view out of the helicopter side door. This view included aerial shots of other helicopters flying past, clouds, and the terrain below which included rice paddies, jungle, and a river.

Sessions four and five exposed the patient to these VEs plus triggered memories. The patient was asked to describe in detail memories triggered by the VEs and to repeat them several times to allow habituation. The content of these triggered memories was controlled by the patient. Sessions 6–14 were spent exposing the patient to the VEs plus imaginal exposure to his most traumatic memories. His most traumatic memories were determined prior to treatment and were prompted by the therapist. As in standard imaginal exposure for PTSD (e.g., Foa, Rothbaum, Riggs, & Murdock, 1991), the patient was asked to recount these memories in the present tense repeatedly until his anxiety decreased. In contrast to standard imaginal exposure, the patient was asked to keep his eyes open, and the therapist attempted to match in virtual reality what the patient was describing as closely as possible, for example, landing and taking off the helicopter when the patient described these activities and gunfire at appropriate times. Self-rating of

Subjective Units of Discomfort (SUDS) from 0 to 100 were elicited from the patient every 5 min during exposure. The therapist simultaneously viewed on a video monitor all of the VEs with which the patient was interacting and therefore was able to comment appropriately and encouraged continued exposure until anxiety habituated. At the end of the session's exposure, practice with the breathing exercise was completed. The patient and therapist discussed the session and the patient's reactions. All treatment sessions were videotaped for supervision by the first author.

Instruments

The following clinician-rated and self report measures of PTSD were incorporated: *Clinician-administered PTSD Scale* (CAPS; Blake et al., 1996); *Combat Exposure Scale* (CES; Foy, Sipprelle, Rueger, & Carroll, 1984); *Structured Clinical Interview for DSM-IV* (SCID; First, Spitzer, Gibbon, & Williams, 1995); *Impact of Events Scale* (IES; Horowitz, Wilner, & Alvarez, 1979); *Beck Depression Inventory* (BDI; Beck, Ward, Mendelsohn, Mock, & Erbaugh, 1961); and *State-Trait Anger Expression Inventory* (STAXI; Spielberger, Jacobs, Russell, & Crane, 1983; Spielberger, 1996).

Full assessments were conducted at pretreatment and posttreatment. A brief midtreatment assessment included only the IES and BDI. The patient was informed that the result of the assessments would not become part of his VA hospital file to try to avoid the confound of improvement in symptoms and loss of compensation. The patient was informed of the payment schedule in which he was to receive $10 for completing the posttreatment assessment, $20 for completing the three month follow-up, and $30 for completing the six month follow-up, for a total of $60. In addition, this patient was reimbursed $7 per session for travel to treatment sessions.

Results

Results from pretreatment to posttreatment on individual measures and the percentage decrease from pre-treatment to the other assessment points can be found in Table 1. As can be seen, scores on all measures decreased from pre- to posttreatment and gains were generally maintained at follow-up. No statistical analyses were incorporated since this was a single subject. Instead, each measure is discussed in terms of clinical significance and references are made, where data exists, to studies with information on these measures in similar populations. In this vein, the patient's pretreatment CAPS Total score of 64 falls into the "severe" range (60–79, Weathers, 1998) and his posttreatment CAPS Total score of 42 falls into the "moderate/threshold" range (40–59) indicating a decrease in clinical severity,

Table 1. Results of Assessments

Measure	Pre (12/97)	Mid (1/98)	Post (2/98)	3 Month (5/98)	6 Month (8/98)	1–2	1–3	1–4
CAPS-total	64	—	42	54	47	34%	15%	26%
Reexperiencing	18	—	7	12	12	61%	33%	33%
Avoidance	21	—	17	19	12	19%	10%	43%
Arousal	25	—	16	23	23	36%	8%	8%
IES-total	33	34	18	20	0	45%	39%	100%[a]
Intrusion	19	29	11	7	0	42%	63%	100%[a]
Avoidance	14	5	7	13	0	50%	7%	100%[a]
Beck Depression Inventory	37	20	30	28	21	19%	24%	43%
STAXI-State	27	—	10	10	10	63%	63%	63%
STAXI-Trait	28	—	22	29	24	21%	−4%	14%

Note. Pre = the results of the pre-treatment assessment; Mid = the results of the mid-treatment assessment; Post = the results of the post-treatment assessment; 3 Month = the results of the 3-month assessment; 6 Month = the results of the 6-month assessment; 1–2 indicates the percentage scores decreased between the pre-treatment assessment and the post-treatment assessment; 1–3 indicates the percentage scores decreased between the pre-treatment assessment and the 3-month assessment; 1–4 indicates the percentage scores decreased between the pre-treatment assessment and the 6-month assessment.

[a] Represents the current status of exactly the same trauma which was specifically addressed during VR therapy and was assessed at each assessment point on the IES.

although obviously still suffering from some PTSD symptoms. His follow-up scores remain in this range. In two samples of Vietnam veterans with PTSD, their IES scores for a specific Vietnam incident was 25 (Pitman, Orr, Forgue, Altman, de Jong, & Herz, 1990; Pitman, Orr, Forgue, de Jong, & Claiborn, 1987). The current patient's pretreatment IES Total score of 33 is more than one standard deviation higher than this group and his posttreatment total score of 18 is greater than 1 *SD* lower, indicating a meaningful over two standard deviation move following therapy. His 6-month follow-up total IES score of 0 indicates a complete absence of intrusive and avoidance symptoms related to the traumatic incident rated (see Discussion). His Beck Depression Inventory pretreatment score of 37 as well as his posttreatment score of 30 indicate severe depression according to the cutoffs recommended by Beck (Steer & Beck, 1988). His BDI 6-month follow-up score of 21 falls into the moderate depression range, indicating a decrease in severity of depression over time although a continuation of meaningful symptoms. The pretreatment STAXI State anger score of 27 is within 1 *SD* of the pretreatment mean of 30.1 of a group of "severely angry Vietnam war veterans suffering from combat-related PTSD" (p. 184, Chemtob, Novaco, Hamada, & Gross, 1997), and the posttreatment STAXI State anger score of 10 is more than 1 *SD* below the posttreatment mean of 19.5 for the treated veterans in the Chemtob, Novaco, Hamada, and Gross (1997) study indicating a meaningful shift in state anger.

Discussion

This case study of the first known Vietnam veteran to undergo virtual reality exposure therapy lends support to the idea that this new medium of exposure therapy may hold promise. The results indicate that PTSD scores decreased following treatment. Depression, anger, and substance abuse do not appear to be adversely affected by the treatment, as has sometimes been the case with exposure therapy for Vietnam veterans (Pitman et al., 1991). It is interesting to note that the patient's midtreatment IES intrusion score increased and avoidance score decreased. The patient was informed prior to treatment that symptoms may increase temporarily during exposure therapy and to try not to avoid trauma-related thoughts or cues during this time. The midtreatment increases on the IES Intrusion scale indicate that, in fact, his intrusive symptoms did increase as predicted. The mid-treatment decreases on the IES Avoidance scale indicate that he was following instructions not to avoid. Had only pre- and posttreatment IES scores been gathered, this information would have been missed.

The six month follow-up IES score of 0 obviously indicates no intrusion or avoidance related to the trauma rated, which, at first glance, is hard to believe. Instructions for the IES refer the patient to a specific incident and to complete the symptoms as they relate to that incident and were followed exactly. Therefore, the patient was asked to rate event-related intrusion and avoidance to his single most traumatic event ("LZ Brown" in his case) rather than his entire combat service in Vietnam. This explains how his six month IES could be 0 whereas he was still symptomatic when rated by the clinician on the CAPS, rating his PTSD symptoms related to his entire service in Vietnam. When completing the IES at the six month assessment, he commented that he hadn't thought of LZ Brown in quite some time, but that it was no longer as distressing to him and therefore he had not been making any particular efforts to avoid thinking about it. This was the patient's most traumatic memory identified at pretreatment and was the focus of the majority of treatment sessions incorporating imaginal exposure.

Obvious limitations to the generalizability of these results center on the fact that this is just one subject and just one component of treatment. The parent study is ongoing and continuing to treat more patients, which will lend more information. Regarding the scope of treatment, VRE therapy is proposed as a component of a comprehensive treatment program. It is generally accepted that this population requires a comprehensive treatment program (Foy et al., 1998) rather than just PTSD focused treatment.

This therapy has the advantages of allowing veterans to virtually reexperience aspects of Vietnam in a controllable manner that allows for habituation. The patient appeared to become immersed in the virtual environment. This was a very "typical" Vietnam combat veteran with PTSD participating in the VA system: he met current criteria for PTSD and major depression and past substance abuse of alcohol. He

was currently on several medications. He was on 100% disability for his PTSD. He was quick to anger and slow to trust, yet unhappy with his current life and verbally expressing motivation to change and to try almost anything that might help. His marriage was in distress, and he had problems in most other areas of his life. He was very weary of this treatment and admitted to not wanting to attend sessions at times. Yet, this treatment appears to have helped, even if modestly. This report is quite limited in its scope, with just one participant, but it is suggestive that imaginal exposure while immersed in Vietnam audio and visual stimuli may be an effective component of a comprehensive treatment package for Vietnam veterans with PTSD and is worthy of further study.

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