Neurobiology of Trauma:
Experience, Behavior & Memory

Indiana Statewide SANE Conference – May 14, 2025

Jim Hopper, Ph.D.
Independent Consultant &
Harvard Medical School
jim@jimhopper.com

1

FOCUS

Sexual assaults, or other assault experiences that are highly stressful/traumatic *as they are happening*.

2

End Violence Against Women International (EVAWI)

Important Things to Get Right About the "Neurobiology of Trauma"

Part 1: Benefits of Understanding the Science

Jim Hopper, PhD

Contributions by Kimberly A. Lonsway, PhD
Sgt. Joanne Archambault (Ret.)

September 2020

Benefits

1. More realistic expectations
2. More perceptive listening
3. More effective information-gathering

3

Conventional Wisdom

Brain-based **behaviors** during high-stress/trauma:

"fight or flight"

"fight, flight, freeze"

"fight, flight, freeze, [whatever]"

"faint" or "flop," "fawn" or "friend"

4

We Need Greater Clarity

What does "fight or flight" actually mean?

What does "freeze" mean?

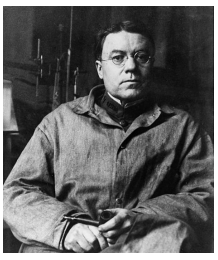
What does "fawn" mean?

What about various possible habit responses?

Are we really stuck with these f-words?

5

Problems with "Fight or Flight"



Walter Cannon was a physiologist. He didn't even study behavior.

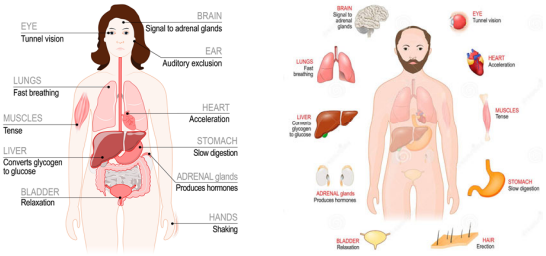
Confuses physiology and behavior.

Many people don't fight or flee while being sexually assaulted.

Blame/shame: People think those are normal/common responses.

6

"Fight or Flight" Was Never Supposed to be About Behavior



7

We Need New Concepts and Language

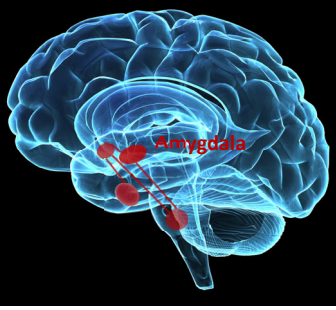
Physiology: "Survival Mode"

Behavior: "Reflexes & Habits"

Let's not confuse physiology and behavior.

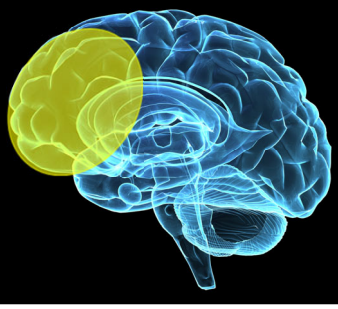
8

Defense Circuitry



9

Prefrontal Cortex



10

High Stress and Fear = Impaired Prefrontal Cortex

Arnsten 1998, *Science, 280,* 1711-1712; Arnsten 2015, *Nature Neuroscience, 18,* 1376-1385

11

Defense circuitry directly implements reflexes

12

Defense circuitry indirectly triggers habit behaviors
(via outputs to habit circuitry)

13

There is no "fight circuitry" or "flight circuitry" in the brain.

Fighting and fleeing can be reflexes or habits.

14

Survival Mode Reflexes & Habits

15

Survival Reflexes

16

Detection Freezing

Stop everything, hold down brake, scan

17

Freezing During Sexual Assault and Harassment

Three brain-based responses, keys to understanding experiences and behaviors. Understanding the neurobiology of freezing can be very helpful – in making sense of one's own experiences, supporting others, and investigating or prosecuting.

Jim Hopper, PhD – April 3, 2018

18

If freezing happens, what usually follows?

If freezing doesn't happen, what types of behaviors usually come first?

19

Self-Protection Habits

20

Common Self-Protection Habits

- **Polite, passive, submissive responses**
  - To dominant or aggressive people
  - To unwanted sexual advances
- **Cultural software** that runs on biological hardware/habit circuitry, learned from:
  - Families, communities, organizations
  - Domination and discrimination based on sex, race, class, etc.

21

22

I have to leave soon.

You've got a girlfriend.

My roommate is home.

My boyfriend will be angry.

23

Famous Case

Perpetrator describing methods on social media:
"Feign intimacy," "then stab them in the back"
and "THROW EM IN THE DUMPSTER."

His victim at trial…

24


"I didn't kick or scream or push."
"I tried to be as polite as possible."
"I wanted to not cause a conflict."
"I didn't want to offend him."

25

26

27

What's Wrong With "Fawn"

Merriam-Webster

Definition of *fawn*

intransitive verb

1 : to court favor by a cringing or flattering manner
// courtiers *fawning* on the king

2 : to show affection —used especially of a dog
// The dog was *fawning* on its master.

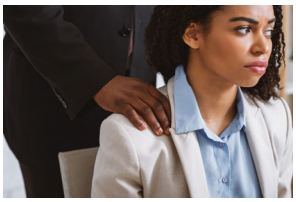
28

What's Wrong With "Fawn"

- What has the word always meant?
- Not a common response
- Victims can hear it as implying attitudes and behaviors that:
  - Don't match their experience
  - Don't match reality
  - Are degrading

29

Are these women likely about to court favor, flatter, or show affection?



How might they feel if you say that "fight, flight, freeze and fawn" are "the" behaviors of people during harassment or assaults?

30

Extreme

Survival Reflexes

Escape When There's
No (Perceived) Escape

31

Tonic Immobility

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

Moller et al., 2017, *Acta Obstet Gynecol Scand*, 932; Marx et al. 2008, *Clin Psychol Sci Practice*, 74; Bovin et al. 2008, *J Trauma Stress*, 402; Fuse et al. 2007, *J Anx Disord*, 265

32

33

Collapsed Immobility

Key differences from tonic immobility

- **Physiological cause = Heart gets massive parasympathetic input, resulting in…**
- **Extreme ↓ in heart rate and blood pressure**
- **Faintness, "sleepiness" or loss of consciousness**
- **Loss of muscle tone – Collapsed, limp, etc.**

Kozlowski et al., 2015, *Harvard Rev Psychiatry*, 1-25; Baldwin 2013, *Neurosci Biobehav Rev*, 1549

34

35

As professional nurse examiners, is it useful to know about tonic immobility and collapsed immobility, and not just think "freeze"?

36

How does knowing that tonic immobility and collapsed immobility are different survival reflexes – from freezing and from each other – help you to listen better?

To understand more?

To gather higher quality information?

37

Dissociation

Blanked/Spaced Out

Disconnected from Body

Autopilot

38

38

39

Does “fight, flight, freeze, [whatever]” help you listen for and gather more information about reflexive dissociative responses? Or does it get in the way?

40

Reflexes & Habits

Freezing
- Detection
- Shocked
- No-Good-Choices

Passive, Polite
- From dating
- From child abuse
- From domination

Extreme Survival Reflexes
- Tonic Immobility
- Collapsed Immobility
- Dissociation

Dissociative
- Autopilot
- Submission
- Sex acts

41

How Brain-Based Behaviors Tend to Unfold Over Time

Freezing
(scientific def.)

Detection Freezing
- Everything stops
- 1-3 seconds

Shocked Freezing
- Can follow detection
- Blank mind, no behavior options to choose from
- Can last several seconds

No-Good-Choices Freezing
- Can follow detection or shocked
- Only “bad” choices of extremely passive vs. reactive behaviors
- Seconds to minutes

Rational, Deliberate Behaviors
- Less likely with more stress and trauma, due to impaired prefrontal cortex
- If do happen, not necessarily effective – and then it’s back to reflex and habit behaviors

Habit Behaviors
- Usually passive and ineffective (no self-defense training)
- Face-saving and submission habits we’ve all learned
- From gender socialization (e.g., “nice girl” habits)
- From childhood abuse experiences

Extreme Survival Reflexes
Escape (seems) impossible, intense fear and/or horror

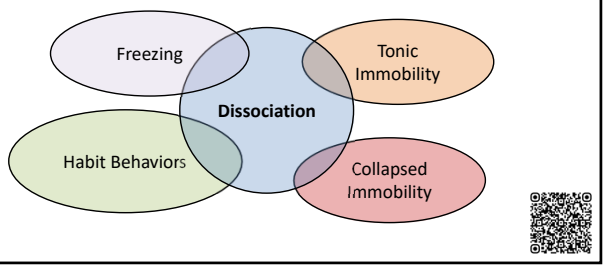
Dissociation: Can kick in early, spaced out and/or autopilot habit behaviors

Tonic Immobility: Paralyzed, muscles rigid

Collapsed Immobility: Muscles limp, dizzy/pass out

42

Potential Overlaps of **Dissociation** with Freezing, Habit Behaviors, and/or Extreme Survival Reflexes



43

Is it helpful to know that dissociation is a reflexive response that may or may not overlap with other survival reflexes or various habit behaviors?

44

Think (maybe say) "Reflexes and Habits," Then Use Their Words

"Froze"
"In shock"
"Paralyzed"
"Couldn't move"
"Passed out"
"Disconnected from my body"
"Just kept saying…"
"Begged him not to…"
"Politely pushed him away"
"On autopilot"
"Gave in"
"Just did what he wanted"

45

More Clarity, Better Listening, and More Helpful in What We Say

Victims talking about their responses during assaults need to be truly heard and understood.

Listen with framework of more accurate concepts. Don't jump to conclusions.

Don't impose simplistic ideas about "fight, flight, freeze, [whatever]"

Remember reflexes and habits!

46

"Reflexes and Habits" Is Much Better Than "Fight or Flight"

Language that reflects the realities of sexual assault and its neurobiology.

Adding "freeze" can't salvage a phrase that harms sexual assault survivors.

Jim Hopper, PhD – February 12, 2021

47

Trauma & Memory

48

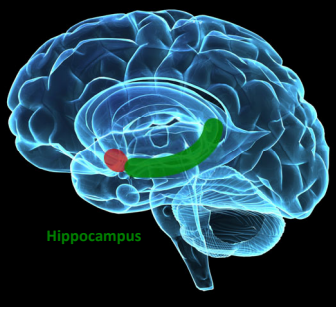
Bottom-Up Attention and Memory

Defense circuitry focus: **what seems most important** to survival and coping

Attended/Significant = Central Details = Encoded

49

Episodic Memory Circuitry



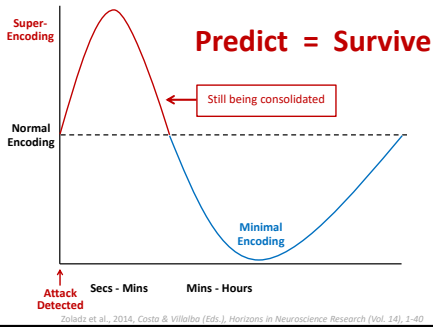
50

51

Are you getting the central details?

52

Time-Dependent Hippocampus Effects



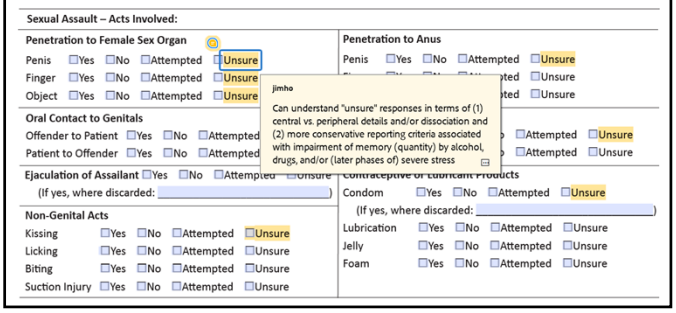
Zoladz et al., 2014, Costa & Villalba (Eds.), Horizons in Neuroscience Research (Vol. 14), 1-40

53

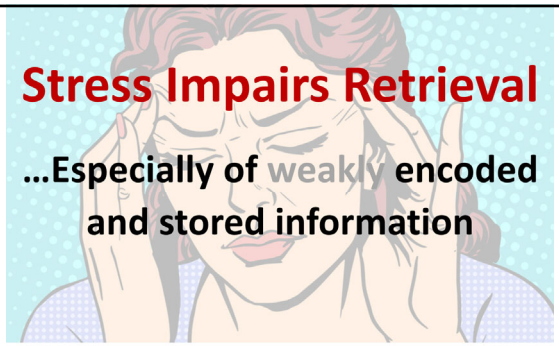
Are you getting and using central/early details?

54

But some peripheral details could be key!



55



e.g., Schwabe et al., 2012; Neurosci Biobehav Rev, 1740; Smith et al., 2016; Science, 354, 1046

56

Implications

1. Very stressed or traumatized victims **cannot recall everything recorded** in their brains, no matter how good and gentle the interview.
2. Don't **add** to their stress, e.g., by asking about prior assaults, abuse, etc.
3. **Yes, recall can get better over time!**

57

Vulnerability to Distortion?

Central Details = Very Low Vulnerability

Peripheral details = High Vulnerability

58

Gist

Abstract

Stripped of many details

e.g., Gilboa & Marlatte, 2017, *Trends in Cognitive Sciences*, 618-631.

59

Implications

4. Lots of details missing, even some central details? **Gist still there.**
5. More time since assault = More of recall is gist + reconstructed details.
6. **However long ago, central details can be vivid and accurate. Don't miss them!**

60

61

Alcohol and Memory

- **Low-moderate dose/intoxication**
  - Impairs context encoding
  - Does not impair encoding of sensations
  - Resembles effect of fear/trauma
- **High dose/intoxication:**
  - Impairs hippocampus-mediated encoding and consolidation of both context and sensations

Melia… LeDoux, 1996, Neuroscience, 74, 313
Bisby et al. 2009, *Psychopharmacology, 204,* 655; Bisby et al. 2010, *Biol Psychiatry, 68,* 280

62

Alcohol and Memory

Amount of details recalled is unrelated to accuracy of what's recalled

- Alcohol reduces correct details recalled
- Does not increase incorrect details
- Higher the dose, fewer details recalled
- Correct central details not affected at moderate doses (BAC < .10)
- Higher doses (BAC ≥ .10) reduce central details too – but if recalled, likely accurate

Jores, … & Flowe, 2019, A meta-analysis of the effects of acute alcohol intoxication on witness recall. *Applied Cognitive Psychology, 33,* 334-343.

63

A meta-analysis of the effects of acute alcohol intoxication on witness recall

Theo Jores[1] | Melissa F. Colloff[1] | Lilian Kloft[2] | Harriet Smailes[3] | Heather D. Flowe[1]

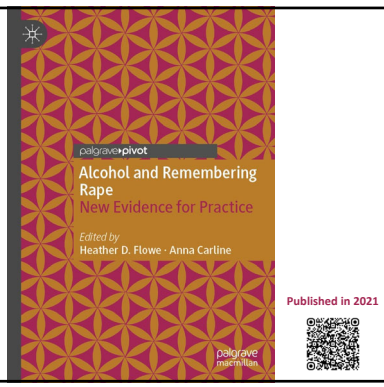
[1]School of Psychology, Centre for Applied Psychology, University of Birmingham, Birmingham, UK
[2]Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, The Netherlands
[3]Department of Neuroscience, Psychology and Behavior, University of Leicester, Leicester, UK

Correspondence
Heather D. Flowe, School of Psychology, Centre for Applied Psychology, University of Birmingham, Hills Building, Edgbaston Park Road, Birmingham B15 2TT, UK.
Email: h.flowe@bham.ac.uk

Summary

There is widespread belief in the legal system that alcohol impairs witness testimony. Nevertheless, most laboratory studies examining the effects of alcohol on witness testimony suggest that alcohol may affect the number of correct but not incorrect details recalled. However, it is difficult to draw conclusions because sample sizes, testing paradigms, and recall measures vary between individual studies. We conducted a meta-analysis to address this issue. We found alcohol intoxication had a significant and moderate sized effect on the number of correct details recalled (g = 0.40). The effect of alcohol on the number of incorrect details recalled was not significant. Further, the effect of alcohol on the recall of correct details was significantly moderated by multiple factors like intoxication level, the retention interval length between encoding and recall, and the types of questions asked (i.e., free recall vs. cued recall). We discuss the applied implications of the results.

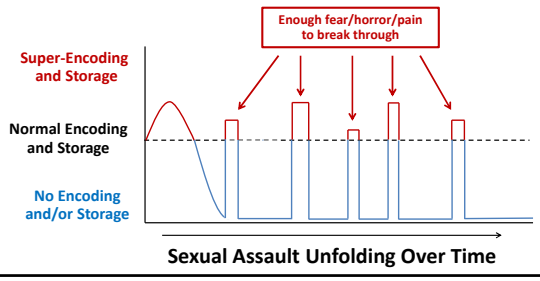
64



Published in 2021

65

Fear/Horror/Pain Can "Break Through" Severe Alcohol/Drug Effects



66

Where there is a **FRAGMENT** there was usually…

FEAR **HORROR**

PAIN

So **listen** and **explore** for them

67

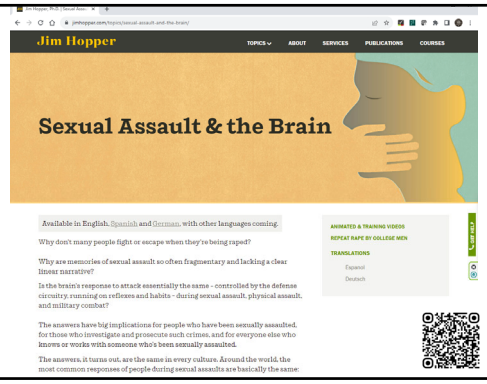
"Reflexes and Habits" Is Much Better Than "Fight or Flight"

Language that reflects the realities of sexual assault and its neurobiology.

Adding "freeze" can't salvage a phrase that harms sexual assault survivors.

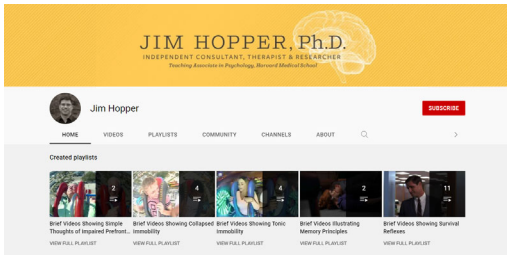
Jim Hopper, PhD – February 12, 2021

68

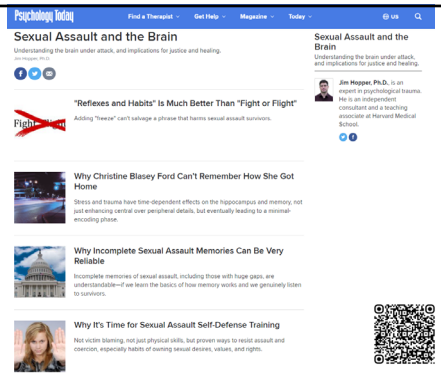


69

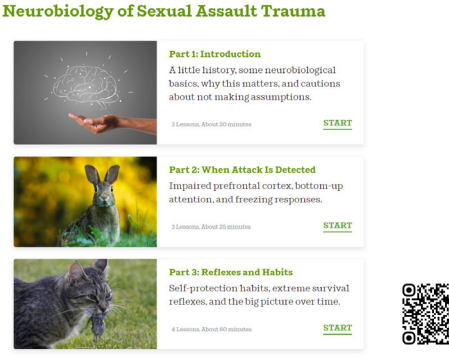
www.youtube.com/c/JimHopperPhD



70



71



72