From Training to Toy to Treatment:
Design and Development of a PTSD VR Exposure Therapy Application for IRAQ WAR MILITARY PERSONNEL

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FULL SPECTRUM VR EXPOSURE THERAPY FOR IRAQ WAR PTSD

Funded by

DEPARTMENT OF THE NAVY
Science & Technology
“...The percentage of study subjects whose responses met the screening criteria for major depression, generalized anxiety, or PTSD was significantly higher after duty in Iraq (15.6 to 17.1 percent) than after duty in Afghanistan (11.2 percent) or before deployment to Iraq (9.3 percent)” (Hoge et al., 2004)
The Iraq War Comes Home
A Pentagon survey of returning U.S. soldiers finds many traumatized by the occupation
By MARK THOMPSON

The Iraq war is coming home, with more than one of every four returning vets complaining of mental or physical wounds caused by the conflict. The first time the U.S. went to war with Iraq, in 1991, ground combat lasted precisely 100 hours, but its impact on the U.S. troops who waged it, including physical and mental scars, was ignored and belittled by the Pentagon hierarchy for years. This time, with the war going much worse for U.S. forces, the Pentagon is paying much closer attention to the invisible wounds combat is leaving on soldiers.
More than one in three soldiers and Marines who have served in Iraq later sought help for mental health problems, according to a comprehensive snapshot by Army experts of the psyches of men and women returning from the wars in Iraq, Afghanistan and other places.

Mental Health Problems, Use of Mental Health Services, and Attrition From Military Service After Returning From Deployment to Iraq or Afghanistan

Charles W. Hoge, MD
Jennifer L. Auchterlonie, MS
Charles S. Milliken, MD

Context The US military has conducted population-level screening for mental health problems among all service members returning from deployment to Afghanistan, Iraq, and other locations. To date, no systematic analysis of this program has been conducted, and studies have not assessed the impact of these deployments on mental health care utilization after deployment.
Post Traumatic Stress Disorder (PTSD)

Post Traumatic Stress Disorder (DSM-4) is caused by traumatic events that are outside the range of usual human experiences such as military combat, violent personal assault, being kidnapped or taken hostage, terrorist attack, torture, incarceration as a prisoner of war, natural or man-made disasters, automobile accidents, or being diagnosed with a life-threatening illness.

The disorder also appears to be more severe and longer lasting when the event is caused by human means and design (bombings, shootings, combat, etc.).
Post Traumatic Stress Disorder

General symptoms

- Re-Experiencing
- Avoidance
- Emotional Numbing
- Hyper-arousal
Post Traumatic Stress Disorder - Specific symptoms

- Intrusive thoughts and flashbacks
- Anger
- Isolation
- Emotional numbing
- Anxiety
- Depression
- Substance abuse
- Survivor guilt

- Hyper-alertness
- Suicidal thoughts
- Negative self-image
- Memory problems
- Intimacy problems
- Emotional distance from family
- Denial of social problems
- Etc.
Severity of PTSD Symptoms

CAPS Score - Symptom Severity

Assessment over Time

PTSD
Non-PTSD

Exposure Therapy Principles

- Exposure to feared stimulus repeatedly and for prolonged period leads to *habituation and extinction*
- Based on *learning principles*
- Reliable findings with animals and phobic disorders
- *Therapeutic* Exposure
Of those diagnosed with Posttraumatic Stress Reaction at 30 Days Post

Comparison between Exposure Therapy, Supportive Counseling and No Treatment on PTSD incidence

(Bryant et al., 1999; 2005)
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Post Traumatic Stress Disorder -

Problems with Imaginal Exposure

Many patients are unwilling or unable to effectively visualize the traumatic event. In fact, avoidance of reminders of the trauma is inherent in PTSD, and is one of the defining symptoms of the disorder. Research on this aspect of PTSD treatment suggests that the inability to emotionally engage (in imagination) is a predictor for negative treatment outcomes (Jaycox, Foa, & Morral, 1998).

“...some patients refuse to engage in the treatment, and others, though they express willingness, are unable to engage their emotions or senses.” (Difede & Hoffman, 2002).
VR PTSD Examples

- Virtual Vietnam - Emory University
- World Trade Center - Weill Cornell Medical Center/U of Wash
- Terrorist Bus Bombing - U. of Haifa/U of Wash
- Motor Vehicle Accidents - Univ. of Buffalo
- Emma’s Room - Universitat de València (Spain)
- Virtual Angola - U. of Lusófona de Humanidades e Tecnologias, Lisbon
- Virtual Iraq - USC Institute for Creative Technologies
Virtual Iraq

Funded by

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Opportunities

Gaming and Entertainment Industry Drivers for VR Scenario Development
FULL SPECTRUM WARRIOR
X-Box Game Conversion for Iraq War PTSD clients!
FULL SPECTRUM WARRIOR
X-Box Game Conversion for Iraq War PTSD clients!
FULL SPECTRUM WARRIOR
Game Conversion for Iraq War PTSD clients!
FSW Conversion Steps

- Gain access to FSW Assets ✓
- Build Prototype ✓
- Get Start up Funding ✓
- Begin Full Scale Development

The Easy Part!!!

User-Centered Feedback Trials now in progress!
Global FSW PTSD Requirements

- Multiple Scenario Settings
- Selectable User Perspective Options
- Create Library of “Trigger” Stimuli
- Integrate Scent and Vibration
- Create a Highly Usable “Wizard of OZ” Clinician Interface
- Integrate Physiological Recording into Clinician Interface

Major Goal: *Customize Graduated Exposure based on Client Needs*
Global FSW PTSD Requirements

- Multiple Scenario Settings
  - City Scenes
  - Small Rural Villages
  - Building Interiors
  - Convoys & Checkpoints
  - Desert Base
  - Desert Highway
Global FSW PTSD Requirements

- Multiple Scenario Settings
- City Scenes
Global FSW PTSD Requirements

- Multiple Scenario Settings
- City Scenes
Global FSW PTSD Requirements

- Multiple Scenario Settings
- Building Interiors
Global FSW PTSD Requirements

- Multiple Scenario Settings
- Desert Highway
Global FSW PTSD Requirements

- Selectable User Perspective Options
  - Walking Alone
  - Walking with One Person
  - Flocking Patrol
  - HUMVEE Interior View
  - Helicopter Interior View
Global FSW PTSD Requirements

- Selectable User Perspective Options
  - Walking Alone
Global FSW PTSD Requirements

- Selectable User Perspective Options
  - Walking with One Person
Global FSW PTSD Requirements

- Selectable User Perspective Options
  - Walking with One Person
Global FSW PTSD Requirements

- Selectable User Perspective Options
- Flocking Patrol
Global FSW PTSD Requirements

- Selectable User Perspective Options
  - HUMVEE *Turret* View
Global FSW PTSD Requirements

- Selectable User Perspective Options
  - HUMVEE *Turret* View
Global FSW PTSD Requirements

- Selectable User Perspective Options
  - HUMVEE Interior Safe View
Global FSW PTSD Requirements

- Selectable User Perspective Options
  - HUMVEE Interior *Action* View
Global FSW PTSD Requirements

- Selectable User Perspective Options
- HUMVEE Interior *Action* View
Global FSW PTSD Requirements

- Selectable User Perspective Options
  - Helicopter Interior View
Global FSW PTSD Requirements

- Selectable User Perspective Options
  - Helicopter Interior View
GO TO VIDEO!

Summary Video January 2005
GO TO VIDEO!

Narrated Summary Video Feb 2005
Global FSW PTSD Requirements

Create a Highly Usable “Wizard of OZ” Clinician Interface

- The “Wizard of Oz” type clinical interface is a key element in the application, as it needs to provide a clinician with a usable tool for placing the user in VE locations that resemble the setting and context in which the traumatic events initially occurred.

- As important, the clinical interface must also allow the clinician to further customize the therapy experience to the patient’s individual needs of via the systematic real-time delivery and control of “trigger” stimuli in the environment.

- Visual Display of client’s FOV and psychophysiological status

- This is essential for fostering the anxiety modulation needed for therapeutic habituation.
**Caveat:** We need guard against the perception that VR Tools are designed to eliminate the need for the Therapist.
“Wizard of OZ” Clinician Interface

Controls

- Scenario Settings
  - Location, Time of Day, Weather, etc.
- User Perspective
  - Alone, Patrol, HUMVEE, Helicopter, etc.
- Real-Time Psychophysiological Display
- TRIGGER Stimuli
“Wizard of OZ” Clinician Interface
“Wizard of OZ” Clinician Interface
Option for Wireless Tablet Controls
FULL SPECTRUM VR PROTOTYPE DEMO

GO TO FULL SPECTRUM INTERFACE DEMO!
“Wizard of OZ” Clinician Interface

TRIGGER Stimuli

- Currently analyzing any user-centered documentation for input to maximize the range of customizable stimulus presentation.

- Four general categories:
  - Audio *(i.e., weapons fire, explosions, vehicle noise, wind, human voices)*
  - Visual - static *(i.e., human remains, wounded civilians and combatants, wrecked vehicles)*
  - Visual - dynamic *(i.e., distant views of human and vehicle movement)*
  - Audio-Visual *(i.e., nearby human and vehicle movement, battlefield engagement with enemy combatants)*
One Useful Source of TRIGGER Stimuli
Insight: Hoge et al. 2004

- Being attacked or ambushed
- Receiving incoming artillery, rocket, or mortar fire
- Being shot at or receiving small-arms fire
- Shooting or directing fire at the enemy
- Being responsible for the death of an enemy combatant
- Being responsible for the death of a noncombatant
- Seeing dead bodies or human remains
- Handling or uncovering human remains
- Seeing dead or seriously injured Americans
- Knowing someone seriously injured or killed
- Participating in de-mining operations
- Seeing ill or injured women or children whom you were unable to help
- Being wounded or injured
- Had a close call, was shot or hit, but protective gear saved you
- Had a buddy shot or hit who was near you
- Clearing or searching homes or buildings, Engaging in hand-to-hand combat, Saved the life of a soldier or civilian.
Display Technology - New Head Mounted Displays...

Introducing the World’s First Video Eyewear

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120-Degree Field of View HMD trial in collaboration with Mark Bolas, USC Cinema
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120-Degree Field of View HMD trial in collaboration with Mark Bolas, USC Cinema
Among Iraq War veterans: “...those whose responses were positive for a mental disorder, only 23 to 40 percent sought mental health care. Those whose responses were positive for a mental disorder were twice as likely as those whose responses were negative to report concern about possible stigmatization and other barriers to seeking mental health care.” (p. 13).
Challenge for Military Healthcare

Option: Reconceptualize Therapy

May appeal to a generation of soldiers who have grown up Digital!
Challenge for Military Healthcare

Option: **Reconceptualize Therapy**

- Integrate VR combat exposure as part of a comprehensive program administered upon return from a tour of duty.
- Since past research is suggestive of differential patterns of physiological reactivity in soldiers with PTSD when exposed to combat-related stimuli (Laor et al., 1998, Keane et al., 1998).
- Use initial reintegration procedure that applies our VR PTSD application with physiological recording could be of value.
- If indicators of such physiological reactivity are present during an initial VR exposure, a referral for continued “Reintegration training” could be negotiated and/or prescribed.

This could provide a format whereby the perceived stigma of seeking help/treatment could be lessened as the soldier would be simply participating in post-combat reintegration “training” in similar fashion to other designated duties to which they are assigned.
Current Research Activities

- Version 1.3 Completed
- User Centered Clinical Trials at the San Diego Naval Medical Ctr & Camp Pendleton
Current Research Activities

The technology has already helped at least one soldier: Marine Cpl. Nicholas Beberniss, a 22-year-old from Denver who was badly hurt when a mine exploded in Iraq. An anti-tank mine hit Beberniss' vehicle on a dark desert road last July. It took him five months to walk — doctors told him it might never happen — and he faces another 18 months of physical therapy. During his ongoing recovery at Naval Medical Center San Diego, Beberniss heard about the facility’s virtual reality therapy research and volunteered for it.

Thanks to simulations, Beberniss learned that his psychological reaction to the explosion was normal. "It made me realize it was the accident and nothing else," he said. By studying his reaction to computer images of Iraq war zones, he was able to isolate the things that were causing him stress. His heart rate and respiration quickened dramatically when the screen images went from day to night — the time the mine exploded.

"At night everything went off on me," Beberniss said of his virtual reality experience. "It was totally different."
Current Research Activities

- Version 1.3 Completed
- User Centered Trials at the San Diego Naval Medical Center & Ctr & Camp Pendelton
  User Centered Trials in IRAQ
  (Equipment funded by TATRC)
User-Centered Feedback thus far:

- n = 17
- HMD comfort = 7.2/10
- Tracking update = 7.4/10
- Graphic realism = 6.7/10
- Audio realism = 7.2/10
- Navigation = 3.2/10
- Side effects = 3/17; 1DC
- Much useful qualitative feedback on architecture, olfactory cues, human content, landscape, etc.
Current Research Activities

- Version 1.3 Completed
- User Centered Trials at the San Diego Naval Medical Center
- User Centered Trials in IRAQ commenced in July (Equipment funded by TATRC)
- Integration of 3D Sound, Scent and Vibration
Integrate Scent and Vibration

Envirodine Scent System

- Gunpowder
- Cordite
- Body Odor
- Garbage
- Burning Rubber
- Diesel Fuel
- Iraqi Spices

And
Night Vision
HMD
Rig...

Courtesy of Quantum 3D
A non-intrusive Virtual Emotion Sensor that is worn much like a pair of glasses. The headset acquires several biometric signals such as EEG, blood oxygen, and motion and processes them in real time. The module is connected to a computer through a wireless link.
Current Research Activities

- Version 1.3 Completed
- User Centered Trials at the San Diego Naval Medical Center
- User Centered Trials in IRAQ commenced in July (Equipment funded by TATRC)
- Integration of 3D Sound, Scent and Vibration
- Clinical Version 1.4 Delivered May 2006
Current Research Activities

- Version 1.3 Completed
- User Centered Trials at the San Diego Naval Medical Center
- User Centered Trials in IRAQ commenced in July (Equipment funded by TATRC)
- Integration of 3D Sound, Scent and Vibration
- Clinical Version 1.4 Expected April 2006
Current Research Activities

- Version 1.3 Completed
- User Centered Trials at the San Diego Naval Medical Center
- User Centered Trials in IRAQ commenced in July (Equipment funded by TATRC)
- Integration of Scent and Vibration
- Virtual Humans, Line Editor and Night Vision
Virtual Behavior Control Framework

Behavior Control Editor:
- Build within Alias Maya
- Developed through implementation of customized scripts, exporters, and external client software
- Merges art content creation with implementation of complex virtual societal behaviors

Goal:
- Create tool for developing complex behaviors for both individual or groups of virtual characters
- Leverage game based artificial intelligence approach to enhance exposure therapy applications
- Eliminate the repetitive nature of virtual therapy applications which are based purely on pre-rendered, one shot animation authoring

Allows therapist to change mood state of a virtual inhabitants:
- Panic state: Characters fleeing from car bombs
- Hostile state: Characters yell, scream, and raise fists in protest to US incursions
- Docile state: Character go about their daily business (walk, play, shop)

Simulation Asset List

Insertion of Character Navigation Waypoint
Future Research Directions

- Enhancing Therapy
- Assess Acute Stress in Theatre
- Assessment of PTSD post-combat
- Potential Aid for Initial Selection
- Adjunct to Training
  - Stress Inoculation
- Context Relevant Cognitive Tests
Future Research Directions

- Enhancing Therapy
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Future Research Opportunities

- VA and NIMH proposals submitted:
  - Randomized Controlled Trial of CBT with Virtual Reality Exposure Therapy for PTSD
    Michael J. Roy, MD MPH Uniformed Services University of the Health Sciences
  - Preventing PTSD via Exposure to Virtual Combat Games, Brain Imaging Evaluation
    Ute Ritterfeld, Ph.D. University of Southern California
  - VR Augmented Treatment for Combat PTSD: A RCT Examined with MRI
    Steve Baumann, PhD Psychology Software Tools, Inc. and Duke University
  - Virtual Reality Exposure and D-cycloserine for Treating PTSD in Combat Veterans
    Rebekah Bradley, Ph.D. Emory University
  - Psychophysiological Reactivity to Identify and Treat Veterans at Risk for PTSD
    Jeffrey M. Pyne, MD Central Arkansas Veterans Healthcare System
  - Virtual Reality Exposure Therapy for the treatment of PTSD in reservists
    JoAnn Difede, Ph.D. New York Presbyterian Hospital
  - Facilitating PTSD psychotherapy with virtual reality and adjunctive medications
    Mark Barad, MD, Ph.D. Los Angeles Veterans Health Administration Hospital
Why do this work???

- **Ethical** Responsibility to reduce human suffering
- **Selection** and **Stress Inoculation** applications could prevent or lower PTSD incidence and produce soldiers better equipped for combat
- **Healthcare savings** via a reduction in long term service connected disability
- Decrease Training Co$t$ by **Reducing Turnover**
Why do this work???

- Decrease Training Costs by Reducing Turnover
A Psychologist’s DREAM!? 

The capacity to design a functional environment, precisely administer stimuli, and measure, treat and train performance within the environment.
Demo

At the cyberarium!
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Three-day Symposium
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University of Haifa, Israel
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August, 2006
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ICDVRAT 2006

Denmark
September, 2006
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The Hyatt Regency
Long Beach, California

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"It would be strange, and embarrassing, if clinical psychologists, supposedly sophisticated methodologically and quantitatively trained, were to lag behind internal medicine, investment analysis, and factory operations control in accepting the computer revolution."

Paul Meehl, 1987
CNN Interview

Reuters Story