The Neurobiology of Trauma

Implications for the Courtroom

David Lisak, Ph.D.

Agenda

1. Impact of trauma on the brain
2. Trauma and the frontal lobes
3. Trauma and memory
4. Implications for the courtroom
5. Your questions
6. A primer on offender behavior

Foundations #1

Evolution

Copyright David Lisak 2008

A Thought Experiment

What Allows a Prey Species to Survive?

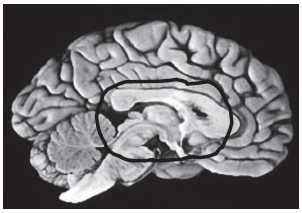
FEAR!

Copyright David Lisak 2008

Evolutionary Origins of the Human Fear System

The neuroarchitecture of fear that helped save the lives of the earliest mammals worked so well that it has changed very little across the eons of mammalian evolution.

The Lesson

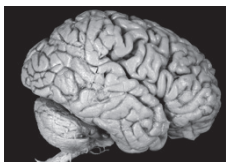


The human brain is a multi-layered map of millions of years of evolution

Our limbic structures are legacies of our mammalian & primate past

Foundations #2

Neural Plasticity



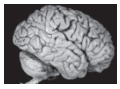
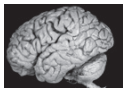
Copyright David Lisak 2008

Neural Plasticity

A Blessing

and

A Curse

Neural Plasticity

The brain's capacity to re-organize neural circuitry in response to changes in the internal or external environment.

Mechanisms of Neural Plasticity

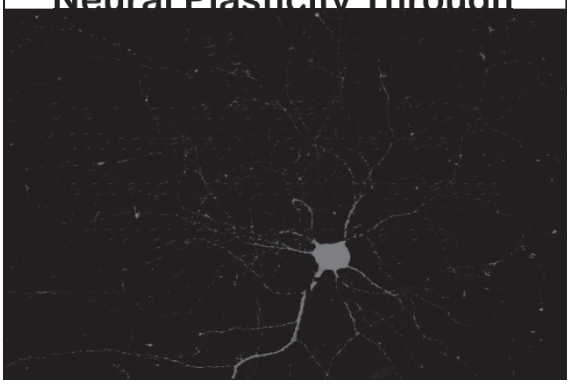
Growth of new neurons

Growth of new synapses

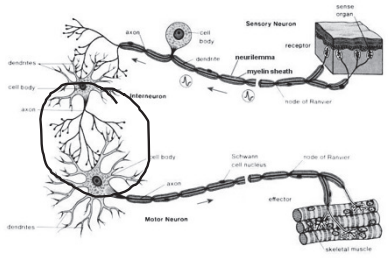
Strengthening of synapses

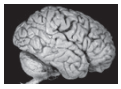
Copyright David Lisak 2008

Neural Plasticity Through

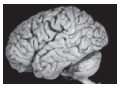


What is Synaptic Growth?





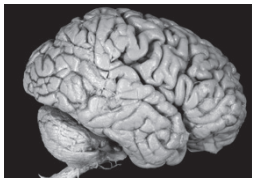
Neural Plasticity



Neural Plasticity

Neural Plasticity

The Human Brain



on Fear

Copyright David Lisak 2008

Gettysburg, 1863

Gettysburg, 1863
Combat Effectiveness

- 27,574 muskets recovered from the battlefield
- 24,000 were loaded
- 12,000 contained multiple bullets in the barrel

F. A. Lord, Civil War Collector's Encyclopedia (Harrisburg, PA: Stackpole Company, 1976), p. 86.

The Neurobiology of a Shoot Out

Retired Chicago police officer, Jim Glennon

Copyright David Lisak 2008

The Neurobiology of a Shoot Out

• **"I forgot** that I had a working radio when trying to make contact with Joe at the end of the hallway 100 feet away. I was using it to talk to units not on the scene, but… it **never dawned on me** to use it in communicating with Joe."

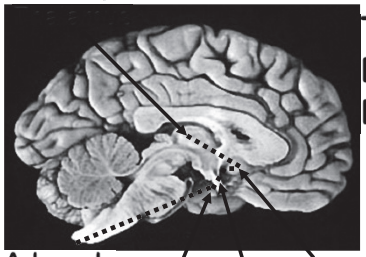
• "Radio traffic. Listening to my radio traffic later was almost embarrassing… I **didn't hear questions** from dispatch and **didn't respond** when called for information."

The Fear System

Critical Brain Structures in the Fear System

Copyright David Lisak 2008

Sensory



The Fear Pathway

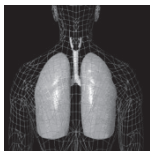
Adrenals

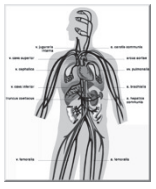
Pituitary

Hypothalamus

Amygdala

Saving Private Ryan



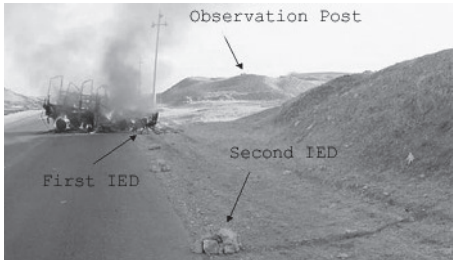


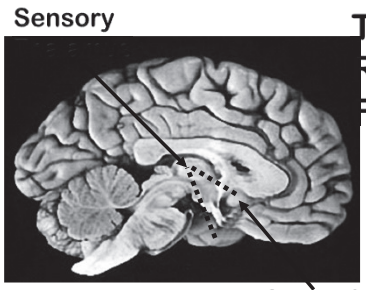
Copyright David Lisak 2008

Two Fear Pathways: High & low

The High Road to Fear

Copyright David Lisak 2008

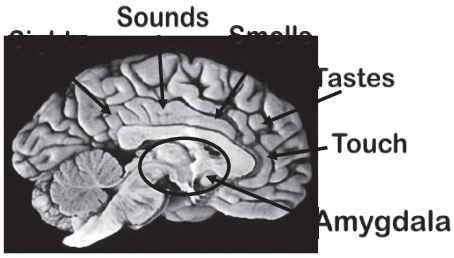




Why the Low Road?

Copyright David Lisak 2008

Problem: The sub-cortical sensory sponge effect

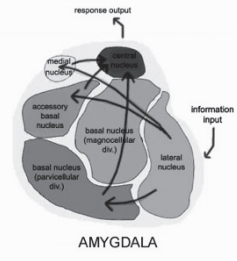


The Low Road Pathway

Fear Conditioning

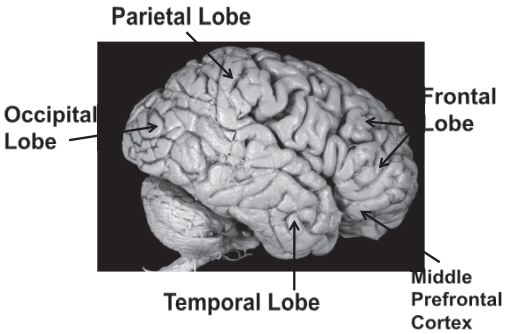
A Lesson from a Former Student

Copyright David Lisak 2008

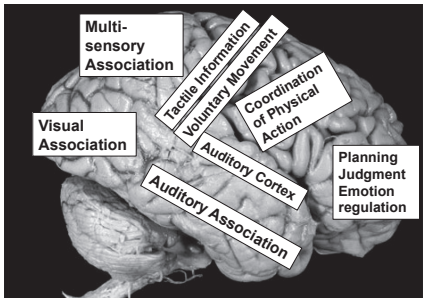


Uncovering the Complexity of the Amygdala

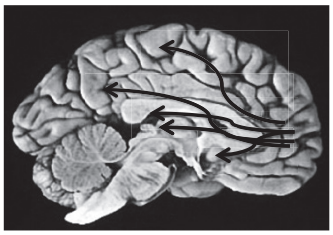
Fear, Trauma and The Frontal Lobes



The Cortical Lobes

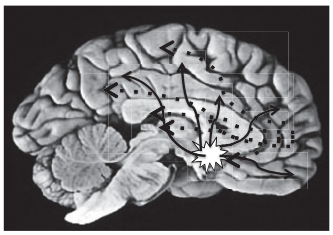


Functional Architecture of the Cortex



Neural circuits linking the frontal lobes to other cortical and sub-cortical areas are critical to our capacity to contain and modulate our emotions and impulses

The Impact of Trauma on Frontal Lobe Functioning

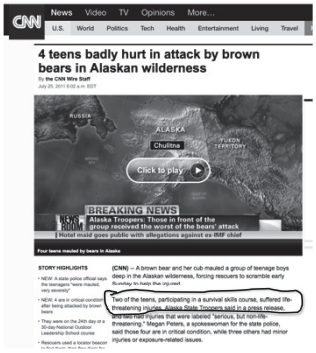


Under severe stress, frontal lobe networks are suppressed while amygdala circuits are amplified

The Impact of Trauma on Frontal Lobe Functioning

Copyright David Lisak 2008

Alaska, a Grizzly, and a Scream



Alaska, a Grizzly, and a Scream

Alaska, a Grizzly, and a Scream

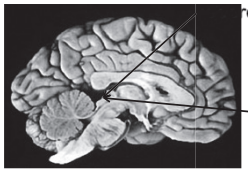
Trauma

Memory

What the Eiffel Tower Reveals About the Nature of Memory

Neuro-mechanics of Memory

1. Subject shown photo of Eiffel Tower & individual neuronal firing recorded



2. Few minutes later, subject asked to recall what they saw
3. As they recalled, exact same neurons fired
4. Neurons fired 2 seconds before they began recalling

Gelbard-Sagiv, H., et al., (2008).
Hippocampus During Free Recall. ***Science Express, 4 September.***

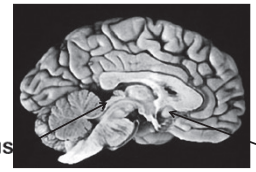
Copyright David Lisak 2008

Explicit & Implicit Memory

Explicit Memory	Implicit Memory
Conscious, willful, sequential, contextual	Unconscious, intrusive, fragmented, acontextual
"Last Saturday, I went to the Red Sox game…"	

Explicit & Implicit Memory

Explicit memory mediated by the hippocampus



Implicit memory mediated by the amygdala

The Case of the Slightly Sadistic Neurologist

Copyright David Lisak 2008

Tonic Immobility & the Freeze Response: Understanding Victim Behavior

Marx, B.P., Forsyth, J.P., Gallup, G.G., & Fuse, T. (2008). Tonic immobility as an evolved predator defense: Implications for sexual assault survivors. 74-90.

TI & Sexual Assault

- Humans: real or perceived entrapment
- Perception of entrapment shaped by prior experience (prior victimization)
- TI symptoms identified in more than 1/3 of adult rape victims
- TI symptoms identified in more than ½ of CSA victims

Marx, B.P., Forsyth, J.P., Gallup, G.G., & Fuse, T. (2008). Tonic immobility as an evolved predator defense: Implications for sexual assault survivors. 74-90.

Copyright David Lisak 2008

Understanding Victim Behaviors

1. Inconsistent statements
2. Fragmented memories
3. Lack of resistance
4. Self-blaming statements
5. Delayed reporting
6. Post-rape contact with offender
7. Your questions

Copyright David Lisak 2008