

PTSD and Neuroplasticity

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Donald Olding Hebb

- 1904-1985
- Seminal influence
 - Psychology
 - Behavioral science (natural minds)
 - Computational neuroscience (artificial minds)
- 1949: *The Organization of Behavior: A Neuropsychological Theory*
- One of two most important biology texts

How does nervous system physiology influence behavior?

- Hebbian Theory
- Three postulates:
 - 1.) Hebbian learning
 - 2.) Cell assemblies
 - 3.) Phase sequence

Neurons that fire together, wire together!

Neural Development

- OLD: Brain development continues through childhood and adolescence, stopping in adulthood when the brain reaches a “fully developed” and stable state. (Cicchetti and Curtis, 2006).
- NEW: The human brain is dynamic and adaptive and is capable of changing in response to both internal and external stimulation. (Pascual-Leone et al., 2005; Kerr et al., 2011; Kays et al., 2012)

Neuroplastic Factors - Internal

- Brain-derived neurotrophic factor (BDNF)
- Vascular endothelial growth factor (VEGF)
- Insulin-like growth factor (IGF)



Selective strengthening (or atrophy) of existing pathways in response to stimulation.

Neuroplastic Factors - External

- Structural changes

– Environment

– Learning

– Behavior

– Emotion



Neural responsiveness

Neuroplastic Factors

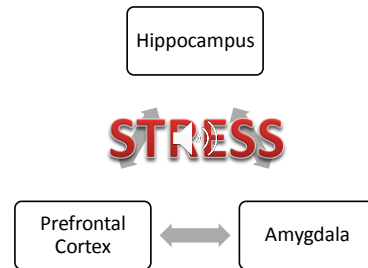
Positive Neuroplasticity	Negative Neuroplasticity
Environmental enrichment	Chronic stress
Learning	Depression
Exercise	Illness
↓	↓
NEUROGENERATION	NEUROATROPHY

Negative neuroplasticity

- Hippocampus: volume reductions, slowed neuron development, decreased dendrite formation
- Prefrontal cortex: decreased dendrite formation
- Amygdala: increased dendrite formation

Stress: Good & Bad

- Adaptive response to environmental demands
- Stress stimulation activates specific brain regions rich in glucocorticoid receptors (GRs)
 - Hippocampus
 - Amygdala
 - Prefrontal cortex
- Activation of GRs produces neuroplastic changes (cell growth and synaptic changes)
- Resulting in (potentially) long-lasting memories of the experiences



Stress: Good & Bad

- The good: we learn from stressful events and adapt to respond to similar events in the future
- The bad: “Survival mode”
 - Psychopathological condition
 - Increased risk of obesity, osteoporosis, cardiovascular disease, depression, anxiety, and PTSD



Fast and Slow Stress Responses

- Fast
 - Sympathetic nervous system
 - HPA axis activation: “fight or flight”
- Slow
 - Recovery
 - Adaptation



What about **PATHOLOGICAL** fear?

PTSD

- Disproportionately affecting Americans
- Lifetime prevalence: 6.8% general US population
- 5.4% - 12%
- Females > Males 
- Varieties
 - Acute (1-3 months)
 - Chronic (>3 months)
 - Delayed onset (symptom onset at least 6 months post trauma)

Combat Exposure and PTSD

- Consistent, positive correlation
- “Signature wound” of OIF/OEF conflicts (Tanielian & Jaycox, 2008)
- Risk and protective factors 
 - Demographics
 - SES
 - Psychiatric history
 - Social support
 - Sex

Criteria for Diagnosis

- Traumatic event involving
 - Death
 - Serious injury
 - Threat to physical integrity of self or others
- Reaction of intense horror, fear, or helplessness
- Symptoms causing significant distress or impairment
- Duration of >1 month

Symptom Clusters

- Re-experiencing of traumatic event
- Avoiding stimuli associated with trauma
- Hyperarousal 

Must have symptoms from all 3 clusters!

PTSD Course

- Variable
- Mild to severe symptoms
- Consistent or periodic



Therapy Approaches for PTSD

- Cognitive Behavioral Therapy (CBT)
 - Cognitive Processing Therapy (CPT)
 - Prolonged Exposure (PE) Therapy
- Eye Movement Desensitization Reprocessing (EMDR)
- Pharmacological Therapy

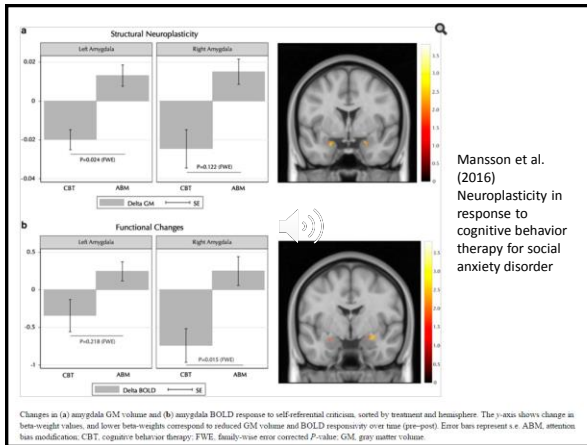
Cognitive Processing Therapy (CPT)

- Changing thoughts as means of changing feelings and actions
- Main components:
 1. Learning about symptoms
 2. Increase awareness of thoughts and feelings
 3. Learning skills to challenge thoughts
 4. Learning how trauma changes beliefs

<http://www.ptsd.va.gov/public/treatment/therapy-med/prolonged-exposure-therapy.asp>

Brain Changes in CBT

- C-J Boraxbekk et al. **Neuroplasticity in response to cognitive behavior therapy for social anxiety disorder.** *Translational Psychiatry*, February 2016 DOI: [10.1038/tp.2015.218](https://doi.org/10.1038/tp.2015.218)
- 26 participants with social anxiety disorder
- 9 week CBT delivered via internet
- Pre/post MRI
- Greater response to treatment corresponded with
 - Reduced volume of amygdala
 - Reduced activity within the amygdala



Prolonged Exposure (PE) Therapy

- Repeated exposure to reduce power of thoughts and feelings
- Main components:
 1. Education
 2. Breathing
 3. Real world practice
 4. Talking through trauma

<http://www.ptsd.va.gov/public/treatment/therapy-med/prolonged-exposure-therapy.asp>

PE Therapy: Mechanisms of Action

- Habituation Theory
- Extinction
- Emotional Processing
- Self-efficacy

Types of exposure: (1) imagery, (2) talking, (3) writing, or (4) practical (in vivo)

<http://www.psychiatristtimes.com/anxiety/exposure-therapy-anxiety-disorders>

PE Therapy: Mechanisms of Action

Psychiatry (Berkeley), 2013;82(6):362-6. doi: 10.1159/000348867. Epub 2013 Sep 20.

Neurosubstrates of remission following prolonged exposure therapy in veterans with posttraumatic stress disorder.

Simmons AN¹, Norman SB, Scadoni AD, Strigo JA.

@ Author information

Abstract

BACKGROUND: Prolonged exposure (PE) therapy is the first-line treatment for posttraumatic stress disorder (PTSD) in combat veterans. The underlying brain changes of treatment effect in PTSD are currently unknown.

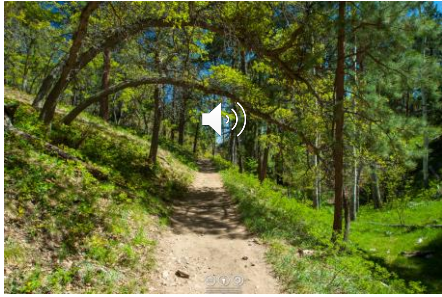
METHODS: A total of 31 veterans with PTSD completed an fMRI scan while performing an affective anticipation task at baseline and were enrolled in PE therapy. Of these, 7 prematurely terminated therapy, while 24 veterans completed PE therapy and an identical follow-up fMRI scan. At follow-up, 15 of the 24 completers still had diagnosable PTSD (NR-PTSD) and 9 of the 24 completers showed complete remission from PTSD (R-PTSD), i.e. they did not meet diagnostic criteria for PTSD.

RESULTS: The left anterior insula showed a significant group by scan session interaction. Specifically, the R-PTSD group showed decreased activation during anticipation of negative images from pre- to posttreatment scans, while the NR-PTSD group showed increased activation during anticipation of positive images in this region. Furthermore, the change in functional activation in the insula co-occurred with increased connectivity between this insular region and the right cingulate and right mid-posterior insular region in R-PTSD.

CONCLUSIONS: These findings suggest that the capacity to effectively remit from PTSD symptoms after PE treatment requires the ability to connect with physiological signals and moderate the discomfort of anticipatory anxiety of exposure therapy. These processes appear to be controlled by a network where the anterior insula is connected with the cingulate and the mid-posterior insula.

PMID: 24081484 DOI: 10.1159/000348867

Changing Behavior: A Road Less Travelled



EMDR Therapy

- Facilitated adaptive information processing (AIP)
- 8 phases of treatment
- Watch an example of EMDR therapy [here](#)

8 Phases of EMDR

F. Shapiro & M.S. Forrest (2004) EMDR: The Breakthrough Therapy for Anxiety, Stress and Trauma. New York: BasicBooks. <http://www.perseusbooksgroup.com/perseus.cgi:bin/display/0-465-04301-1>

- History and treatment planning
- Preparation
- Assessment
- Reprocessing
- Desensitization
- Installation
- Body scan
- Closure
- Reevaluation



- [Link to 20/20 Video](#)

Pharmacological Interventions

- Monoamine oxidase inhibitors
- Selective serotonin reuptake inhibitors (SSRIs)
- Tricyclic antidepressants
- Benzodiazepines



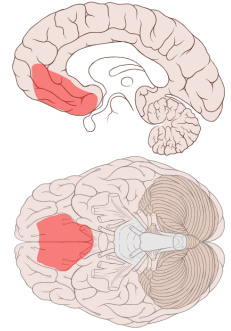
In general, only modest benefit in combination with behavioral therapies.

D-Cycloserine and Neuroplasticity

- New class of “cognitive enhancer” drugs
- Mixed results with PTSD
 - DCS+CBT benefit for most severe patients (de Kleine, Hendriks, Kussers, Broekman, & van Minnen, 2012)
 - Patients with DCS with more symptoms post treatment than placebo (Litz, Salters-Pedneault, Steenkamp, Hermos, Bryant, Otto, & Hofmann, 2012)

D-Cycloserine and Neuroplasticity

- Fear extinction – activation of medial prefrontal cortex and basolateral nucleus of the amygdala
- Binding of glutamate and glycine to N-methyl-D-aspartate (NMDA) receptor leads to long-term potentiation (LTP).
- DCS is a glycine agonist at NMDA receptor sites



Treatment Evolution

- New interventions
 - Interpersonal psychotherapy
 - Acceptance and commitment therapy
 - Mantra repetition
 - Psychodynamic therapy
 - Modified cognitive processing
 - Art based therapies
- New deliveries: telemedicine and computer delivered CBT
- Adapted approaches to target populations

Warrior Stories Platform



The PTSD Epidemic

- 7% - 20% of those who served in OEF / OIF affected
- Over 200,000 Vietnam era vets still have PTSD
- 500,000 sought care through the VA in 2013
- Symptoms:
 - Anxiety, depression, sleeplessness, emotional numbing, hyperarousal
 - Can lead to inability to work, substance abuse, domestic violence, and suicide

Sources: "Treatment for Posttraumatic Stress Disorder in Military and Veteran Populations," Institute of Medicine, June 2014.
 "Course of Posttraumatic Stress Disorder 40 Years After the Vietnam War: Findings From the National Vietnam Veterans Longitudinal Study," JAMA Psychiatry, September 2015.



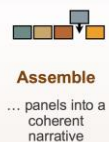
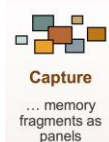
History

- **The problem:** Poor treatment compliance
 - Few seek treatment due to stigma
 - Traditional talk therapy approaches not well suited to the military population
 - Many who begin treatment get frustrated and quit after 1 – 2 sessions
- **The proposed solution:** create a tool that was engaging and effective
- **Essential features:** comic book style expressive medium



Creative Focus

- Grounded in art therapy practice
- Emphasis on Military Culture
- Collaborative effort
- Phase II Recreational Pilot Testing



Pilot Goals

- User feedback
- Recreational, versus therapeutic focus
- Trigger potential
- **You** are in control!



Thank you!

- www.kinecton.com
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