

# Virtual Reality in the Treatment of Survivors of Terrorism in Israel

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**Abstract.** Due to the numerous terrorist attacks that have occurred in Israel during the last five years there are many people suffering from PTSD who are seeking therapeutic help. Previous studies support the role of virtual reality (VR) as an effective tool for the treatment of PTSD. This chapter describes the development of a VR environment for the treatment of PTSD for people who were traumatized by suicide bus bombings in Israel. We present an overview of the simulation software and the study design including the clinical protocol and outcome measures. Included in these measures is the client's occupational performance which, to date, has received less attention by those investigating PTSD.

**Keywords.** PTSD, terror, Virtual reality

## 1. Introduction

Over 1,000 Israelis have been killed, during the past five years, in a series of attacks, including: shooting incidents, car bombings and suicide bomb attacks, frequently targeting public transport. Many more people have been physically wounded, and an uncountable number of people have become psychological casualties; these "silent" victims do not assume a special status or become heroes, are frequently ashamed of their disability, and moreover are destined to suffer for prolonged periods, possibly for the rest of their lives

Since the beginning of the Palestinian "Intifada" or uprising in September 2000, 6979 Israeli civilians have been treated for trauma in the aftermath of deadly terrorist attacks. On the Palestinian side, between September 29, 2000 and July 8, 2003, 2,572 Palestinians have been killed, and more than 41,000 injured.

An initial telephone survey conducted in Israel examined the impact of terrorism on a nation-wide representative sample (Bleich, Gelkopf & Solomon 2003). Using a strata sampling method, 512 participants responded to the survey aimed at assessing the psychological impact of ongoing terrorism in Israel. Survey results revealed that 45% of the sample had been impacted by terror. Six percent of the sample experienced personal exposure or had relatives or friends who were wounded or killed. An additional 3.3% had personal exposure or relatives or friends who were exposed but not wounded and 7% had been personally exposed but did not have relatives or friends

who were exposed. Sixteen percent had no personal exposure but had relatives or friends wounded and/or killed, while 12% had no personal exposure but had relatives or friends who were exposed but not wounded.

Nothing in life can prepare a citizen for the horror of an act of terrorism. Even in Israel, despite the statistics presented above, few expect such a thing to happen to them. Reactions to the abnormal events of terrorism include a wide range of powerful feelings that may feel abnormal to the person having them or seem strange to those who have not gone through such a disaster. Terrorism evokes a fundamental fear of helplessness. The violent actions are random, unprovoked by the individuals attacked, and intentional, and often are targeted at defenseless citizens.

This chapter describes the development of a VR environment for the treatment of PTSD as an alternative to conventional imaginal exposure therapy. We present an overview of the simulation software, developed especially to represent bus-bombings in Israel, and the study design including the clinical protocol and outcome measures. Included in these measures is the client's occupational performance which, to date, has received less attention by those investigating PTSD.

## **2. The effects of terrorism**

Victims of terror, including those who have not been physically injured, frequently manifest a severe emotional reaction. People who have experienced the trauma often fall into the following categories:

- Survivors of past traumatic events (e.g. veterans, survivors of wars, terrorism, or torture, and survivors of domestic violence, child abuse or street crime); these individuals may have a heightened sense of vulnerability.
- People who personally witnessed or were victims of the terrorist attack.
- People who experience traumatization from learning of relatives, friends and acquaintances that were subject to the violence or from exposure to repeated media accounts of the trauma.
- People who provide aid and assistance to terror victims (Shalev, Peri, Canetti, & Schreiber, 1996; Somer, Keinan, & Carmil, 1996).

Timely secondary prevention may reduce the risk for ASD or PTSD. Posttraumatic distress may include one or all of the following symptoms:

- shock and numbness
- intense emotion
- fear
- guilt
- anger and resentment
- depression and loneliness
- isolation
- physical symptoms of distress
- panic
- inability to resume normal activity.

The DSM-IV-TR (APA, 2000) groups PTSD symptoms in three categories: re-experience of the trauma, avoidance, and increased arousal. A delayed reaction may occur in some individuals. They may indeed be energized by the initial stressful situation and not react until weeks or months later. Mental health professionals need to educate the public and community physicians about this risk (Shalev, 1996; Schlenger, Caddell, Ebert, Jordan, Rourke, Wilson, Thalji, Dennis, Fairbank, & Kulka, 2002).

A number of therapeutic approaches have been developed for the treatment of PTSD. These include Exposure Therapy, Pharmacotherapy, Eye Movement Desensitization and Reprocessing (EMDR), Group treatment, and Brief Psychodynamic Psychotherapy. Exposure therapy, often regarded as the gold standard for successful treatment of PTSD, focuses primarily on evoking self-generated images to facilitate the recreation of the client's traumatic memories. This approach, however, poses a major difficulty since the clients' natural inclination is to avoid thinking about or imagining the traumatic event thereby preventing or hampering subsequent treatment improvement.

### **3. Virtual Reality as an intervention tool for PTSD**

VR-based therapy has been shown to be highly effective for the treatment of phobias (Anderson, Jacobs & Rothbaum, 2004; Hodges, Anderson, Burdea, Hoffman, & Rothbaum, 2001) and for the reduction of pain during burn care (Hoffman, Patterson, & Carrougher, 2000; Hoffman, 2004) and venipuncture (Reger, Rizzo, Buckwalter, Gold, Allen, Augustine, & Mendelowitz, 2003).

More recently, VR has been successfully used to treat PTSD in case studies and a non-controlled trial. Until the recent introduction of VR based therapies, imaginal exposure therapies relied primarily on the imaginative and memory capacity of patients. Virtual reality affords opportunities not only to capitalize on the patient's imagery ability, but also to supplement them with visual and auditory computer-simulated experiences. For patients who are hesitant or unable to recall the traumatic events, the sensory-rich virtual environment engenders an evocative therapeutic experience which may nurture the patient's emotional engagement. Since the patient encounters the virtual environment at a self-determined pace, it is easier to distinguish between the act of remembering (and staying in control) and the act of reliving (becoming overwhelmed by the re-experience) (Difede & Hoffman, 2002). Additionally, VR technology allows for graded exposure to increasingly feared virtual environments/objects/events that can be carefully monitored and tailored to the individual patient. As a result, VR therapy experiences may increase a patient's feelings of self-efficacy and of being an active agent of his or her own therapeutic experience.

VR -based therapy for PTSD was introduced by Rothbaum and colleagues. Based theories of Foa and colleagues, Rothbaum and colleagues proposed that the illusion of going into in the computer-generated virtual environment facilitates emotional processing of memories associated with the traumatic event. They developed and evaluated the therapeutic effectiveness of VR exposure (Virtual Vietnam), for the treatment of combat-related PTSD experienced by soldiers who had been in Vietnam as one component of a comprehensive treatment program (Rothbaum, et al., 1999). In this case study, a Vietnam veteran exposed to a helicopter environment

and an open field environment that elicited strong emotional responses from the participant. Results suggested that being immersed in Virtual Vietnam can be an effective aid to assist PTSD sufferers in imagining, visualizing and describing their traumatic experiences. The participant showed a 34% decrease in symptoms on clinician-rated PTSD and a 45% decrease on self-rated PTSD. Treatment gains were maintained at the 6-month follow-up examination (Rothbaum, et al., 1999). In an uncontrolled study, 10 males with PTSD were treated with Virtual Vietnam for eight to 16 sessions. Results indicated that in the clinician-rated PTSD scale at 6-month follow-up, there was a statistically significant reduction ( $p=.0021$ ) in symptoms associated with specific reported traumatic experiences. Although chronic PTSD in Vietnam Veterans is notoriously difficult to treat successfully, all eight participants reported reductions in PTSD symptoms ranging from 15% to 67% with significant decreases were seen in all three symptoms clusters ( $p<.02$ ). Participants' self-reported intrusion symptoms as measured by the Impact of Event Scale (Weiss & Marmar, (1997) were significantly lower ( $p<.05$ ) at 3 months than at baseline but not at 6 months, although there was a clear trend toward fewer intrusive thoughts and somewhat less avoidance. The researchers concluded that VR exposure therapy holds promise for treating PTSD in Vietnam veterans (Rothbaum et al., 2001).

Difede & Hoffman (2002) developed the first virtual environment to treat civilian PTSD following the terrorist attack on the World Trade Center Twin Towers in 2001. Using a course of only six one-hour VR exposure therapy sessions involved cognitive behavioral therapy with VR exposure, a PTSD patient who had previously failed to respond to traditional PTSD therapy with imaginal exposure was gradually and systematically exposed to increasingly realistic VR simulations of Sept 11th. On her first session, the patient put on a VR helmet and looked at the towers with no attack. Then, virtual planes flew over the World Trade Center without crashing, As the patient habituated, she was able to tolerate more eventful simulations until in the final sessions, planes crashed into the buildings with animated explosions and sound effects, virtual people jumped to their deaths from the burning buildings, the towers collapsed into dust clouds and sound effects (screaming, sirens, etc). Depression and PTSD symptoms as measured by the Beck Depression Inventory (Beck & Steer, 1987) and Clinician Administered PTSD Scale indicated a large (83%) reduction in depression, and large (90%) reduction in PTSD symptoms

In summary, the results of these preliminary studies showed that VR exposure is a promising tool in the field of PTSD. Controlled trials are needed to establish the efficacy of VR exposure in comparison with imaginal exposure and control conditions.

#### **4. The essence of a client's occupation**

Despite the search for effective interventions for PTSD, no study has as yet examined the impact that this condition has on the sufferer's inability to continue participation in daily occupations and their subsequent rehabilitation to pre-trauma occupational life. Occupations are what we do for a living. They provide the basis for feelings about ourselves. Our jobs help engage us in the world around us, and in so doing, enable us to survive and maintain ourselves. They develop our abilities and skills, allow us to pursue our interests, relate with other people, and express our values (Baum & Christiansen , 2004).

One of the major goals of occupational therapy is to enable the client to achieve a satisfying and productive life by the development or rehabilitation of occupation-related skills, which facilitate functioning at a satisfactory personal and interpersonal level. The desired outcome of intervention is for the client to be able to meet his own needs, as far as possible, and to have the motivation to continue working towards achieving his full potential. Sub-goals which lead to this major goal are to:

- assess client needs in terms of the occupations which are important to him;
- identify the skills needed to support those occupations;
- remove or minimize barriers to successful occupational performance;
- assist the client to develop, relearn or maintain skills to a level of competence that will allow him to perform occupations to his own satisfaction; and
- help the client to achieve a satisfactory balance of activities in his daily life.

Most of the interventions for PTSD clients focus on decreasing the number and severity of symptoms, and the occupation component is not mentioned in the literature. We propose adding this component both in our evaluation and intervention of the PTSD clients.

## **5. BusWorld: Bus Bomb Survivor PTSD Therapy**

A typical immersive virtual reality system consists of a virtual reality helmet that positions miniature computer displays near the participants eyes, and blocks their view of the real world. An electromagnetic xyz coordinate position tracking system attached to the helmet sends information to the computer. When users look around in the virtual world by moving their head orientation, the computer correspondingly changes what they see in VR. Clients put on a VR helmet and experience a virtual world designed to give them the illusion of being on a sidewalk in Israel, across the street from a bus stop (see Figures 1-4 below).

There are a number of different levels in this graded exposure, which the therapist controls by pressing a button on the keyboard. For the first level, no bus ever appears at the bus stop (see Figure 1 below). For the second level, a bus comes around the corner and stops at the bus stop but there is no attack (see Figure 2). For the third level, a bus pulls up, and breaks in half as if exploding, but there are no sound effects and no explosion or fire. Additional levels add explosion sound effects, visual special effects of an explosion and the bus on fire (see Figure 4), sounds of people screaming and crying in Hebrew, police sirens and flashing lights pulling up.

BusWorld was designed by several members of our team, based on interviews with Israeli PTSD victims, therapists. BusWorld was programmed by Worldbuilder Ari Hollander ([www.imprintit.com](http://www.imprintit.com)) using sound effects made available by DaneTracks, audio clips created by sound engineer Cmd. Russ Shilling, and texture maps from digitized photos taken in Israel. Photos of actual terrorist bus bomb scenes were used to guide the special effects used in BusWorld (e.g., the geometry of the bus and exploded bus frameworks). A video clip showing the full simulation experienced by the patient on their final therapy session is appended on CD.

Figure 1



Figure 2



Figure 3



Figure 4

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## 6. Clinical Protocol

The treatment program is virtual reality exposure therapy (Rothbaum et al., 2001) which is an adaptation of an empirically validated CBT program, Prolonged Exposure (PE) developed by Foa & Rothbaum (1998) and upgraded by Foa, Hembree & Dancu, (2002). The main component of the traditional PE program, exposure to the trauma memories, is usually conducted using imagination. In this study we use a new tool, virtual reality exposure. . Exposure to the trauma is conducted gradually exposing the clients to the different sequences of a VR program simulating a bus bombing attack (described in the previous section). The therapists who apply the PE program with the VR treatment are previously trained in the application of the traditional PE program and in the use of VR exposure. VR therapy is a powerful tool, it is especially important that therapists are well trained and experienced in treating PTSD before using it.

The length of the treatment is 10 sessions that last 90-120 minutes each conducted weekly. The components of the treatment program are the following:

- Education about the common reactions to trauma (Sessions 1 and 2).
- Breathing retraining (sessions 1 and 2).
- In vivo exposure to situations related to the traumatic event (Session 2 through 9).

- VR exposure to the traumatic event (Sessions 3 through 9).  
Homework for VR exposure: The Clients will use a DVD of the VR session conducted with the therapist in the consultation room to conduct exposure at home.

To test the efficacy and effectiveness of this VR program an assessment protocol including PTSD measures, as well as general psychopathology measures, and compliance and satisfaction measures is administered at pre-treatment, post-treatment and follow-ups.

## **7. Outcome measures**

Six different assessment tools are used in this study; all questionnaires are standardized with Hebrew translations:

1. Clinician Administered PTSD Scale (CAPS): a standardized diagnostic interview to determine DSM-IV criteria for the PTSD questionnaire (Blake et al., 1990).
2. Post Traumatic Diagnostic Scale (PDS): a standardized self-report questionnaire to measure PTSD symptoms (Foa, 1995).
3. Beck Depression Inventory (BDI): a standardized questionnaire measuring symptoms of depression (Beck & Steer, 1987).
4. Brief Symptom Inventory (BSI): a standardized questionnaire measuring general psychopathology symptoms (Derogatis & 1983).
5. Presence Questionnaire (PQ): a standardized questionnaire to investigate perceptions and feelings of presence in the VR environment (Witmer & Singer, 1998).
6. Activity Card Sort (ACS): a standardized measure of activity participation (Baum & Edwards, 2000). The ACS employs pictures of people involved in real-life activities and thus can elicit vivid responses from participants. This instrument was adapted to Israeli culture through several in-depth studies (Katz, Karpin, Lak, Furman, & Hartman-Maeir, 2003; Sachs & Josman, 2003).

## **8. Progress to date**

The software was first tested with more than 30 non-symptomatic users who viewed and interacted with it while wearing an HMD at various demonstration events. Overall these users found the environment to be realistic and evocative of a suicide bombing. It was clear that key features such as the trademark green bus, palm trees and distant sight of the Mediterranean were in accordance with a true Haifa city view. There were no reports of cybersickness-like side effects although some users requested to stop the simulation due to feelings of distress. Feedback from these non-PTSD sufferers provided strong support for the ecological validity of BusWorld.

## 9. Conclusions

This chapter described the development of BusWorld, a VR environment for the treatment of PTSD as an alternative to conventional imaginal exposure therapy. We presented an overview of the simulation software, developed especially to represent bus-bombings in Israel. Feedback from non-PTSD sufferers provided initial support for the ecological validity of BusWorld. We are currently recruiting five subjects with PTSD due to suicide bus bombings to test the feasibility and effectiveness of VR-based exposure therapy.

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