Integrative approach to PTSD and aggression

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Definitions

- aggression
  - not easily defined
  - refer to verbal aggression, physical aggression towards people or objects
Definitions

– includes the intent to harm or otherwise injure another person
– different types of behaviors are aggressive even though they do not involve physical injury (verbal aggression, coercion, intimidation, social ostracism...)¹
– some authors include self directed aggression
– violence – physical aggression towards other person

Predictors of aggression

- aggressive acts – mostly against persons they know
- probability of aggressive behavior increases when
  - person become psychologically decompensated, or
  - when the onset of a mental disorder is rapid
- any given set of conditions that are increasing aggressive impulses and decreasing self control can lead to aggressive acts
Predictors of aggression

- some predictors of dangerousness to others$^1$
  - high degree of intent to harm
  - presence of a victim
  - frequent and open threats
  - concrete plan
  - access to instruments of violence
  - history of loss of control
  - chronic anger, hostility or resentment
  - enjoyment in watching or inflicting harm
  - lack of compassion

Predictors of aggression

• some predictors of dangerousness to others (cont)
  – self view as a victim
  – resentful of authority
  – childhood brutality or deprivation
  – decreased warmth and affection in home
  – early loss of parent
  – fire setting, bed wetting and cruelty to animals
  – reckless driving

• the best predictor is a history of violent behavior
Predictors of aggression

- also important
  - psychiatric disorders with delusions and hallucinations
  - alcohol or drug intoxication, abuse or dependence
  - lack of impulse control
  - antisocial personality traits
  - environmental factors – family or social environment
Psychological factors

Instinctive behavior

• S. Freud
  – different views
  – aggression – stems from the redirection of the self-destructive death instinct away from the self and toward others

• K. Lorenz
  – aggression – from a fighting instinct that humans share with other organisms
Psychological factors

Learned behavior

• aggression is a learned form of social behavior
  – acquired and maintained as other forms of activity
• A. Bandura
  – persons engage in assaults because they
    • acquired aggressive responses through past experience
    • receive or anticipate various forms of reward for such actions
    • directly instigated to aggression by specific social or environmental conditions
Social factors

**Frustration**

- the single most potent means of inciting human beings to aggression
- frustrated persons do not always respond with aggression
  - resignation, depression, despair
• important factors
  – frustration increase aggression when the frustration is intense, and
  – frustration is likely to facilitate aggression when it is perceived as arbitrary or illegitimate
Social factors

Direct provocation
- physical or verbal abuse

Television violence
- link between aggression and exposure to televised violence

Environmental factors
Noise
Crowding
Situational factors

**Physical arousal**
- competitive activities
- exercise
- provocative films

**Sexual arousal**

**Pain**
- may lead to aggression against any target – including the ones that are not involved in persons discomfort
Biological factors

*Neurotransmitters*¹

- induction of aggression – cholinergic and catecholaminergic systems
- inhibiting aggression – serotonergic and GABA systems

Biological factors

• dopamine facilitate aggressive behavior
• androgen levels – testosteron
  – some studies showed that increased levels in males are linked with social aggressivity, not necessarily with violence
Biological factors

• serotonin
  – increasing serotoninergic activity → decreasing violence outbursts in psychiatric patients
  – persons with the history of violent behavior → lower CSF serotonin levels
  – some authors point out on increased levels of testosterone and lowered serotonin
  – borderline personality disorders – deficits in central serotoninergic function
Biological factors

Neuroanatomical bases

• model by Davidson et al.\textsuperscript{2, 3}
  – impulsive aggression – arising from dysfunction in a set of interrelated brain structures that regulate emotional processing and reactivity
  • including the prefrontal cortex (orbitofrontal and ventromedial), the anterior cingulate cortex and subcortical-limbic structures (amygdala, hippocampus and hypothalamus)

Biological factors

• subcortical elements play a primary role in activating emotional states, whereas the anterior cingulate and prefrontal cortices detect circumstances under which affective control is needed and to implement control processes

• repetitive episodes of impulsive aggression reflect a breakdown in the normal capacity to recognize and respond to signals of possible provocation as they arise and/or to modulate defensive reactivity
Posttraumatic stress disorder

• DSM IV criteria
  – A. the person has been exposed to a traumatic event
  – B. the traumatic event is persistently reexperienced
  – C. Persistent avoidance of stimuli associated with the trauma and numbing of general responsiveness
Posttraumatic stress disorder

– D. Persistent symptoms of increased arousal
  • difficulty falling of staying asleep
  • irritability or outbursts of anger
  • difficulty concentrating
  • hipervigilance
  • exaggerated startle response
– E. duration more than 1 month
– the disturbance causes clinically significant
distress or impairment in social, occupational,
or other important areas of functioning
Stressor

• stressor alone does not suffice to cause the disorder

• important preexisting
  – biological factors
  – psychosocial factors
  – events before and after the trauma

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Risk factors

- childhood trauma
- personality disorder traits (borderline, paranoid, dependent, antisocial)
- low social support
- female gender
- genetic vulnerability
- stressful life changes
- external locus of control (natural cause) rather than internal (human cause)
- excessive alcohol intake
Biological factors

- stress leads to acute and chronic changes in neurochemical brain systems – which lead to long term changes in brain circuits involved in stress response
- different biological models of PTSD

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4 Vermetten E, Bremner JD. Circuits and systems in stress. II. Applications to neurobiology and treatment of PTSD. Depress Anxiety. 2002;16:14-38.
**Biological factors**

**Neurotransmitters**\(^1,6,7\)

- changes in different neurotransmitter systems
  - noradrenergic
  - dopaminergic
  - serotonergic
  - GABA
  - glutaminergic
  - endogenous opiate system
  - HPA (hypothalamus – pituitary – adrenal) axis

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Biological factors

*Neuroanatomy*\(^8\)

- relatively consistent findings of increased amygdala responsiveness in patients with PTSD
- because of heightened responsiveness of the basic threat circuitry – suggestion of the increased risk for reactive aggression in PTSD patients
- threat stimulus that might elicit freezing in a healthy individual – more likely to elicit reactive aggression in a PTSD patient
  - because the basic threat system is primed to respond by the earlier trauma

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Biological factors

• also associated with decreased responding within regions of the middle prefrontal cortex\(^8\) and orbitoprefrontal dysfunction\(^9\)

• given that these frontal regions may regulate the responsiveness of the basic threat circuitry
  – possible that the increased risk for reactive aggression in PTSD patients reflects a reduction of this frontal regulation


Biological factors

• important distinction – individuals with psychopathic tendencies are at increased risk for reactive and instrumental aggression\(^8\)
  – difference
    • psychopathy is associated with decreased amygdala responsiveness, whereas PTSD is associated with increased amygdala responsiveness
    • therefore dysfunction occurring in psychopathy - incompatible with that observed in PTSD

PTSD and aggression

- similarities – from basic to higher functioning
  - neuroanatomical circuits
  - neurotransmitters (catecholaminergic systems – norepinephrine)
  - physical arousal
  - frustration and social factors
Our studies

- recent study on association of PTSD diagnosis and aggressive traits
  - inpatients treated in Department of psychiatry, University hospital Dubrava
  - part of the larger study, results not yet published
Our studies

• for this study information from each patient was collected using
  – structured psychiatric interview
  – psychiatric and psychological scales
    • Clinician-Administered PTSD Scale (CAPS)\(^9\)
    • Minnesota Multiphasic Personality Inventory-2 – MMPI-2\(^10\)

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Our studies

• diagnosis was made by the psychiatrist using DSM IV TR classification\textsuperscript{11}
• study included 216 patients
  – PTSD patients (n=161)
  – other psychiatric diagnoses (depression, anxiety disorders) (n=55)

Our studies

- possible associations between aggressive items and PTSD diagnosis
  - CAPS item 14 - irritability or outbursts of anger
  - MMPI
    - ASP – antisocial behavior
    - CYN – cynicism
    - ANG – anger
    - PD – psychopathic deviation
Our studies

- results

<table>
<thead>
<tr>
<th>Items</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMPI2 Antisocial behavior</td>
<td>0.824</td>
</tr>
<tr>
<td>Cynicism</td>
<td>0.085</td>
</tr>
<tr>
<td>Anger</td>
<td>0.941</td>
</tr>
<tr>
<td>Psychopathic deviation</td>
<td>0.940</td>
</tr>
<tr>
<td>CAPS Irritability or outbursts of anger</td>
<td>0.002</td>
</tr>
</tbody>
</table>
Our studies

• results
  – only CAPS D criterion - Irritability or outbursts of anger was found as significantly statistically different between two groups
  – MMPI 2 cynicism item close, but not significant
Our studies

- similar as our previous studies - where CAPS criterion D (hyperarousal symptoms) was shown as linked with PTSD diagnoses\(^\text{12}\)

<table>
<thead>
<tr>
<th>Z-score</th>
<th>Attribute</th>
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<tbody>
<tr>
<td>221.43</td>
<td>CAPS criterion D (hyperarousal symptoms)</td>
</tr>
<tr>
<td>190.53</td>
<td>CAPS total score</td>
</tr>
<tr>
<td>164.48</td>
<td>PANSS additional criteria score (anger, difficulty in delaying gratification and affective lability)</td>
</tr>
<tr>
<td>148.10</td>
<td>group of comorbid diagnoses – neurotic, stress-related, and somatoform disorders</td>
</tr>
<tr>
<td>141.78</td>
<td>CAPS criterion C (avoidance symptoms)</td>
</tr>
</tbody>
</table>

Our studies

- similar as our previous studies – results from the technological project, not published

<table>
<thead>
<tr>
<th>Combination of characteristics</th>
<th>Sens. (%)</th>
<th>Specif. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule Characteristic 1 Characteristic 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. MPTSD more than 138.5 weighted CAPS total score more than 161.0</td>
<td>60.8</td>
<td>100.0</td>
</tr>
<tr>
<td>2. CAPS C avoidance an numbing more than 19.5 percentage of disability more than 19.5</td>
<td>47.1</td>
<td>100.0</td>
</tr>
<tr>
<td>3. CAPS D hyperarousal symptoms hypnotics in therapy</td>
<td>52.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>90.2</td>
<td>100.0</td>
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</tbody>
</table>
Conclusions

• possible explanation
  – patients are under continuous psychiatric care
  – improvement in some symptom clusters
  – have social support
  – improvement of socioeconomic status
  – suicidal behavior – diagnosed in a small number of veterans
  → more/less socially compensated in a stable and protective environment
Conclusions

• but – underlying biological features cause irritability or outbursts of anger
• therefore – importance of long term integrated health care
Thank you for your attention!
The Use of Virtual Reality in the Continuum of Care for the Warfighter

Dennis Wood, PhD, and Brenda Wiederhold, PhD
Virtual Reality Medical Center

Presented by
Jim Spira, PhD, MPH, RTI International
Selected examples of the projects and products VRMC and its partners have developed or are developing, include:

- Stress Inoculation Training
- Injury Creation Science
- Combat Medic Training
- Mixed Reality Rehabilitation
- Cognitive Rehabilitation
- Post Traumatic Stress Disorder Treatment
- Pain Distraction Treatments
Overview

- Continuum of Care
  - Support across the range of problems associated with wounds of war
    - Polytrauma vs “pure PTSD”
  - Support throughout the deployment cycle
    - Predeployment
    - Combat Deployment
    - Post-deployment
- Current Progress, Barriers, and Future Directions
Assisting Throughout the Deployment Cycle

- Primary Prevention
  - Preventing PTSD
  - Assessing who is at greatest risk
    - For development of PTSD
    - For treatment type and resistance

- Secondary Prevention
  - Monitoring those at greatest risk
  - Preventing worsening Sx for those at greatest risk
Two Approaches to Stress Inoculation

1) Exposure Only
   - Leading to arousal habituation
   - Very specific to that situation

2) Arousal Control and Attentional Focus
   - Leads to recognition and control of ANS
   - Trains one to recognize distraction and stay absorbed in the mission at hand
   - Generalizable to multiple situations
Heart Rate Variability Frequency Distribution During 5" of Baseline, Zen Meditation and Stress Recall

26 consecutive patients referred for Stress Management. 1st session data
Spira, 2006: Funded by Dept of the Navy
Primary Prevention

Pre-deployment Stress Inoculation Training (ONR)

- 800 Marines – part of predeployment workup
- Assess with HRV and RT during a virtual mission
- RCT:
  - ½ lecture only
  - ½ Zen practice
- Field practice
- Re-assess
- Follow for reduced rates of PTSD post deployment

Preliminary Findings:
- HRV and speed/accuracy both improve in the first 30 Tx group v control group
Pre-SIT (video RT task)
Primary Prevention

- **Handheld Technology for Personal Monitoring and Intervention Devices:**
  - **ANAM (DoD):** Baseline neuropsychological testing with (and in context), in country (if a TBI), and upon return (to determine risk for PTSD based on poor cognitive functioning)
  - **StressEraser (APA)** personal biofeedback device
    - Useful in the field (or returning home) to improve sleep and recuperate from stressful periods
  - **iPhone/iTouch & Windows Mobile 6.0 (CDMRP)** for assessment and intelligent streaming support
    - Useful for assessing in real time and offering support needed in that moment (HRV-stress; Sleep; intrusive thoughts, etc.)
Secondary Prevention

- **Wounded Warrior Family Resiliency Program (BUMED)**
  - For about $250/family, we were tasked with helping 5000 wounded warriors and their primary support person.
  - Assess each service member and family member on a 20 minute web based assessment, f/u every three months.
  - Case manager calls (webcam or phone) to discuss results, and triage into specific workshops (or, if severe, to healthcare in their area) based on areas of concern or interest by participants.
  - A general (normalizing) 90 minute introduction, followed by several different 4-week groups 60 minute groups (depending upon need).
  - Workshops are Psycho-Educational webcam based interactive groups
    - Introducing a general principles (such as communication in relationships, or adapting from what’s appropriate for a war environment to what’s important for a home-life mentality),
    - Exercises to individualize for each person
    - Discussion to work on what interferes with implementing this.
Secondary Prevention

- Wounded Warrior Family Resiliency Program
  - Web-cam internet based groups to bring geographically separated families together, or to bring families who are distant from therapeutic centers together with the therapist and peers.
  - Web-based assessments and support (streaming audio-video support; homework assignments, and chat rooms for graduates of programs).
  - Hoping to add additional distance-based programs:
    - Webcam-based meeting for teens to reduce substance abuse (perhaps using 2nd life for feasibility)
    - www.WebKids.Com: Internet-based programs for kids playing therapeutic games with avatars (getting points for correctly identifying feelings of others, choosing the best responses to difficult situations, learning breathing techniques, and other healthy activities. Points help to personalize one’s own avatar, and also to enter into new rooms (including chat rooms with others).
• Validating the effectiveness of improving trauma training skills with a combination of SIT and training with prototype kits of life-like human tissue
• **Deliverable:** Trauma Training Kits
• **Military Relevance:** Advanced medical training tools
• **Endorsements:** U.S. Army, Shands Jacksonville
• **Contract #:** N661339-07-C-0035 (RDECOM STTC)
• Developed, tested, and validated a low cost interactive simulation (video game) to augment trauma care training for Army Combat Medics

• Using a commercially available video game engine (Quest 3D), developed an adjunct to the 68W Combat Medic Advanced Skills Training Curriculum (CMAST)

• **Deliverable**: Combat Medic Simulation Trainer

• **Military Relevance**:  
  - Simulate the stages of Tactical Combat Casualty Care (TCCC)  
  - Care Under Fire, Tactical Field Care, and Combat Casualty Evacuation Care

• **Endorsements**: Office of the Surgeon General (Army) recruiting van
VR for Treating Combat Stress

- Virtual Reality Facilitated Exposure Therapy
  - Funded by ONR in 1994
  - Why VR?
    - for this population: concrete (50% had blast injury); therapy averse; enjoys games
  - Three approaches:
    - PE alone
    - VR-PE
    - VR-PE-AC
VR for Treating Combat Stress

- PE alone
  - Good outcomes with single index trauma from assault and MVA civilian patients (mostly female)
  - May not be directly transferable to mostly male combat related PTSD without requiring modifications, due to:
    - Complex chronic PTSD (multiple co-morbidities, including SA/pain/tbi)
    - No specific index trauma, but an accumulation of stress over many deployments
    - Personality Style (concrete cognition/emotionally blunted; hyper-aroused and flooded with intrusive thoughts and feelings; etc).
    - Problem with drop out rates (as high as 50% in studies of PTSD or with exposure based therapies).
VR for Treating Combat Stress

- PE + Virtual Reality
  - Similar to PE, but therapist controls exposure
  - Reliance upon sustained exposure for treatment efficacy
  - Useful for those who have low visual imagery
  - Useful for those prone to avoidance
  - Benefits include controlling stimuli intensity
  - Effective for phobias
  - Effective for PTSD
  - Effective for combat-related PTSD

- Two small single group studies (one in 1999, one just completed) with combat-PTSD showed 70% clinically significant reductions in PCL scores and more than half no longer meeting PTSD criterion
  - However, this was with completers
  - 60% drop out rate (half of those after Tx began); no intention to treat
VR for Treating Combat Stress

- PE + Virtual Reality + Arousal and Attentional Control
  - Based upon Stress Inoculation Therapy: skills + situational practice
  - Similar to PE, but therapist controls exposure AND trains patient to control reactivity (before and after each session, & in session prn)
  - Reliance upon control of somatic and cognitive reactivity for treatment efficacy
    - Helps engage patient more fully in therapy
    - Helps with in-vivo homework
    - Helps with daily living (staying more fully engaged v distracted)
- Effective for phobias; PTSD; combat-related PTSD
- Effective for a wide range of co-morbid conditions
  - Useful in any situation where one’s mental, emotional and physical reactivity need control
    - Pain, insomnia, anger, night terrors, mTBI
    - Waking up with nightmares; hearing a backfire or helicopter in the street
## VR for Treating Combat Stress

<table>
<thead>
<tr>
<th><strong>Low Initial Exposure</strong></th>
<th><strong>Talk Therapy</strong></th>
<th><strong>Systematic Desensitization</strong></th>
</tr>
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<tbody>
<tr>
<td>(build gradually)</td>
<td></td>
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<table>
<thead>
<tr>
<th><strong>Threshold Exposure</strong></th>
<th><strong>Prolonged Exposure</strong></th>
<th><strong>Prolonged Exposure</strong></th>
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<tbody>
<tr>
<td>(build rapidly to the extent tolerated)</td>
<td></td>
<td>with Arousal Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Spira/Wiederhold)</td>
</tr>
</tbody>
</table>

- **Exposure experience**
  - breaks conditioning
  - (emphasis on exposure)
  - (specific to area of concern)

- **Arousal control**
  - brakes the conditioning
  - (emphasis on skill development)
  - (Generalizes to many Sx)
VR for Treating Combat Stress

Exposure Therapy with Integrated Arousal Control

- Patients are first taught to control their autonomic arousal and attend more fully in the moment.
- Once achieved (after the first or second session, and with homework practice), they apply these skills in VR.
- Patients are continually physiologically monitored (HRV, SC, Respiration).
- Arousal is observed, allowed to increase to specified parameters, and then patients are asked to decrease their arousal and focus in the moment without reactivity until arousal decreases sufficiently.
- This is repeated continually until patients no longer become significantly aroused during sessions or outside of sessions.
VR EXPOSURE
VR for Treating Combat Stress

Pilot Results:
- 22% drop out (intention to treat); but NO drop outs once treatment began;
- 72% significant decrease in PTSD Sx (PCL-m scores).

RCT:
- NO drop outs in Tx condition
- 70% clinically significant decrease in PTSD (CAPS) in an RCT tx group (vs 10% in non-exposure based TAU).
- 66% of treated subjects were deemed fit for full duty.
- 83% of patients significantly improved depression (PHQ-9).

Less somatically aroused patients were more cognitively engaged during tx.

Thus, arousal control, when used appropriately, can help patients engage in exposure therapy more fully.
VR for Treating Combat Stress

- What is the effect of treatment on autonomic reactivity?
Co-morbid Conditions: Effects of blast exposure?

- Three conditions were assessed at Study Baseline and Follow-up:
  - 5” **Rest** (sit quietly as we make sure the equipment is working)
  - 5” **Stress Recall** (what are the most troubling thoughts and feelings you have associated with your combat experience?)
  - 5” **Recuperation** (put those thoughts out of your mind and rest as comfortably as you can)
Skin Conductance over 3 conditions pre and post Tx

Condition x Time Repeated Measures

- Pre-Tx: p<.001
  - Power = .978
  - Effect Size = .493

- Post-Tx: p<.20
  - Power = .634
  - Effect Size = .558

Condition x Time:
- p<.033
- Power = .634
- Effect Size = .558
Co-morbid Conditions: Effects of blast exposure?

- What is the effect of blast exposure (mTBI) on the ability to control arousal?

- 19/39 patients (49%) of patients with PTSD also were exposed to blast and experienced being “dazed and confused”

- Separate by blast exposure vs no blast exposure
Effects of Blast Exposure

Regression analysis revealed that prior to treatment:

- the more effects of blast (exposure, dazed and confused, memory loss)
  - the greater the autonomic dysregulation (SC and HRV)
  - the less likely to be able to recover, compared to those with no blast exposure
  - (p<.01)
- Exposure treatment with arousal control eliminated these differences
SC Reactivity per condition for

PTSD vs PTSD/mTBI patients Pre vs Post Tx

Group x Time x Condition ANOVA p<.001

Group x Time ANOVA = n.s.

Group x Time ANOVA p<.01
86% success rate
DEPLOYED PTSD SYSTEMS

VRMC PTSD systems are currently being used at VA hospitals and medical institutions throughout the country.

Our systems are also currently deployed in Iraq, Poland, and Croatia.
Optimizing Treatments

The next step (current proposal):

- N=240, 10 VA sites (systems already in place)
- CPT vs PE vs VR-PE vs VR-PE-AAC
- Who benefits most from these approaches?
  - Substance Abusers; Pain; mTBI; Cognitive Style (concrete/reflective); women/men;
- And in what ways?
  - PTSD Sx/Dx, Drop-out rate; neuro-cognitive functioning; substance use; somatic reactivity; quality of life; relationships; etc.
Co-morbid Conditions: Effects of blast exposure?

- Post Concussive Syndrome stems is associated with sensitivity to light and sound, changes in taste and smell, problems with balance and dizziness, headaches, and problems with STM, focus, confusion, emotional lability, impulsivity, etc.

- Is PCS associated with mTBI (no findings on imaging) that lasts more than six months essentially PTSD, as Hogue and DVBIC have suggested?
  - If so, then treat all PCS>6mo as PTSD
  - If not, then we are condemning these patients to a lifetime of cognitive problems.
    - If PCS due to mTBI is not treated aggressively with appropriate Cognitive Remediation within the first year (ideally, the first six months), then it is far less likely to resolve.
2008 MHB DoD Anonymous Survey  N=32,000 (RTI)

% respondents reporting 3 or more PCS-PDHA Sx 1yr post-deployment

<table>
<thead>
<tr>
<th>PCL</th>
<th>&lt;30</th>
<th>31-49</th>
<th>&gt;50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blast</td>
<td>N</td>
<td>---*</td>
<td>pcs**</td>
</tr>
<tr>
<td>Exposed</td>
<td>Y</td>
<td>pcs^</td>
<td>PCS^^</td>
</tr>
</tbody>
</table>

*** Only PTSD: no blast, high PCLs report many PCS Sx; perhaps somaticising their PTSD, or simply super sensitized to sensations due to sleep deprivation or limbic changes. This supports Hoge’s contentions.

^Only PCS: Blast exposed, low PCLs - likely true PCS, can’t be easily explained by PTSD. These are the disenfranchised doomed to a lifetime of dysfunction if Sx are dismissed as merely PTSD.

Both PCS and PTSD: Blast exposed moderate (^^) and high PCL (^^^) report more PCS than can be accounted for by PCLs alone (compared to equivalent levels of PCL in non-blast patients)
• Partnered with the University of Central Florida to develop a tool that:
  • Scans in a relevant environment (e.g. kitchen)
  • Lets patients see them moving their real arm and interacting with real objects (e.g. cup) in the virtual environment.

• Used in transitional phases of Physical/Occupational Therapy to improve physical functioning in a realistic situation

• Also useful for providing cognitive rehabilitation for warfighters suffering from TBI
VR in Pain Management

- Includes:
  - Absorption into the moment
    - and away from one’s absorption with one’s pain
    - Traversing the terrain
    - Game Playing for fuller involvement
  - Skill Development
    - Relaxation
    - Self-hypnosis
    - Meditation
The Use of VR in Pain Self Management

- **Acute Pain**
  - distraction
  - switching modalities
  - Skill development

- **Chronic Pain**
  - lessons learned
    - If you have less pain being absorbed in this game, then what can you do to be more absorbed in your daily life activities?
  - skills training
    - relaxation
    - Self-hypnosis
    - Meditation (attentional retraining)
Effectiveness of Meditation for Pain Control

Heart Rate Variability Frequency Distribution During Baseline, Zen Meditation and Pain Focus

- SNS
- PSNS

- V/v+l+h
- L/v+l+h

% HRV Frequency

Base (pain=5.4) | Pain Focus (pain=7.8) | Zen Meditation (pain=2.6)
VR in Pain Management
VR in Pain Management
BUILD THE DNA

LAB STATION

FANTASY CREATURE
VR in Pain Management
VR in Pain Management
VR in Pain Management
Effectiveness of Meditation for Pain Control

Heart Rate Variability Frequency Distribution During Baseline, Zen Meditation and Pain Focus

% HRV Frequency

V/v+l+h
L/v+l+h

SNS
PSNS

Base (pain=5.4)    Pain Focus (pain=7.8)    Zen Meditation (pain=2.6)    VR Immersion (Pain=0.9)
Mobile Technology

- Need for daily practice and support
  - Audio guidance (skill development)
  - Video guidance (absorption)
  - Audio-video interaction (interactive therapeutic gaming)

- Mobile technology
  - MP3 (audio)
  - MP4 (video)
  - Cell phones
    - Audio
    - Video
    - Interactive
• An immersive virtual reality pain treatment system environment that relieves pain
• Delivered over multiple platforms providing the patient with 24 hour access to pain relief
• **Deliverables:** Pain Treatment System
• **Military Relevance:** Applicable to soldiers with injuries or PTSD
Mobile Technology

- The same technology that has been developed for a PC and head mount can be used on many mobile and smartphones
  - With less immersion
  - With less interactive sophistication
  - With less tie to a therapists office
  - With positive results
Mobile Technology

6 patients were able to hold their hands in the cold water for a significantly longer period of time (25% longer) using cell phone VR.

6 chronic pain patients described less pain with the use of cell phone VR than without it.
- Ice challenge w/ immersive VR (75% improvement):
  NO VR, Pain = 5.5; VR, Pain = 1.3
- No Ice challenge (28% improvement):
  No Cell Phone, Pain = 2.5, Cell Phone Pain = 1.8
Future Directions

- Web-based Applications:
  - Group Therapy (participants being anywhere)
  - Helping Teens avoid substance abuse (Second Life)
  - Helping kids learn stress management and communication skills (with web-based games)
  - VR Therapy conducted over the web
  - Training of therapists in videoconferencing seminars (where the SME needs to see what they are doing)
  - Etc – anything we can do currently in the office can theoretically be done over the web
    - With what trade offs?
Future Directions

- **Situational Simulations:**
  - Training: like combat medic program; SIT for any MOS
  - Support for PTSD Diagnosis
    - Combat Scenario for correspondence of subjective reactivity with psychophysiological reactivity (establish norms for PTSD vs no PTSD)
  - Return to Duty:
    - PTSD: Exposure simulation with performance metric (shoot / no-shoot)
    - mTBI: Complex multiple processing scenario (similar to operating in theater) with performance metric
  - Relationship Functioning
    - simulated scenarios for reintegration transition, etc.
PARTNERS & PROGRAMS

- Human Identification at a Distance
- Cultural Influences on Virtual Reality Environment Response Behavior
- Student State

- ARO Adaptive Displays Conference at AMC SIGGRAPH 2004
- Combat Medic
- Injury Creation Science
- SIT for AeroMeds
- PTSD in Iraq
- PTSD Coalition Forces

- Mobile Medical Monitor
- SIT
- PTSD
- Rehabilitation

- CDC VR Driving Simulator for Training and Evaluating Driver Behavior
- TBI Cognitive Rehabilitation

- Science for Peace and Security
  North Atlantic Treaty Organization

- BioWatch
- ICS Severe Trauma Training

- VR for Pain Distraction during Dental Procedures
- VR for Burn Pain Distraction
- VR for Chronic Pain
- VR and physiological Monitoring for pain
- Cyber Therapy Conference

- Mixed Reality Rehabilitation System

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.
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