VIRTUAL REALITY GOES TO WAR

Applications for the Prevention, Assessment and Treatment of PTSD

Skip Rizzo, Ph.D.
University of Southern California
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VIRTUAL REALITY GOES TO WAR

Applications for the Prevention, Assessment and Treatment of PTSD

Skip Rizzo, Barbara Rothbaum, JoAnn Difede, Greg Reger, Josh Spitalnick, Kevin M. Holloway, Judith Cukor, Maryrose Gerardi, Arno Hartholt, Brad Newman, Mike Roy, Clarke Lethin, Kevin Feeley & Russell Shilling

USC-Institute for Creative Technologies, Emory University, Weill Medical College at Cornell, NMCSD, Virtually Better, Inc., WRAMC, T2-Ft. Lewis, DARPA
VIRTUAL REALITY GOES TO WAR
Applications for the Prevention, Assessment and Treatment of PTSD

Talk Outline:
- Introduction
- PTSD VR Exposure Therapy
- Related Efforts
  - Cognitive Assessment
  - RCTs
  - fMRI Studies
- PTSD Assessment
- System Update
- Resilience Training
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  - System Update
- Resilience Training
Medical VR Research Group

Skip Rizzo, Belinda Lange, Galen Buckwalter, Eric Forbell, Sebastian Koenig, Kevin Feeley, Jack Mondonedo, Luke Yeh & Kevin Chang

Project Areas

Psychological

Motor

Virtual Humans

Virtual Patient

SimCoach

VR EXPOSURE THERAPY

ADHD Assessment

Cognitive

Motor

Virtual Humans

Post Stroke Rehab
Interdisciplinary Expertise

Skip Rizzo, Ph.D., MedVR Director
  Clinical, Neuro, Experimental Psychology

Belinda Lange, Ph.D.
  Physical Therapy, VR Design & Evaluation

J. Galen Buckwalter, Ph.D.
  Clinical, Neuro Psychology

Sebastian Koenig, Ph.D.
  Experimental Neuropsychology, VR Development

Thomas Talbot, M.D.
  Principal Medical Expert

Kevin Feeley, M.P.S.
  Project/Creative Management

Jack Mondenedo
  Project/Financial Management

Eric Forbell
  Computer Science, Software Engineering
But it does drive advances:

- **Medicine**
- **Psychology**
- **Neuropsychology**
- **Rehabilitation**

**Wound to Kill Ratios**

- Civil War = 0.7
- WWII = 2.4
- Korea = 2.6
- Vietnam = 3.0
- OIF/OEF = 9

(Fischer, Klarman, and Oboroceanu, 2007)
WAR Sucks!

But it does drive advances:

- **WWI** - Army Alpha/Beta Kicks off Civilian IQ Testing Movement
- **WWII** - The birth of Psychology as a clinical profession in the USA & Luria’s groundbreaking work with Russian Vets with TBI sets the stage for clinical neuropsychology!
- **Arab-Israeli Wars** - Further drives developments in Neuropsychological Rehabilitation
- **Vietnam War** - Drove recognition of PTSD as a clinical disorder
- **OIF/OEF** - Will it drive advances in technology for TBI, PTSD, Prosthetics, Rehab?
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The aim of exposure is to help the patient to confront the feared stimulus in order to correct the dysfunctional *associations* that have been established between the stimulus and perceived *threat* (e.g., it is dangerous, I can’t cope).
Virtual Reality Exposure Therapy for Anxiety Disorders

- Heights
- Flying
- Driving
- Spiders/snakes
- Public Speaking
- Claustrophobia
- Generalized Social Phobia
- Panic Disorder w/Agoraphobia
- Posttraumatic Stress Disorder
VR Claustrophobia Application
(Botella et al)

1997
New version of the Virtually Better Inc. Fear of Flying Application
New versions of the Virtually Better Inc. Social Phobia/Addiction Applications
20th Century

21st Century
Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: A meta-analysis

Thomas D. Parsons*, Albert A. Rizzo

Institute for Creative Technologies, University of Southern California, 13274 Fiji Way, Office 301, Marina del Rey, CA 90292-4019, USA

Received 24 October 2006; received in revised form 6 July 2007; accepted 18 July 2007

Abstract

Virtual reality exposure therapy (VRET) is an increasingly common treatment for anxiety and specific phobias. Lacking is a quantitative meta-analysis that enhances understanding of the variability and clinical significance of anxiety reduction outcomes after VRET. Searches of electronic databases yielded 52 studies, and of these, 21 studies (300 subjects) met inclusion criteria. Although meta-analysis revealed large declines in anxiety symptoms following VRET, moderator analyses were limited due to inconsistent reporting in the VRET literature. This highlights the need for future research studies that report uniform and detailed information regarding presence, immersion, anxiety and/or phobia duration, and demographics.

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Keywords: Virtual reality; Exposure; Anxiety; Phobia; Meta-analysis

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Review

Virtual reality exposure therapy for anxiety disorders: A meta-analysis

Mark B. Powers*, Paul M.G. Emmelkamp

University of Amsterdam, The Netherlands

Received 1 March 2007; received in revised form 11 April 2007; accepted 20 April 2007

Abstract

There is now a substantial literature investigating virtual reality exposure therapy (VRET) as a viable treatment option for anxiety disorders. In this meta-analysis we provide effect size estimates for virtual reality treatment in comparison to in vivo exposure and control conditions (waitlist, attention control, etc.). A comprehensive search of the literature identified 13 studies (n = 397) that were included in the final analyses. Consistent with prediction the primary random effects analysis showed a large mean effect size for VRET compared to control conditions, Cohen’s $d = 1.11$ (S.E. = 0.15, 95% CI: 0.82–1.39). This finding was consistent across secondary outcome categories as well (domain-specific, general subjective distress, cognition, behavior, and psychophysiology). Also as expected in vivo treatment was not significantly more effective than VRET. In fact, there was a small effect size favoring VRET over in vivo conditions, Cohen’s $d = 0.35$ (S.E. = 0.15, 95% CI: 0.05–0.65). There was a trend for a dose–response relationship with more VRET sessions showing larger effects ($p = 0.06$). Outcome was not related to publication year or sample size. Implications are discussed.

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Keywords: Virtual reality; Exposure; Anxiety; Meta-analysis
**VR Anxiety Disorders Meta-Analysis**

Table 2: The Average Random Effect Sizes, including the Variance and Confidence Limits for the Mean Effect Sizes, for the Affective Domains and the Anxiety Total.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Average Random Effect Size</th>
<th>Effect Size Variance</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
<th>r</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTSD</td>
<td>0.94</td>
<td>0.01</td>
<td>0.78</td>
<td>1.10</td>
<td>0.42</td>
<td>0.18</td>
</tr>
<tr>
<td>Social phobia</td>
<td>0.96</td>
<td>0.10</td>
<td>0.34</td>
<td>1.59</td>
<td>0.43</td>
<td>0.19</td>
</tr>
<tr>
<td>Arachnophobia</td>
<td>0.92</td>
<td>0.12</td>
<td>0.25</td>
<td>1.59</td>
<td>0.42</td>
<td>0.18</td>
</tr>
<tr>
<td>Acrophobia</td>
<td>0.93</td>
<td>0.06</td>
<td>0.44</td>
<td>1.43</td>
<td>0.42</td>
<td>0.18</td>
</tr>
<tr>
<td>Panic disorder with agoraphobia</td>
<td>1.79</td>
<td>0.02</td>
<td>1.52</td>
<td>2.06</td>
<td>0.67</td>
<td>0.44</td>
</tr>
<tr>
<td>Aerophobia</td>
<td>1.75</td>
<td>0.07</td>
<td>1.25</td>
<td>2.26</td>
<td>0.66</td>
<td>0.43</td>
</tr>
<tr>
<td>Anxiety Total</td>
<td><strong>0.96</strong></td>
<td><strong>0.02</strong></td>
<td><strong>0.68</strong></td>
<td><strong>1.25</strong></td>
<td><strong>0.43</strong></td>
<td><strong>0.19</strong></td>
</tr>
</tbody>
</table>

Note: All reported random effect sizes reflect large effects for VRET on decrease of negative affective symptoms. PTSD = Post-Traumatic Stress Disorder. % = percent of variance accounted for by VRET. The average weighted effect sizes were calculated for each of the six affective domains and an overall affective effect size (Anxiety Total). This involved combining the standardized effect sizes within each affective domain (within and across domains for Anxiety total) into a composite-mean weighted effect size, and examining each domain’s significance. Total N= 266.
Virtual reality exposure therapy (VRET) is a promising intervention for the treatment of the anxiety disorders. The main objective of this meta-analysis is to compare the efficacy of VRET, used in a behavioral or cognitive-behavioral framework, with that of the classical evidence-based treatments, in anxiety disorders. A comprehensive search of the literature identified 23 studies (n = 608) that were included in the final analysis. The results show that in the case of anxiety disorders, (1) VRET does far better than the waitlist control; (2) the post-treatment results show similar efficacy between the behavioral and the cognitive behavioral interventions incorporating a virtual reality exposure component and the classical evidence-based interventions, with no virtual reality exposure component; (3) VRET has a powerful real-life impact, similar to that of the classical evidence-based treatments; (4) VRET has a good stability of results over time, similar to that of the classical evidence-based treatments; (5) there is a dose–response relationship for VRET; and (6) there is no difference in the dropout rate between the virtual reality exposure and the in vivo exposure. Implications are discussed. Depression and Anxiety 29:85–93, 2012.
Virtual Reality Exposure Therapy for Anxiety Disorders

- Heights
- Flying
- Driving
- Spiders/snakes
- Public Speaking
- Claustrophobia
- Generalized Social Phobia
- Panic Disorder w/Agoraphobia
- Posttraumatic Stress Disorder
Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care

Charles W. Hoge, M.D., Carl A. Castro, Ph.D., Stephen C. Messer, Ph.D., Dennis McGurk, Ph.D., Dave I. Cotting, Ph.D., and Robert L. Koffman, M.D., M.P.H.

“...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%)” (Hoge et al., 2004)
Overall Mental Health Diagnoses = 31%
One In Five Iraq and Afghanistan Veterans Suffer from PTSD or Major Depression

Nearly 20 percent of military service members who have returned from Iraq and Afghanistan — 300,000 in all — report symptoms of post traumatic stress disorder or major depression, yet only slightly more than half have sought treatment, according to a new RAND Corporation study.

In addition, researchers found about 19 percent of returning service members report that they experienced a possible traumatic brain injury while deployed, with 7 percent reporting both a probable brain injury and current PTSD or major depression.

Many service members said they do not seek treatment for psychological illnesses because they fear it will harm their careers. But even among those who do seek help for PTSD or major depression, only about half receive treatment that researchers consider "minimally adequate" for their illnesses.
The committee reviewed 53 studies of pharmaceuticals and 37 studies of psychotherapies used in PTSD treatment and concluded that because of shortcomings in many of the studies, there is not enough reliable evidence to draw conclusions about the effectiveness of most treatments. There are sufficient data to conclude that exposure therapies -- such as exposing individuals to a real or surrogate threat in a safe environment to help them overcome their fears -- are effective in treating people with PTSD.
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).
Edna Foa

Human beings are hardwired to fear things — the lion in the grass, the assailant in the alley — and if one of those fears gets realized, we may never settle down again. The pain associated with that condition is known as posttraumatic stress disorder (PTSD), a mix of depression, anxiety, anger and isolation. No one is doing more to end that suffering than psychologist Edna Foa, 72, of the University of Pennsylvania.

The severity of PTSD is matched by the horror of the things that set it off — rape, childhood sexual abuse, natural disasters. And then there's war. Half a million veterans from the Vietnam era alone may suffer from PTSD — and up to 300,000 from the wars in Afghanistan and Iraq. Too many cope with the disorder by working to exhaustion, drinking to unconsciousness and never, ever talking.
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 World - *Universitat de València (Spain)*
- Virtual Angola - *U. of Lusófona de Humanidades e Tecnologias, Lisbon*
- Virtual Iraq - *USC Institute for Creative Technologies*
VIRTUAL IRAQ/AFGHANISTAN

Funded by:

[Logos of various organizations]
Virtual Iraq/Afghanistan

Skip Rizzo, Barbara Rothbaum, JoAnn Difede, Greg Reger, Josh Spitalnick, Kevin M. Holloway, COL. Mike Roy, COL. Greg Gahm & CDR. Russell Shilling

USC-Institute for Creative Technologies, Emory University, Weill Medical College at Cornell, NMCSD, Virtually Better, Inc., WRAMC, MAMC-Ft. Lewis
Major Goal: Customize Graduated Exposure based on Patient Needs

- Multiple Scenario Settings
- Selectable User Perspective Options
- Library of “Trigger” Stimuli
- Highly Usable “Wizard of OZ” Clinician Interface
- Integrate Scent, Vibration and Phys. Props
- Use Physiological Monitoring to Assess User State in Session

Virtual Iraq

Global PTSD Requirements

National Defense

Unmanned Aviation Turf War Over?
Scientists Ponder Lighter Chem-Bio Suits

Hidden Wounds
To heal mental scars, soldiers relive sights and sounds of war in ‘Virtual Iraq’
FULL SPECTRUM WARRIOR
X-Box Game Conversion for Iraq War PTSD clients!
FULL SPECTRUM WARRIOR

X-Box Game Conversion for Iraq War PTSD clients!
TATRC-Funded User Centered Design Protocol in Iraq

CPT. GREG REGER PH.D.
98TH MED DET.
COMBAT STRESS CONTROL TEAM
TALLIL AB LSA ADDER IRAQ
User-Centered Feedback from Iraq and MAMC-Ft. Lewis

- HMD comfort = 7.2/10
- Tracking update = 7.4/10
- Graphic realism = 6.7/10
- Audio realism = 7.2/10
- Navigation = 6.2/10
- Side effects = 3/27; 1DC
- Much useful qualitative feedback on architecture, olfactory cues, human content, landscape, etc.

Reger, Gahm, Rizzo, Swanson & Duma
Soldier Evaluation of the Virtual Reality Iraq

In: Telemedicine and E-Health
Virtual Iraq

Time of Day and Weather Controls
Virtual Iraq

City Scenario
Virtual Iraq

Desert Highway Checkpoint
Virtual Iraq

Bridge Attack
Afghanistan-like Content Added
Virtual Iraq/Afghanistan
Various City and Desert Scenes

Safe USA Desert Environment
24 Block Iraq/Afghanistan City
Different User Perspectives
Provocative “Fog of War” Settings
Virtual Iraq/Afghanistan

New Build Prototype

Foot Patrol in Middleast City

Vehicle Borne IED

Afghanistan Humvee Drive Through

Night Vision Setting
Need to Guard Against the perception that VR Tools are designed to eliminate the need for a Well Trained Clinician.

Technology doesn’t “fix” anyone, it is simply a tool for extending the skill of a clinician.
“Wizard of OZ”
Clinician Interface

- **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

Wireless Tablet Option
“Wizard of OZ”
Clinician Interface
“Wizard of OZ” Clinician Interface
NATURAL NAVIGATIONAL CONTROL

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

Scent and Vibration

Night Vision

HMD

Rig

Courtesy of Quantum 3D

Base Shaker

Platform

Integrate Scent and Vibration

Natural Navigational Control

Graphic Rendering by:
Clinical Research

Skip Rizzo, Barbara Rothbaum, JoAnn Difede, Greg Reger CTR, Josh Spitalnick, Rob Mclay LCDR, Kevin Holloway, Judith Cukor Maryrose Gerardi, Mike Roy COL, Greg Gahm COL, & Russell Shilling CDR
Emory University (Rothbaum et al)
Clinician Administered PTSD Scale (CAPS)
PreTreatment & PostTreatment

PTSD Checklist-Military (PCL-M)
PreTreatment & PostTreatment

Open Clinical Trial Protocol  
Naval Medical Center San Diego  

- **Session 1**  
  - Clinical interview to identify the index trauma, provide psychoeducation on trauma and PTSD, and instruction on a deep breathing technique for general stress management purposes.

- **Session 2**  
  - Provide instruction on the use of Subjective Units of Distress (SUDS), the rationale for prolonged exposure (PE), including imaginal exposure and in-vivo exposure. First experience with imaginal exposure of the index trauma and in-vivo hierarchy exposure list was constructed with the first item assigned as homework.

- **Session 3**  
  - Present rationale for VRET and have the participant experience the VR environment without recounting the index trauma narrative for approximately 25 minutes with no provocative trigger stimuli introduced. The purpose of not recounting the index trauma was to allow the participant to navigate Virtual Iraq in an exploratory manner and to function as a “bridge session” from imaginal alone to imaginal exposure combined with virtual reality.

- **Sessions 4-10**  
  - Focus on engagement in Virtual Iraq while recounting the trauma narrative
### Demographics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment Completers n=20</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>19 (95%)</td>
</tr>
<tr>
<td>Female</td>
<td>1 (5.0%)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>28.1 (sd=8.4)</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>14 (70%)</td>
</tr>
<tr>
<td>Divorced</td>
<td>2 (10%)</td>
</tr>
<tr>
<td>Widowed</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Separated</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Never been</td>
<td>2 (10%)</td>
</tr>
<tr>
<td><strong>Years Service</strong></td>
<td>8.4 (7.8)</td>
</tr>
<tr>
<td><strong>Months since last DEPLOYMENT</strong></td>
<td>8.3 (2.5)</td>
</tr>
<tr>
<td><strong>DEPLOYMENTS (# in career)</strong></td>
<td>2.6 (2.1)</td>
</tr>
<tr>
<td><strong>Branch</strong></td>
<td></td>
</tr>
<tr>
<td>Army</td>
<td>2 (10%)</td>
</tr>
<tr>
<td>Marines</td>
<td>18 (90%)</td>
</tr>
<tr>
<td><strong>Rank</strong></td>
<td></td>
</tr>
<tr>
<td>E1-E2</td>
<td>2 (10%)</td>
</tr>
<tr>
<td>E3-E4</td>
<td>9 (45%)</td>
</tr>
<tr>
<td>E5-E6</td>
<td>6 (30%)</td>
</tr>
<tr>
<td>E7-E9</td>
<td>3 (15%)</td>
</tr>
</tbody>
</table>

All subjects had been unsuccessful at some form of previous treatment!
16 of 20 No Longer meet DSM criteria for PTSD at Post-TX

Naval Med Center SD/Camp Pendleton
PTSD Checklist-Military (PCL-M)
PreTreatment, PostTreatment & 3 Month Follow-up

Naval Med Center SD/Camp Pendleton
PTSD Checklist-Military (PCL-M)
PreTreatment, PostTreatment & 3 Month Follow-up

16 Successful Treatment Completers n=20
Average # of Sessions < 11

Assessment over Time
Beck Anxiety & PHQ Depression
Pre-Treatment, Post-Treatment & 3 Month Follow-up

Naval Med Center SD/Camp Pendleton

16 of 20 No Longer meet DSM criteria for PTSD at Post-TX

Pre-Treatment
Post-Treatment
3 Month FU

Treatment Completers n=20
Average # of Sessions < 11

Treatment Completers \( n=24 \)
Average # of Sessions < 7.4

**Pre-Treatment & Post-Treatment**

- **Effect Size**
  - \( d = 1.17 \)
  - Reliable Improvement Index = 62%

Prolonged Exposure VR Exposure

Pre-Treatment
Post-Treatment & 3 Month Follow-up

Naval Med Center SD/Camp Pendleton
Clinician Administered PTSD Scale (CAPS)
PreTreatment, PostTreatment & 3 Month Follow-up

VR Produced Significantly Better Follow-Up Outcomes Compared to Traditional Prolonged Exposure

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!

VR Post Deployment Reset Training
User Comments...

CBC National

PBS Frontline

CNN-Sanjay Gupta Reports

CNN

CNN

CBC Nightline
First Air Date: June 19, 2012
Clinical/Research Test Sites

**DOD Sites:**
- Naval Medical Center San Diego
- Walter Reed Army Medical Ctr
- Madigan Army Medical Ctr
- Camp Pendleton Ft. Sill
- Travis AFB
- McGuire AFB
- Eglin AFB
- Andrews AFB
- Langley AFB
- Elmendorf AFB
- Lackland AFB
- Wright Patterson AFB
- Moody AFB
- Ramstein AFB

**Private/University Affiliated:**
- Weill Medical College of Cornell
- Emory University
- Institute of Living, Hartford Hospital
- SUNY- Upstate Medical University
- Alexian Neurosciences Institute
- Hofstra University
- St. Johns University
- Medical University of S. Carolina
- University of Central Florida
- Cedar Springs Hospital

**Veteran’s Affairs**
- Ann Arbor VA
- Atlanta VA
- Baltimore VAMC
- Bronx VA
- Brooklyn VA
- Colchester VA
- Central Arkansas VA
- Dayton VA
- Houston VA
- Long Beach VAMC
- Madison VA
- Manhattan VA
- Montrose VA
- Providence VA
- Shreveport VA
- San Antonio VA
- Washington DC VA
- West Los Angeles VAMC
- White River Jct. VA

**International Sites:**
- University of Reading, UK
- Babes-Bolyai University, Romania
- Czech Central Military Hospital

**Contact:**
Skip Rizzo - arizzo@usc.edu
Josh Spitalnick - spitalnick@virtuallybetter.com

Seven more sites pending funding
VIRTUAL REALITY GOES TO WAR

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  - fMRI Studies
  - PTSD Assessment
  - System Update
- Resilience Training
Research Activities Spawned from Virtual Iraq

- Military Cognitive Test in VR (w/ Parsons et al)
- Randomized Controlled Trials (RCT) (w/ Reger et al; Beidel et al)
- Enhancing Therapy w/D-Cycloserine (RCT) (w/ Difede/Rothbaum et al)
- PTSD/TBI fMRI Trial (w/ Roy et al)
- Exploratory fMRI Project (w/ Damasio & Damasio)
- Assessment of PTSD Post-Deployment (w/ Unger et al; Roy et al; Pollack et al.)
- Rebuild/Update of Virtual Iraq/Afghanistan (Rizzo et al.)
- Spherical Video and CAVE Version (w/ Loesberg & Sharkey)
- Stress Resilience Training (w/ Lethin et al)
Military Cognitive Test in VR
(w/ Parsons et al)

Better prediction of real world cognitive performance within highly controllable context relevant VR simulations

- Enhanced Ecological Validity
- Flexible Stimulus Delivery
- Advanced Response Capture
- Psychophysiological Integration Options
Military Cognitive Test in VR
(w/ Parsons et al)
4 Randomized Controlled Trials (RCT) at Ft. Lewis, Ft. Bragg (Reger et al) & UCF (Biedel et al)
Military Cognitive Test in VR (w/ Parsons et al)

Randomized Controlled Trials (RCT) (w/ Reger et al; Beidel et al)

Enhancing Therapy w/D-Cycloserine (RCT) (w/ Difede/Rothbaum et al)

Research Activities Spawned from Virtual Iraq

- PTSD/TBI fMRI Trial (w/Roy et al)

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES
Issue: Psychiatric and Neurologic Aspects of War
Improvement in brain function with PTSD treatment

Figure 1. fMRI before versus after treatment, activation across areas of interest.
Research Activities Spawned from Virtual Iraq

- Military Cognitive Test in VR (w/ Parsons et al)
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- PTSD/TBI Trial (w/ Roy et al)
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- Stress Resilience Training (w/ Lethin et al)
A Virtual Test for Post-Traumatic Stress Disorder

Researchers hope the use of multiple sensors will result in a more objective way of diagnosing this anxiety disorder.

By combining virtual reality with data from physiological sensors, researchers at Draper Laboratory are trying to develop a new way to diagnose post-traumatic stress disorder (PTSD), in which people who have undergone a traumatic event experience it again and again.

The research is of particular interest to the military, because many fighters returning from Iraq and Afghanistan have PTSD. Many have also been subjected to explosions or other trauma, often resulting in mild traumatic brain injury. The two disorders have similar symptoms but require different treatments, so accurate diagnosis is crucial.

A diagnosis of PTSD is currently based on interviews with a physician and the presence of certain symptoms, such as flashbacks of the trauma and difficulty in sleeping and concentrating. But if the disorder could be diagnosed more precisely and objectively, it could help physicians distinguish PTSD from other disorders, and also help in assessing the effectiveness of specific treatments.
Research Activities Spawned from Virtual Iraq

- Military Cognitive Test in VR (w/ Parsons et al)
- Randomized Controlled Trial (RCT) (w/ Reger et al)
- PTSD/TBI Trial (w/ Roy et al)
- Enhancing Therapy w/D-Cycloserine (RCT) (w/ Difede/Rothbaum et al)
- Exploratory fMRI Project (w/ Damasio & Damasio)
- Assessment of PTSD Post-Deployment (w/ Unger et al; Roy et al; Pollack et al.)
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Research Activities Spawned from Virtual Iraq

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- Spherical Video and CAVE Version (w/Loesberg & Sharkey)
- Stress Resilience Training (w/Lethin et al.)
VIRTUAL IRAQ/AFGHANISTAN
NEW BUILD PROTOTYPE

University of Southern California

ICT INSTITUTE FOR CREATIVE TECHNOLOGIES

MedVRlab
VIRTUAL IRAQ/AFGHANISTAN
NEW BUILD PROTOTYPE

University of Southern California

ICT
INSTITUTE FOR CREATIVE TECHNOLOGIES

MedVR lab

USC
VIRTUAL IRAQ/AFGHANISTAN
NEW BUILD PROTOTYPE
Virtual Iraq/Afghanistan

New Build Prototype

Afghan Village

Exiting Humvee & Foot Patrol

Checkpoint Patrol in Middleast Suburb

Moving Turret
VIRTUAL IRAQ/AFGHANISTAN
NEW BUILD PROTOTYPE
<table>
<thead>
<tr>
<th>Research Activities Spawned from Virtual Iraq</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Military Cognitive Test in VR (w/ Parsons et al)</td>
</tr>
<tr>
<td>- Randomized Controlled Trial (RCT) (w/ Reger et al)</td>
</tr>
<tr>
<td>- PTSD/TBI Trial (w/ Roy et al)</td>
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<tr>
<td>- Enhancing Therapy w/ D-Cycloserine (RCT) (w/ Difede/Rothbaum et al)</td>
</tr>
<tr>
<td>- Exploratory fMRI Project (w/ Damasio &amp; Damasio)</td>
</tr>
<tr>
<td>- Assessment of PTSD Post-Deployment (w/ Unger et al; Roy et al; Pollack et al.)</td>
</tr>
<tr>
<td>- Rebuild/Update of Virtual Iraq/Afghanistan (Rizzo et al.)</td>
</tr>
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</table>
STRIVE: STRESS RESILIENCE IN VIRTUAL ENVIRONMENTS

Skip Rizzo, Ph.D.
Associate Director Medical VR
Institute for Creative Technologies
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J. Galen Buckwalter, Ph.D.
Research Scientist
Institute for Creative Technologies
University of Southern California
THE Emotional OBSTACLE COURSE
"...we are moving beyond a “treatment-centric” approach to one that focuses on prevention and on the enhancement of the psychological strengths already present in our soldiers.”

STRIVE: STRESS RESILIENCE IN VIRTUAL ENVIRONMENTS

- STRIVE is an immersive INTERACTIVE NARRATIVE using Virtual Iraq/Afghanistan Exposure Therapy content to create a series of 30 “Band of Brothers” type episodes that conclude with exposure to stressful situations not unlike what SMs would experience in OIF/OEF.

The episodes can be seen as stations in an emotional obstacle course.

- Coping Skills that underlie psychological fitness and resilience will be trained in the context of this simulation under controlled conditions drawing from evidence-based approaches endorsed by the DOD and from other sources.

**Warning: Some X-Rated Language Ahead**

**IED ATTACK**

**CIVILIAN DEATH**
STRIVE: STRESS RESILIENCE IN VIRTUAL ENVIRONMENTS

- Virtual Human (VH) Characters are being scripted as squad members. Users will develop emotional connections with these VH characters as the episodes evolve in this interactive narrative.

- Virtual Mentor Character conducts the AAR debrief immediately after the incident and guides the user through the training content (e.g., psychoeducational, physio self-awareness, mindfulness, stress management tactics, Positive Psychology CBT activities)

- Visualizations used to support learning
STRIVE: STRESS RESILIENCE IN VIRTUAL ENVIRONMENTS

- Cinematic Strategies (narration, constrained emphasis, aerial camera fade-outs) will support user engagement and direct attention within the interactive narrative.

Video Storyboards of Episode 2 (in Progress)
STRIVE: STRESS RESILIENCE IN VIRTUAL ENVIRONMENTS

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Outcome and CBT Mentor Intro

Video Storyboards of Episode 2 (in Progress)
STRIVE: STRESS RESILIENCE IN VIRTUAL ENVIRONMENTS

Episodes in Development

Ep 1: Humvee – “RoadKill”
Ep 2: Humvee – “First Hit”
Ep 3: Dismounted Patrol – “Culture Shock”
Ep 4: Dismounted Patrol – “The Innocent”
Ep 5: Dismounted Patrol – “A Live One, A Dead One”
Ep 6: FOB – “Movin’ On with Loss”

In both Soldier and Marine Formats
STRIVE
STress Resilience In Virtual Environments

Applied and Basic Science for Promoting and Understanding Stress Resilience

Leverages ICT Advanced Tech & Unique Expertise

Informed Design & Efficient ReUse of Assets

30 Episode Interactive Narrative & Virtual Human Agent Mentors

Informed by Theory & Experimental Behavioral Science

Objective Measurement & Basic Science

Behavioral Theory on Latent Inhibition & State Dependent Learning

Physiological Assessment of Stress Response and Allostatic Load

THE EMOTIONAL OBSTACLE COURSE

Built off Virtual Iraq/Afghanistan Exposure System

MedVRlab
STRIVE: STRESS RESILIENCE IN VIRTUAL ENVIRONMENTS

- Key Biomarkers will be measured that have been demonstrated to predict poor stress response, including PTSD (Allostatic Load).
- Systematic Measurement of psychophysiological and hormonal aspects of acute stress before and during stress exposure and during stress resilience training.
VR can be safely used with persons having Anxiety Disorders and PTSD

VR Exposure Therapy, NOT “VR Therapy”

VR is MORE effective than imaginal exposure

VR is AS effective as in-vivo exposure

Doesn’t have to be an exact replica of reality to have a positive TX effect

VR is a TOOL to extend the skills of a well trained clinician

VR Tools can be multipurposed to save $$
Virtual Human Patients to Teach Clinical Interviewing Skills

USC Institute for Creative Technologies
USC School of Social Work
USC Department of Psychiatry

Patrick Kenny – ICT
Skip Rizzo – ICT
Thomas Parsons – ICT
Marilyn Flynn – Social Work

Carolyn Pataki – Dept of Psychiatry
Michele Pato – Dept of Psychiatry
Cheryl St George – Dept of Psychiatry
Jeff Sugar – Dept of Psychiatry

The projects or efforts depicted were or are sponsored by the U.S. Army Research, Development, and Engineering Command (RDECOM), and/or the US Army Research Institute. The content or information presented does not necessarily reflect the position or policy of the Government, and no official endorsement should be inferred.
This initial work drove the establishment of the Virtual Patient Project.

Key components:
- **Marketing**
- **Research**
- **Virtual Humans**
- **Training**
- **Support**

**Virtual Patients**:
- Dr. Perez (SASO-ST, SASO-EN)
- Elder-Al-Hassan (SASO-EN)
- Sgt. Star
- Gunslinger
- Radiobots (JFETS Training)
- Justina (Virtual Patient)
- Justin (Virtual Patient)
- Sgt. Blackwell
- Veterans Center
- SimCoach
- ELECT Bi-Lat

**Other Components**:
- C3IT Cultural training
- Emotional Dialog Modeling
- Rapport Agent Study
- Tactical Questioning
- Museum Guide & Coach
- Radiobots (JFETS Training)

**Virtual Humans** represent a portfolio of characters designed for various applications.
Virtual Patients Lab

Virtual Patients – Military and Civilian Applications

Collaboration with the USC School of Social Work
Masters in Military Social Work Program

SickCall

Justin

Justina

Virtual Patients w/USC Psychiatry

USC Social Work Military MSW Program

Virtual Patients Lab

Virtual Patients Lab

Virtual Patients Lab
### Results of VP Q/R Clusters

A summary of relations between each cluster of Question/Response pairs for the DSM Categories:

<table>
<thead>
<tr>
<th>Category</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Trauma</td>
<td>.45</td>
</tr>
<tr>
<td>(B) Re-experience</td>
<td>.55</td>
</tr>
<tr>
<td>(C) Avoidance</td>
<td></td>
</tr>
<tr>
<td>(D) Other</td>
<td></td>
</tr>
<tr>
<td>(G) Communication</td>
<td>.56</td>
</tr>
<tr>
<td>(H) Other</td>
<td></td>
</tr>
</tbody>
</table>

Moderate effects existed between User Questions and VR Response pairs.

Effect size: Small .2 | Moderate .5 | Large .8

Clinicians ask similar questions for Diagnostic Interviews with Virtual Humans as with the real thing!

[Rizzo, Parsons & Kenny, 2010]
SimCoach - An Intelligent Virtual Agent for Healthcare Support

USC Institute for Creative Technologies

Breaking Down Barriers to Care in Service Members, Veterans and their Families
Problem to be Solved—Barriers to Care

- For Service Members, Veterans and their Families, the need for healthcare information is growing at an astounding rate.
- Since 2004, numerous blue ribbon panels of experts have assessed the current DOD and VA healthcare delivery system and provide recommendations for improvement.
- The consistent theme across these reports:
  - Need to improve healthcare dissemination and delivery system
  - Need to improve awareness and access to care
  - Reduce the Stigma of help-seeking.
- New methods are required to reduce barriers to care.
An online intelligent, interactive Virtual Human Agent program

Designed to attract and engage Service Members and their significant others who might not otherwise seek help

Create an experience that will motivate users to take the first step to empower themselves with regard to their Healthcare

Support users' efforts to understand their situation better, explore available options and initiate the treatment process when needed.

SimCoach will not provide diagnostic or therapy services.
But it does drive advances:

- **WWI** - Army Alpha/Beta Kicks off Civilian IQ Testing Movement
- **WWII** - The birth of Psychology as a clinical profession in the USA & Luria’s groundbreaking work with Russian Vets with TBI sets the stage for clinical neuropsychology!
- **Arab-Israeli Wars** - Further drives developments in Neuropsychological Rehabilitation
- **Vietnam War** - Drove recognition of PTSD as a clinical disorder
- **OIF/OEF** - Will it drive advances in TBI, PTSD, Prosthetics, Rehab, DCAPS??
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A Psychologist’s Dream?

The capacity to design a simulated environment, precisely administer stimuli, and measure, treat and train performance within the environment.
So, Tell me about your mother?

Traditional Approaches
Need to Guard Against the perception that VR Tools are designed to eliminate the need for a Well Trained Clinician.

Technology doesn’t “fix” anyone, it is simply a tool for extending the skill of a clinician.
“A new century is at hand, and a fast-spreading technology promises to change society forever. It will let people live and work wherever they please, and create dynamic new communities linked by electronics.”

- An article about the telephone, 1898
SOCIETY FOR 
TECHNOLOGY AND 
PSYCHOLOGY

New APA Division Forming
Please sign our petition!

http://stp-apa.net/

"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
A Copy of this talk is available for all attendees. Please cite the source if you use any of the materials from this talk.
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Research Professor - Dept. of Psychiatry and School of Gerontology
University of Southern California
Los Angeles, CA., USA
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