

The neurobiology of trauma in 90 minutes

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Who am I?



Psychologist

Trainer/Clinician/Evaluator
Expert in the field of DV

Translator and Comedian

The humor is to keep you
awake and interested

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Why neuroscience?



3

Why neuroscience?



Trauma = HARD SCIENCE

4

And we need to overcome:



I know what I'd do if that happened to me...

5

And we need to overcome:



It's just human nature to...

6

Why neuroscience?



To understand **ACTUAL**
“human nature”

Defining Trauma



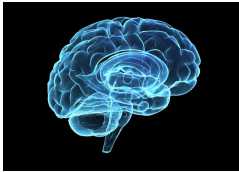
PLUS



EQUALS

Extreme threat/terror/horror

Lack of control/perceived lack of control

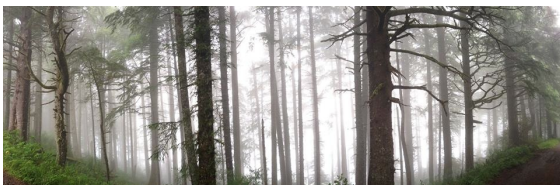


Very real changes in the brain
at the time of the incident
AND after the incident

Defining Trauma

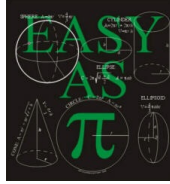
“It’s just the brain doing what the brain does.”

~ Me

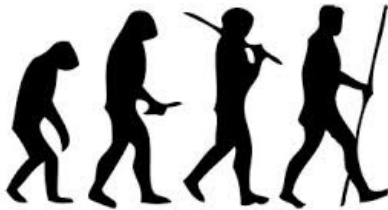


Overview of today's talk

- Brain basics
- Brain science & trauma
 - Threat networks without trauma
 - The brain during trauma



**Circuits =
Baked in to your brain**



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**Neural Networks =
Repetition over time!**



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We learn by generalizing...

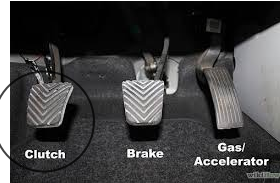
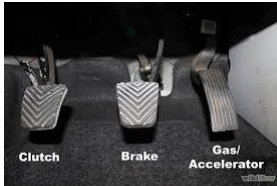
14

And then differentiating!

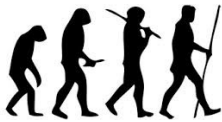
15

What's the take away?

You can't wish away or logically think away
an established neural network
(or defense circuitry)!



TRAUMA affects circuits



and
networks!



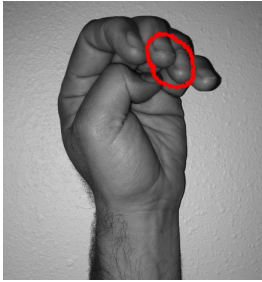
A few brain basics

You have a brain-map in your fist!



A few brain basics

Pre-frontal cortex = your middle nails

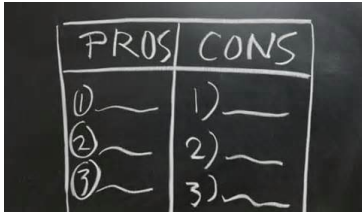


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A few brain basics

Pre-frontal cortex plays a role in:

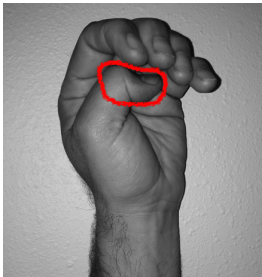
Logical decision making



20

A few brain basics

Limbic System = area around your thumb



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A few brain basics

Limbic System plays a role in:

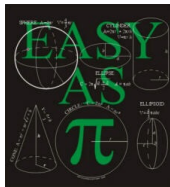
Defense circuitry!



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Predict and Protect!



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Consistently assess for safety



Involves:

- Eyes, ears, nose, etc.
- Your maps of safety/danger

Our level of vigilance depends on the environment

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The brain is constantly mapping



26

Low or high vigilance?



The extremes are easy to understand...

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Low or high?



Sometimes it's not so obvious...

28

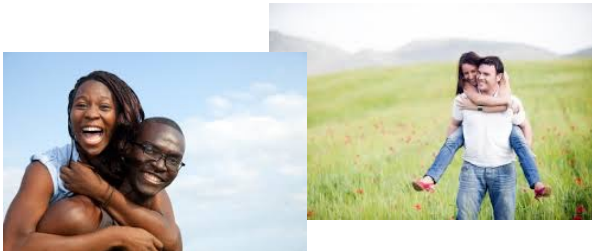
Low or high?



Sometimes it's not so obvious...

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Intimate partner is supposed to = Map of Safety!



30

Family is supposed to = Map of Safety!



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“Sense” Danger

**DANGER
WILL ROBINSON!**



Involves:

- Eyes, ears, nose, etc...
- Fear network
(featuring the **amygdala**)
- NOT the pre-frontal cortex!

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Assess the threat!



Involves:

- Eyes, ears, nose, etc.

**Map of threat?
or
Map of safety?**

(thanks to the **hippocampus**)

33

Assess the threat!



Ears
Eyes
Nose
Etc...



Map of threat?
or
Map of safety?

34

The power of habituation



Ears
Eyes
Nose
Etc...



Map of threat?
or
Map of safety?

some kids become numb

35

Assess the threat!



Threat is **contextual**
and **subjective!**

36

Assess the threat!



Threat is **contextual**
and **subjective!**

37

Assess the threat!



Threat is **contextual**
and **subjective!**

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Respond to the threat...



We do not think about our
response, we simply react.

More on this later...

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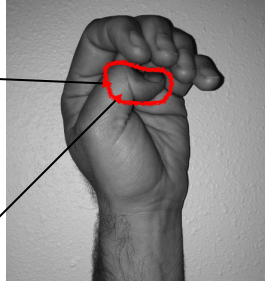
So far we haven't even made it up to the Pre-frontal Cortex!



Map of threat?
or
Map of safety?

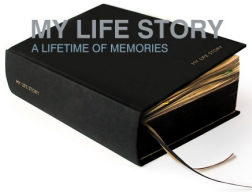
Amygdala

Hippocampus



Once the threat has passed...

Learn from experience
Make logical decisions to minimize future risk
MAKE MEANING



Involves:

The integrative function of the pre-frontal cortex

Imagine for a moment...



Additionally...



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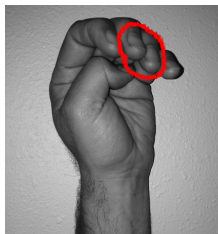
Additionally...



The beauty of extinction

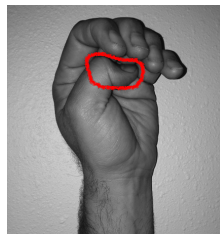
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The high road vs the low road



Fear

vs

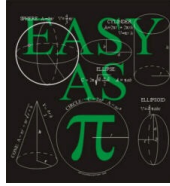


threat

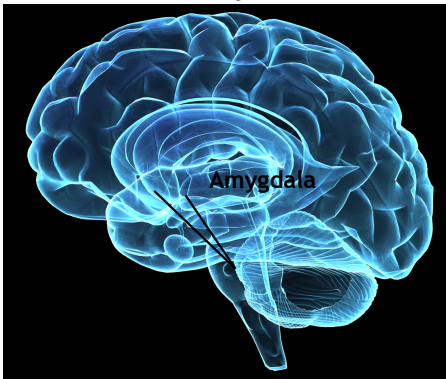
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During an assault Threat Circuitry is in charge!



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Threat Circuitry taking over =

- Impact on responding:
 - *Impaired* pre-frontal cortex
 - Survival reflexes/reactions
 - Self-protection habits



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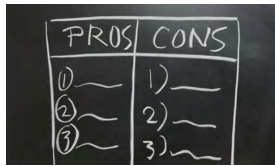
High Stress + Fear = Impaired Prefrontal Cortex

Arnsten 1998, *Science*, 280, 1711-1712; Arnsten 2009, *Nature Reviews Neuroscience*, 10, ⁴⁹

A few brain basics

Pre-frontal cortex plays a role in:

Logical decision making



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A few brain basics

Pre-frontal cortex plays a role in:

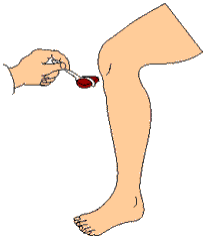
~~Logical decision making~~



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A few brain basics

With no pre-frontal cortex...what are you left with?



Reflexes and habitual behavior!

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Threat Circuitry in charge =

- Impact on responding:
 - *Impaired* pre-frontal cortex
 - Survival reflexes/reactions
 - Self-protection habits



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**IF you have a fear of snakes,
you may want to close your eyes.**

54



Freeze/Pause



Maybe the monster won't see me!

56

Freeze/Pause



Ready to suddenly
burst into action

57

Are we predators or prey?

58



We started out as prey!



59

~~Fight or flight?~~



What's your instinct when you see this dude on the trail?

60

~~Fight or flight?~~



We freeze first,
then flee if possible.

61

FREEZE → FLEE → FIGHT!



It's not a CHOICE!

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**How to FLEE when there's
no (perceived) escape route**



Drastic survival reflexes...

63

Dissociation

Blanked/Spaced Out
Disconnected from Body



Autopilot

64

Tonic Immobility

- *Freezing* = Alert and immobile, but able to move
- Tonic immobility = Paralysis, can't move or speak
- Caused by extreme fear, physical contact with perpetrator, restraint, perception of inescapability
- Can occur in sexual *and* non-sexual assaults

Marx et al. 2008, *Clin Psychol Sci Practice*, 74; Bovin et al. 2008, *J Trauma Stress*, 402; Brickman & Briere 1984, *Int J Women's Studies*, 195; Fuse et al. 2007, *J Anx Disord*, 265 ⁶⁵

Collapsed Immobility

Similar to tonic immobility

- Can't move or speak
- Causes = extreme fear, physical contact with perpetrator, restraint, perceived inescapability
- Evolutionarily old response
- Sudden onset (but more gradual offset)

Kozlowski et al., in press, *Harvard Rev Psychiatry*; Baldwin 2013, *Neurosci Biobehav Rev*, 1549; Bracha 2004, *CNS Spectrums*, 679

Collapsed Immobility

Key differences from Tonic Immobility

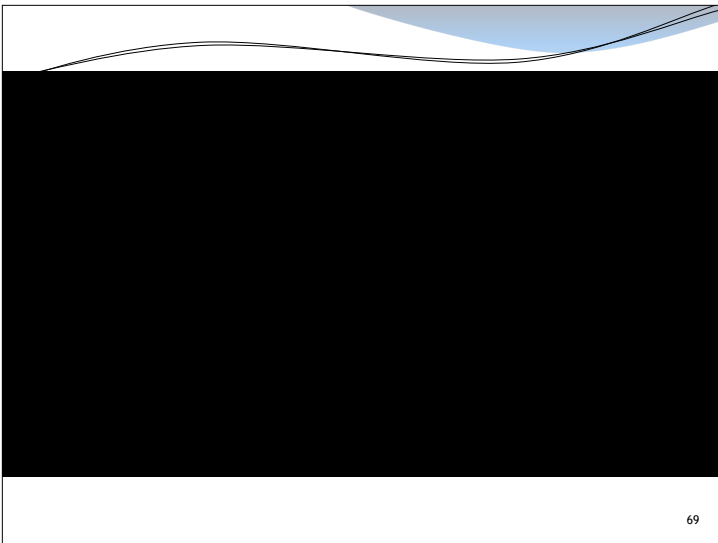
- Extreme ↓ in heart rate and blood pressure
- Faintness, “sleepiness” or loss of consciousness
- Loss of muscle tone - Collapsed, limp, etc.

Kozlowski et al., in press, *Harvard Rev Psychiatry* ; Baldwin 2013, *Neurosci Biobehav Rev*, 1949

So when does the brain respond to threat with “fight?”



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69

The perpetrator is a shark...



disguised as a dolphin!

70

Intimate partners are supposed to be
DOLPHINS not SHARKS!



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Tend & befriend
an alternative to Freeze/Flee/Fight



Threat Circuitry taking over =

- Impact on responding:
 - *Impaired* pre-frontal cortex
 - Survival reflexes/reactions
 - Self-protection habits



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Self-Protection Habits



represent neural networks!

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Self-Protection Habits

They have evolved from:

- Polite responses to aggressive and dominant people, e.g., superior officers
- Hoping and pretending its no big deal - trying to save face

And result in:

- Polite responses to unwanted sexual advances or mistreatment

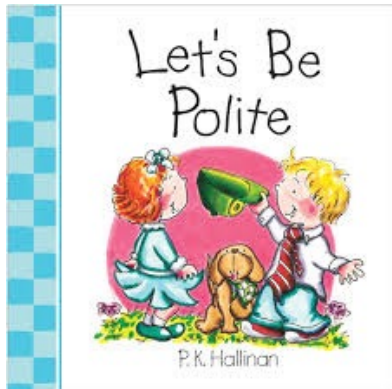
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Habits from childhood...



Habits from childhood...



Habits from the way you were raised...

Fear-Habit Paradox



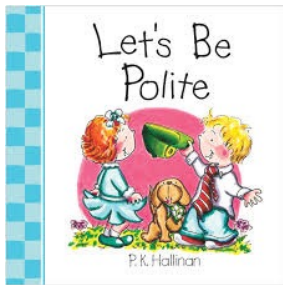
→ fear
kicks in

Initial response is HABITUAL & based on the just prior NORMAL INTERACTION

e.g., Schwabe 2013, *Hippocampus*, 1035-1043; Packard 2009, *Brain Research*, 121-128.

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In response to boyfriend anally raping her:



“Are you sure this is okay?”

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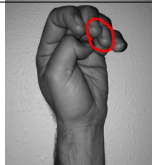
Exposure to trauma =



Anxiety on Campus



Impaired functioning



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Exposure to trauma over time = A hyper-sensitive “Danger Will Robinson”



We learn by generalizing...



And then differentiating...

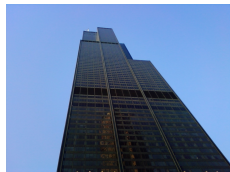


Extinction is possible because we can differentiate...



85

TRAUMA blocks differentiation!



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We ALSO become HYPER Vigilant - more aware!

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Exposure to trauma over time =

Map of threat?

ACCESS DENIED

Map of safety?

When the amygdala fires intensely,
the hippocampus is impaired!

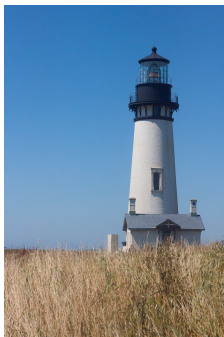
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More science behind the experience



89

More science behind the experience



90

More science behind the experience

91

The photos are...



92

More science behind the experience



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Exposure to trauma =

Hippocampus not functioning optimally...

When is a bang more than just a loud noise?



Exposure to trauma =

Hippocampus not functioning optimally...

When is a bang more than just a loud noise?

When you can't put it in context!



So you're saying



When you get triggered, you can't just "notice you're safe" without some help or until you crash

Avoidance behavior



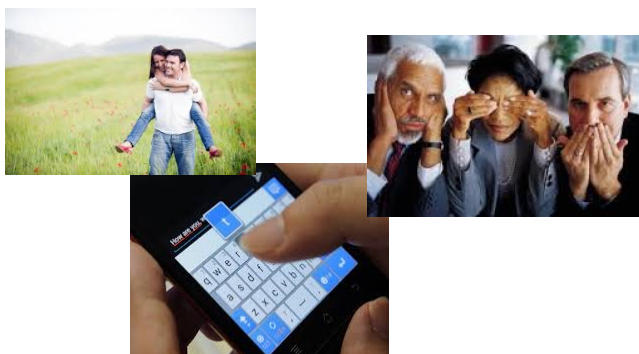
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Tension reducing behavior



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Normalizing behaviors



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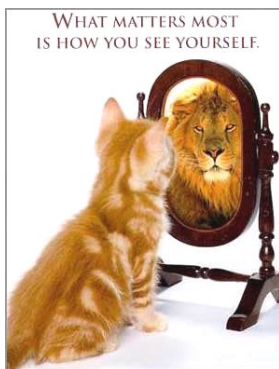
The Left-prefrontal Cortex

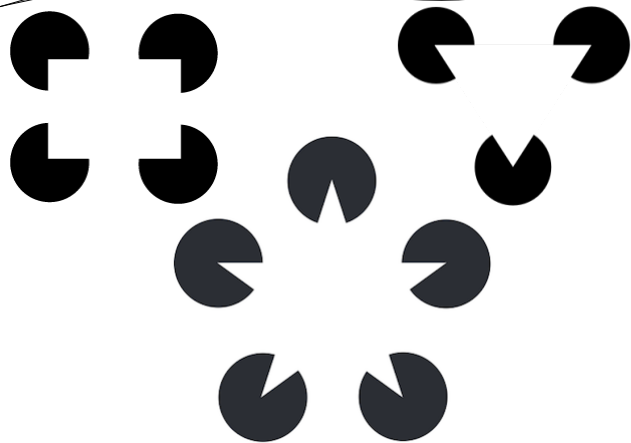
Combines:

Subjective logic

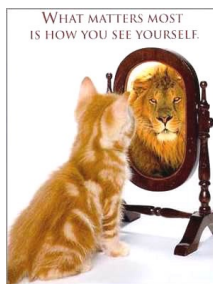
Language

to create the story of your life





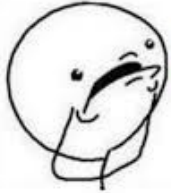
Internalized self-doubt/blame!





We are who we tell ourselves we are...

That awkward moment when someone asks you to tell more about yourself, and you're like:



OH GOD,
WHO AM I?

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The science tells us:



105

The science tells us:



At all levels of the process WE impact the “pot” of experiences a victim has...

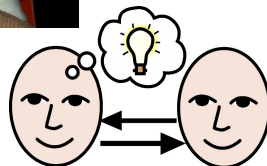
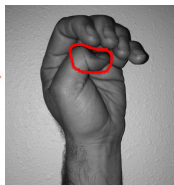
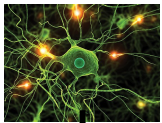
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Remember mirror neurons?

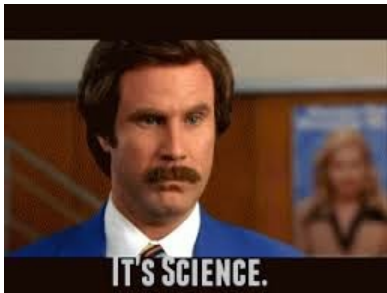


- Monkey see...monkey do...
- Monkey see...monkey's brain fires like he's doing...but he's not doing!
- What the WHAT???

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***You gotta use
Soft eyes!***



109

**Soft eyes = I honor your
experience and humanity**

**Hard eyes = I have a job to do/
investigation to run**

110

Pick a partner

**Person #1 - talk to your partner about
something awesome or exciting that
has happened to you**

Person #2 - listen with HARD EYES

111

The science says:

use **SOFT EYES**
all the time!



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One last thought...

“As part of its legacy, trauma leaves its victims with fear networks etched into the amygdala, networks that can be triggered by a multitude of cues that would ordinarily not evoke fear. Trauma also leaves its victims with fragmented and discontinuous memories of what happened to them. As a consequence of these legacies, the...victim faces enormous challenges in the judicial process. To participate in that process - to endlessly recount their trauma, to appear in the court room where the [perpetrator] sits - is equivalent to the zebra consciously choosing to return to the water hole where the lion attacked.” (Lisak, 2002)



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Questions? Comments?

Please feel free to contact me:
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