An Analog Study of Simulation
Trauma Severity:
Sensitivity of 'Bus-World' for VR
Exposure Therapy

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• Over 900 Israelis have been killed in a prolonged series of attacks, including: shooting incidents, car bombings and suicide bomb attacks on public transportation.

• Since the beginning of the Intifada (uprising) in September 2000, 7590 Israeli civilians have been treated for trauma in the aftermath of deadly terrorist attacks.
On the other side, between September 29, 2000 and July 8, 2003, 2,572 Palestinians have been killed, and more than 41,000 injured.

No one wins....
• Many victims of terrorism display severe emotional reactions, even in the absence of a physical injury.
• Some develop Post-traumatic Stress Disorder (PTSD).
• Symptoms include:
  • shock and numbness
  • fear, anger, depression
  • decrease in daily occupational or leisure-based activities

Who is affected by terrorism?
Virtual Reality as an intervention

• VR has been shown to be highly effective for the treatment of phobias (Hodges, Anderson, Burdea, Hoffman, & Rothbaum, 2001).

• Virtual Vietnam (VV) – has been created for the treatment of Vietnam war veterans with PTSD (Rothbaum, et al., 1999; 2001).

Virtual reality as an intervention of PTSD

• World Trade Center (Difede & Hoffman, 2002).

• Full Spectrum VR Application for Iraq War PTSD (Rizzo, et al., 2005)
Study Objectives

• To design and build a simulation of a terrorist suicide bus bombing attack in Israel

• To investigate the physiological and subjective responses of healthy individuals to this virtual environment

Methods

Participants

• 30 healthy volunteers (12 males, 18 females)
• Aged 23 to 63 years, (Mean=40.2, SD=13.1)
• Convenience sample
Inclusion Criteria

• All subjects Posttraumatic Diagnostic Scale (PDS) < 1.1
  (range of normal scale)

Exclusion Criteria

• Without a history of PTSD
• Without a history of any form of treatment related to trauma
• Were not present at a terrorist attack
Instruments

• Post Traumatic Diagnostic Scale (PDS) (Foa, 1995)
• Short Feedback Questionnaire (SFQ) (Kizony et al. 2003) - an abbreviated version of Witmer & Singer’s (1998) Presence Questionnaire.
• Subjective Units of Distress (SUDs) (Wolpe & Adams, 1991)
• Heart Rate Monitor
**Procedure**

- Institutional Review Board approval
- Participant agreement
- Screening for exclusion criteria (PDS)
- Exposure for 90 s to each of four graded stages of Bus-World:
  - Stage 1: street scene, bus stop, no bus
  - Stage 2: bus arrives at stop but does not explode
  - Stage 5: bus explodes with fire and smoke, no sound
  - Stage 12: bus explodes loudly with all visual effects, loud crowd sounds and sirens, human remains
• Immediately following each exposure, heart rate was measured and the participants were asked to rate their SUDs and to complete the SFQ.

Results

Short Feedback Questionnaire (SFQ)

Exposure Level

Stage 1 Stage 2 Stage 5 Stage 12

Feedback
Control
Realism
Presence
Discomfort

P<0.05
Short Feedback Questionnaire (SFQ)

- Significant differences in sense of being in environment between the 4 stages of exposure
- Increasing the exposure:
  - ✓ increase in sense of being in environment
  - ✓ decrease in feeling of control
  - ✓ increase in perception that environment is realistic
  - ✓ no differences regarding feedback and discomfort

Heart Rate

<table>
<thead>
<tr>
<th>Exposure Level</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 5</th>
<th>Stage 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (beats/min)</td>
<td>70</td>
<td>75</td>
<td>70</td>
<td>75</td>
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P ≤ 0.05
Subjective Units of Distress (SUDs)

Increasing the exposure → increased anxiety

Summary of Results

- **Performance experience** – participants felt comfortable, few side effects
- **Subjective presence** – significantly affected by exposure
- **Heart Rate** – significant but small differences, no functional meaning
- **SUDs** - anxiety increased with the severity of exposure. (Rothbaum et al., 1995; Wilhelm et al., 2005)
Discussion

• Sensitivity of ‘BusWorld’ - Potential to provide graded exposure
• Importance of Analog studies – testing the scenario before you test it on symptomatic subjects
• Limitations- Responses of non-symptomatic subjects may differ from symptomatic subjects (Robillard et al., 2003)

Future Studies

• Test simulation with wider sample of participants who differ in age, culture, and exposure to trauma
• Use real time, continuous measures of physiological response
• Add feedback to the environment (smell, vibration via sub-woofer)
Acknowledgment