

# What is the role of psychological trauma in chronic pain?

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- ▶ BIOETHICS AND HUMANITIES



# Disclosures

- ▶ Physicians for Safe Opioid Prescribing (PROP)
  - ▶ board member, unpaid

# Agenda

- ▶ Case: Francine 48 yr old police officer
- ▶ ACEs (adverse childhood experiences) vs PTSD (post-traumatic stress disorder)
- ▶ Health effects of ACEs
- ▶ Effects of psychological trauma and PTSD on chronic pain
- ▶ Mechanisms for trauma effect on chronic pain
- ▶ Treatments for PTSD and psychological trauma and their effects on chronic pain

## Case: Francine 48 yr old police officer

- ▶ In 2015, during an arrest, she was held with a gun to her head as the suspect threatened to shoot her if he was not released.
- ▶ She has had headaches, shoulder and neck pain since this episode.
- ▶ She has been unable to return to work despite treatment with: cervical nerve blocks, sumatriptan, oxycodone, physical therapy



# What is the relationship between chronic pain and trauma?



# CDC *Vital*signs™

#vitalsigns  
NOV. 2019

## Adverse Childhood Experiences (ACEs) Preventing early trauma to improve adult health



Want to learn more?  
[www.cdc.gov/vitalsigns/aces](http://www.cdc.gov/vitalsigns/aces)

**1 in 6**

1 in 6 adults experienced four or more types of ACEs.

**5 of 10**

At least 5 of the top 10 leading causes of death are associated with ACEs.

**44%**

Preventing ACEs could reduce the number of adults with depression by as much as 44%.

# THE ACES QUIZ

The Adverse Childhood Experiences, or “ACEs,” quiz was developed in the 1990s through research conducted by the CDC and Kaiser Permanente.



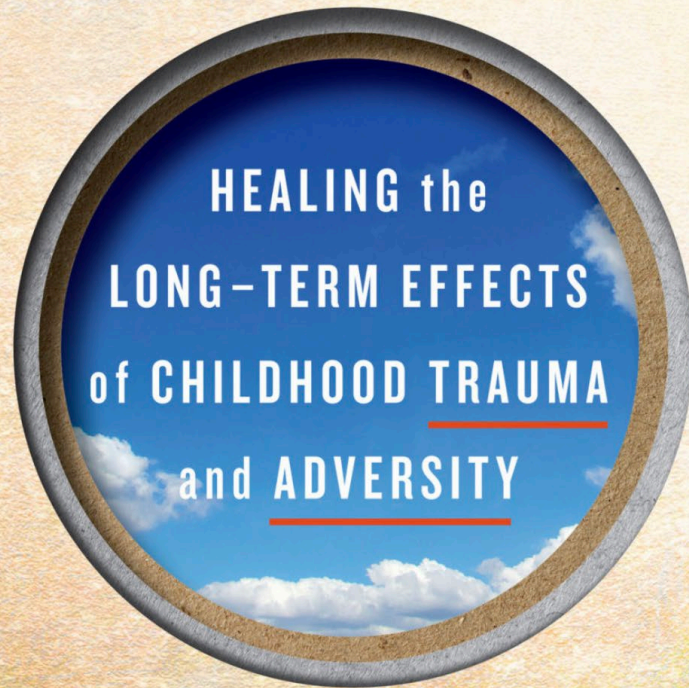
Researchers determined that 10 specific traumatic childhood experiences, or ACEs, could be linked to a higher likelihood of health challenges later in life, and that the likelihood of these negative effects increased with the number of “ACEs” a child experienced.

## **THE 10 ACES WERE DEFINED AS THE FOLLOWING CHILDHOOD EXPERIENCES:**

- **Physical, sexual or verbal abuse**
- **Physical or emotional neglect**
- **Separation or divorce**
- **A family member with mental illness**
- **A family member addicted to drugs or alcohol**
- **A family member who is in prison**
- **Witnessing a parent being abused**

Still, there are variables this quiz doesn’t account for – including stressors outside of the home, as well as the important role positive influences play on buffering the effects of trauma.

# the deepest well



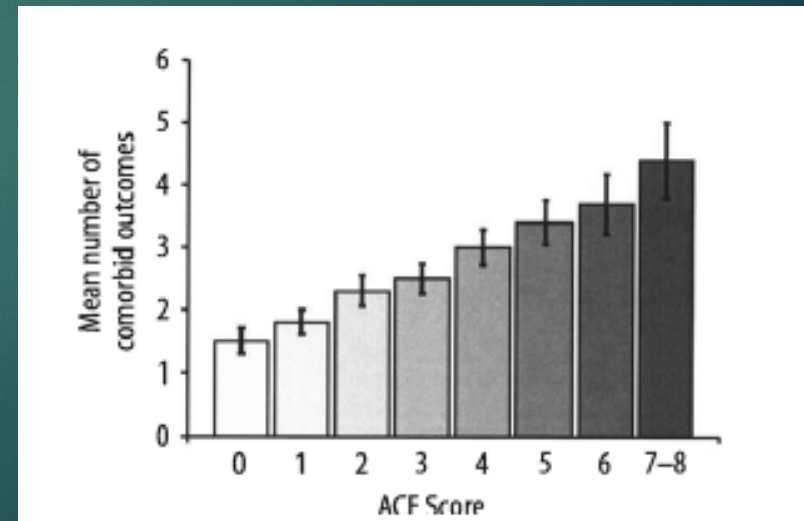
**NADINE BURKE HARRIS, M.D.**





# Dose-response relationship: ACEs to health

- ▶ Representative US population sample (N=13,494) showed  $\geq 4$  ACEs increased risk for: CAD, CA, obesity, alcoholism, COPD, depression
  - ▶ Felitti 1998, Anda 2006
- ▶ Greater number of ACEs  $\rightarrow$  more pain intensity, interference, anx/dep
  - ▶ Dennis 2019, Sherman 2015, Davis 2005



# Evidence for ACEs leading to chronic pain

- ▶ ACEs exposure increases the likelihood of chronic pain
  - ▶ Sherman 2015, You 2019
- ▶ ACEs exposure (abuse/neglect) increases pain symptoms/conditions
  - ▶ Davis 2005, (esp. FM) Kaleycheva 2021, (documented ACEs) Raphael 2011
- ▶ Physical abuse in childhood increases risk neck/back pain in adults
  - ▶ Kopec 2005, Linton 2002
- ▶ ACEs increase risk of depression and suicide in patients with pain
  - ▶ Sommer 2019, Fuller-Thomson 2016, Cicchetti 2016
- ▶ ACEs often manifest as PTSD in adults, but may not
  - ▶ Nelson 2021

# Biological mechanisms of ACEs effects

- ▶ ACEs exposure associated with elevated inflammatory biomarkers (TNF $\alpha$ , IL-6, CRP)
  - ▶ Agorastos 2019, Baumeister 2016, Coelho 2014
- ▶ Inflammation can produce peripheral sensitization, hyperalgesia and chronic widespread pain, neuroinflammation w/ microglia
  - ▶ Ji 2018, Tak 2018, Chen 2018, Danese 2007
- ▶ Allostatic overload (chronic, overwhelming stress) can produce epigenetic modulation of HPA system increasing its reactivity
  - ▶ Parade 2021, Weaver 2004
- ▶ Threat perception driven by sensitization of cortisol and amygdala
  - ▶ Shekhar 2005, Vachon-Preseau 2013

# Psychological mechanisms of ACEs effects

- ▶ Pain Catastrophizing (rumination, magnification, helplessness) increased in persons with ACEs
  - ▶ MacDonald 2021, Zlotnick 2022
- ▶ Fear avoidance (of pain) and experiential avoidance (of trauma reminders) are associated in populations with ACEs and PTSD
  - ▶ Stark 2015, Sicorello 2021
- ▶ ACEs associated with early attrition from psych-behavioral treatments
  - ▶ Harte 2013, Hardman 2019

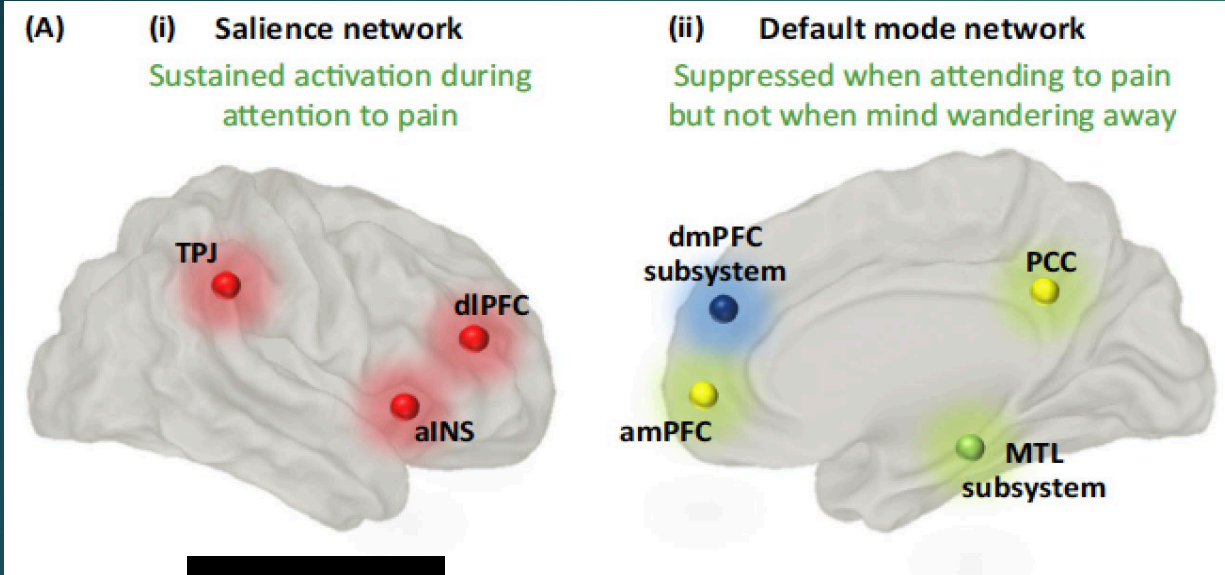
# How Might Early Adversity Amplify Pain?



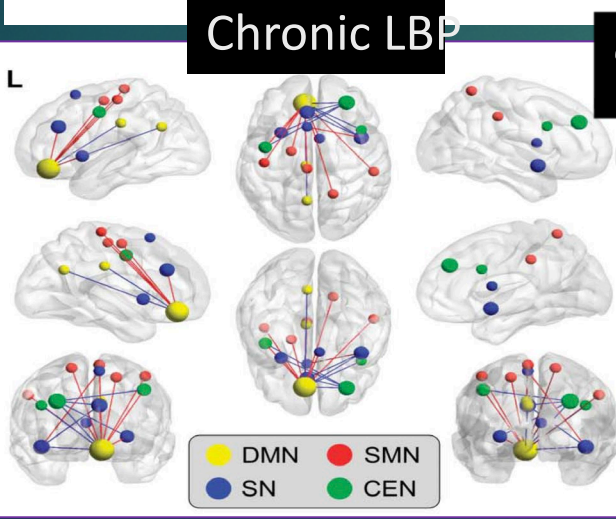
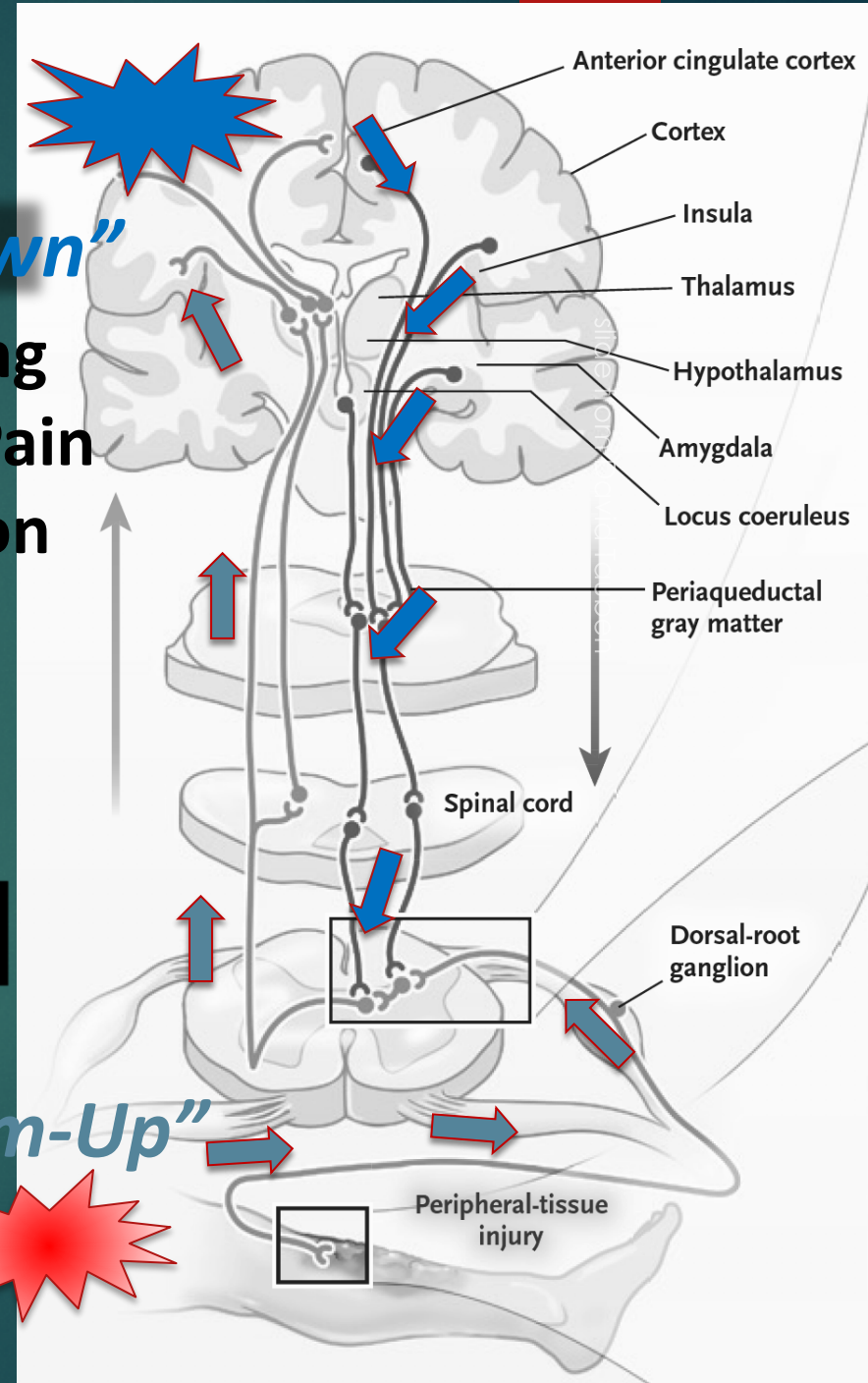
- In childhood emotions are interpersonally regulated
  - Fordyce: toddlers look to parent after a fall to interpret risk
- In the context of abuse and neglect, this type of regulation does not occur or is limited when it is needed most
- A common solution is to tune out internal emotional distress and become vigilant for external threats
- Abused children also do not receive the empathic attunement and mirroring from others that would enable them to know what they are feeling

# “Preexisting Brain States Modulate Experience of Pain”

Attention paying    Mind wandering



**“Top-Down”**  
Descending Inhibitory Pain Modulation



**“The Dynamic Pain Connectome”**

Kucyi A, Davis KD. Trends in Neurosciences, 2015

**“Bottom-Up”**

# Biased Competition Favoring Physical Over Emotional Pain: A Possible Explanation for the Link Between Early Adversity and Chronic Pain

Richard D. Lane, MD, PhD, Frances Sommer Anderson, PhD, and Ryan Smith, PhD

Unpleasant experiences:

- 1) Interpreted interpersonally as emotions- seek non-medical remedies
- 2) Interpreted bodily as symptoms- seek medical remedies

**Psychosomatic Medicine 2018; 80: 880-890**

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# Intentional Painful Self-Injury as a Means to Reduce Emotional Distress



Localized physical pain is used as an antidote to overwhelming and disorganizing emotional pain



## The Pair of ACEs

### Adverse Childhood Experiences

Maternal Depression

Physical & Emotional Neglect

Emotional & Sexual Abuse

Divorce

Substance Abuse

Mental Illness

Incarceration

Domestic Violence

Homelessness

### Adverse Community Environments

Poverty

Violence

Discrimination

Poor Housing Quality & Affordability

Community Disruption

Lack of Opportunity, Economic Mobility & Social Capital

Ellis, W., Dietz, W. (2017) A New Framework for Addressing Adverse Childhood and Community Experiences: The Building Community Resilience (BCR) Model. *Academic Pediatrics*. 17 (2017) pp. S86-S93. DOI information: 10.1016/j.acap.2016.12.011



# History of PTSD

- ▶ Civil War: traumatic stress self-medicated with opiates and alcohol
- ▶ 1900's: trauma reactivates childhood traumas and conflicts (hysteria)
- ▶ WW1: 'shell shock' (now distinguished as TBI)
- ▶ WW2: 'combat neurosis', 'concentration camp syndrome'
- ▶ Vietnam War: "PTSD"
  - ▶ Controversy among veterans: "PTS" vs PTSD

# PTSD in DSM-V (2013)

- ▶ Traumatic event: actual or threatened death, serious injury, sexual violence
  - ▶ Direct experience, witnessing, learning of close family or friend's exposure
- ▶ Traumatic event reexperienced
  - ▶ Recurrent distressing memories or dreams
  - ▶ Dissociative reactions, flashbacks, event recurring
  - ▶ Intense distress at reminders
  - ▶ Physiological reaction to reminders

# PTSD in DSM-V (2013)

- ▶ Persistent avoidance of reminders
  - ▶ Avoidance of distressing memories, thoughts, feelings of traumatic event
  - ▶ Avoidance of external reminders: people, places, conversations, activities, situations

# PTSD in DSM- V

- ▶ Negative alteration cognitions, mood
  - ▶ Inability to recall aspect of trauma
  - ▶ Persistent negative beliefs re: self and world
  - ▶ Distorted cognitions re: cause of event
  - ▶ Persistent negative emotions (fear, anger, guilt)
  - ▶ Diminished interest important activities
  - ▶ Feeling of detachment from others
  - ▶ Inability to experience positive emotions

# PTSD in DSM-V (2013)

- ▶ Marked alterations in arousal, reactivity
  - ▶ Irritability, anger outbursts
  - ▶ Reckless, self-destructive behavior
  - ▶ Hypervigilance
  - ▶ Exaggerated startle response
  - ▶ Difficulty concentrating
  - ▶ Difficulty falling or staying asleep

# PTSD natural history: most get better

- ▶ PTSD symptoms emerge in 30% of those exposed to extreme stressors within days of the exposure, but usually resolve in a few weeks
- ▶ For 10-20%, PTSD symptoms persist w impairment in functioning
- ▶ 50% w PTSD improve without treatment 1yr, 10-20% develop a chronic disorder

# Barlow's Triple Vulnerability Model of PTSD

- ▶ Exposure to a traumatic event alone is not sufficient to cause PTSD
- ▶ Generalized Biological Vulnerability
  - ▶ Genetically inherited tendency to respond anxiously when faced with a threat
- ▶ General Psychological Vulnerability
  - ▶ Based on childhood experiences that taught the world is not a safe place
- ▶ Specific Psychological Vulnerability
  - ▶ Focus on catastrophic thoughts in specific situations



# PTSD epidemiology

- ▶ US
  - ▶ Lifetime prevalence: 6.8%
  - ▶ 12-month prevalence: 3.6%
- ▶ Vietnam veterans
  - ▶ Lifetime prevalence: 18.7%
  - ▶ 12-month prevalence: 9.1%
- ▶ Iraq veterans: 12.6%
- ▶ Afghanistan veterans: 6.2%

# PTSD-pain epidemiology

- ▶ 39% of MVA survivors seeking medical care
- ▶ 39% of assault victims seeking medical care
- ▶ Injured workers sent for rehab 35%
- ▶ Fibromyalgia 20% current, 42% lifetime
- ▶ In young adults, PTSD is the psych disorder most strongly associated with medically unexplained pain (Andreski et al. 1998).

# UWMC PainTracker data relationship with PTSD symptoms

Number of PTSD symptoms was significantly associated with ALL outcomes tracked in PainTracker. Effects were not limited to those patients that screened positive for PTSD (3/4 symptom domains)

Not only anxiety, depression and sleep. But pain intensity, interference, physical function, and opioid risk.

Number of PTSD symptoms	0 48% (N=1370)	1 13% (N=361)	2 12% (N=330)	3 10% (N=276)	4 17% (N=487)
OR Severe Pain $\geq 7$	reference	1.1 (0.9, 1.4)	<b>1.7 (1.3, 2.2)</b>	<b>2.0 (1.5, 2.6)</b>	<b>2.2 (1.8, 2.8)</b>
OR ORT High Risk	reference	<b>2.1 (1.5, 2.9)</b>	<b>2.4 (1.7, 3.3)</b>	<b>3.3 (2.4, 4.6)</b>	<b>4.6 (3.5, 6.0)</b>

Langford DJ, Theodore BR, Balsiger D, Tran C, Doorenbos AZ, Tauben D, Sullivan MD, Number of Post-Traumatic Stress Disorder (PTSD) Symptom Domains is associated with Patient-Reported Outcomes in Patients with Chronic Pain, *J Pain*, 2018

# Caring for patients with ACEs and chronic pain

- ▶ Trauma-informed care: rebuilding physical, psychological, social safety
- ▶ Shift from “what is wrong with you?” to “what happened to you?”
  - ▶ Expand conversation from medical issues to broader sense of stressors
  - ▶ From reports of damage to reports of danger
- ▶ Ask open-ended questions followed by active listening
  - ▶ Begin with questions about where they were born and raised and with whom
  - ▶ Then ask: “what was it like growing up in your family?”
  - ▶ Let patient reveal what they are ready to reveal, don’t press for most painful details

“When your brain is on fire, I can’t help your pain...” - David Tauben MD

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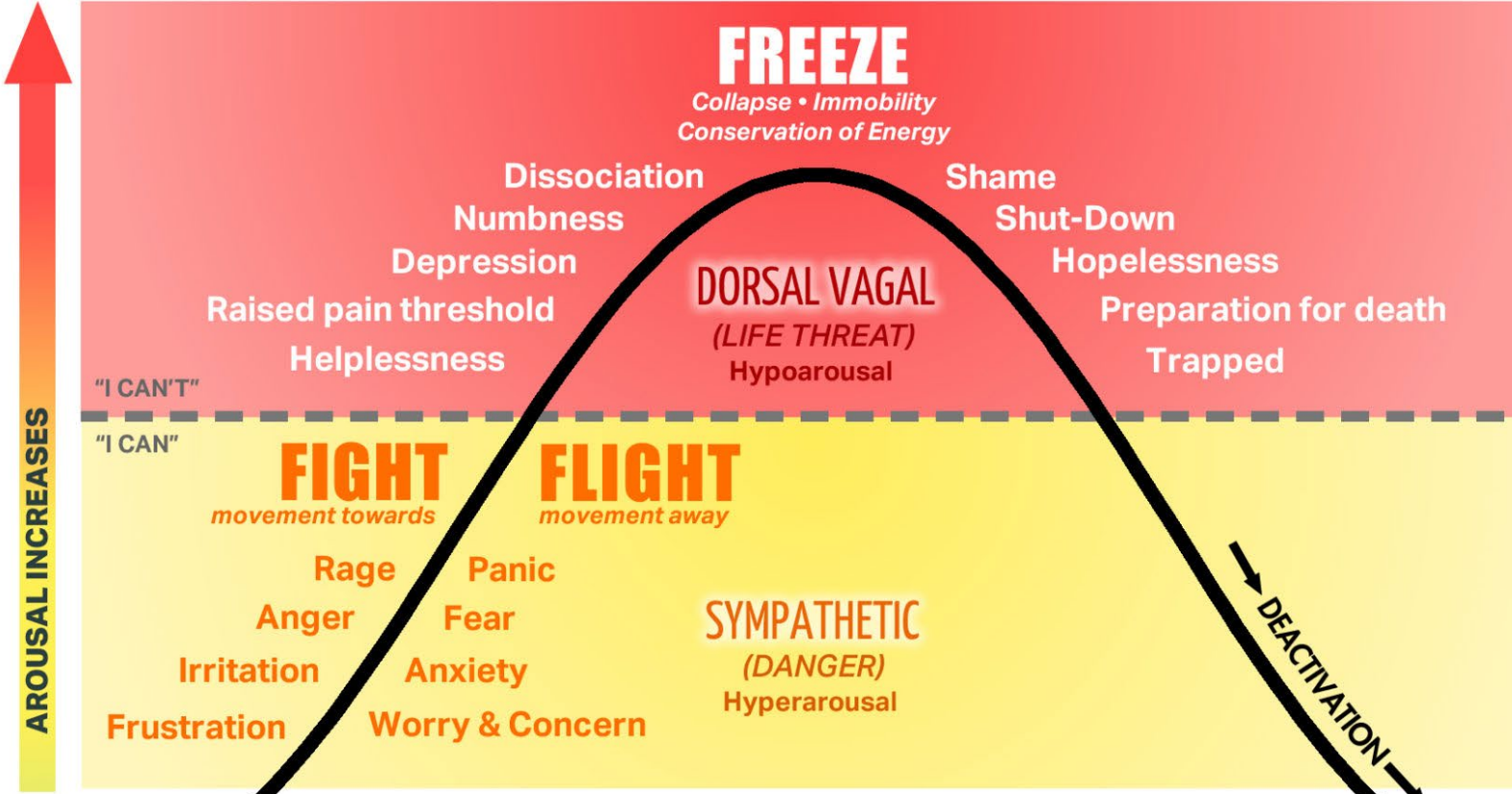
*Brain primed by trauma to be threat vigilant-- heightens pain experience through psychological and inflammatory mechanisms*

# Porges's polyvagal approach to trauma and dissociation

- ▶ Stephen Porges's polyvagal theory of the neurobiology of feeling safe
  - ▶ Based on neural regulation of mammalian autonomic state through vagus n.
    - ▶ Ventral (newer, myelinated) vagus: from nucleus ambiguus to organs above diaphragm
      - ▶ Sympathetic nervous system- Fight or flight response (released by ventral vagal withdrawal)
    - ▶ Dorsal (older, unmyelinated) vagus: from DNV to organs below diaphragm
      - ▶ Parasympathetic nervous system- Freeze response (shut down, dissociation)
  - ▶ Trauma can activate both aspects of the vagal stress response
    - ▶ We often consider only the sympathetic fight or flight response, but severe or early trauma tends to activate the parasympathetic freeze response
    - ▶ PTSD includes symptoms related to both dorsal and ventral vagus activation
      - ▶ FREEZE as well as FIGHT OR FLIGHT
  - ▶ Safety turns off defensive strategies and allows social engagement to occur, which increases resources for safety

# POLYVAGAL CHART

The nervous system with a neuroception of threat:



## PARASYMPATHETIC NERVOUS SYSTEM

DORSAL VAGAL COMPLEX

### Increases

Fuel storage & insulin activity • Immobilization behavior (with fear)  
Endorphins that help numb and raise the pain threshold  
Conservation of metabolic resources

### Decreases

Heart Rate • Blood Pressure • Temperature • Muscle Tone  
Facial Expressions & Eye Contact • Depth of Breath • Social Behavior  
Attunement to Human Voice • Sexual Responses • Immune Response

## SYMPATHETIC NERVOUS SYSTEM

### Increases

Blood Pressure • Heart Rate • Fuel Availability • Adrenaline  
Oxygen Circulation to Vital Organs • Blood Clotting • Pupil Size  
Dilation of Bronchi • Defensive Responses

### Decreases

Fuel Storage • Insulin Activity • Digestion • Salivation  
Relational Ability • Immune Response

The nervous system with a neuroception of safety:



## PARASYMPATHETIC NERVOUS SYSTEM

VENTRAL VAGAL COMPLEX

### Increases

Digestion • Intestinal Motility • Resistance to Infection  
Immune Response • Rest and Recuperation • Health & Vitality  
Circulation to non-vital organs (skin, extremities)  
Oxytocin (neuromodulator involved in social bonds that allows immobility without fear) • Ability to Relate and Connect  
Movement in eyes and head turning • Prosody in voice • Breath

### Decreases

Defensive Responses

# Pain as signal of damage or danger?

## From pain matrix to salience network

- ▶ Pain traditionally understood as a signal of actual or potential tissue damage that activates a distributed set of brain centers: “pain matrix”
- ▶ But activity throughout the “pain matrix” is actually stimulated by multisensory signals of danger, reaching beyond somatosensory system: vision, hearing, smell, taste (Legrain 2011, 2012)
- ▶ This “salience network” is activated by threats to bodily integrity (homeostasis) as well as by threats to personal integrity (identity)
- ▶ The salience network thus offers a way that threats from inside the body and threats outside the body can be integrated into the pain experience (De Paepe 2016)



# A smarter pain system oriented toward: survival, homeostasis, integrity preservation

- ▶ Relation between pain and tissue damage highly variable
  - ▶ Mismatch is common, not limited to rare circumstances
  - ▶ Bad idea that chronic pain is providing information about tissue damage
- ▶ Pain is continuously modulated to promote **survival**
  - ▶ Pain is protective more than informative; it commands protection
  - ▶ Pain is interoceptive like temperature, not exteroceptive like touch
  - ▶ Focused on danger detection: threats to bodily, personal integrity
  - ▶ Similar to other protective homeostatic emotions: anxiety, depr.

## Case: Francine 48 yr old police officer

- ▶ In 2015, during an arrest, she was held with a gun to her head as the suspect threatened to shoot her if he was not released.
- ▶ She has had headaches, shoulder and neck pain since this episode.
- ▶ She has been unable to return to work despite treatment with: cervical nerve blocks, sumatriptan, oxycodone, physical therapy



## Case: Francine 48 yr old policewoman

- ▶ During your 3<sup>rd</sup> clinic visit, Francine tells you she is divorced from her husband because of repeated episodes of domestic violence. When he drank, he would hit her in the head, neck, and face.
- ▶ During your 10<sup>th</sup> clinic visit, Francine tells you that she recently started to remember episodes when she was 7-10 years old when her grandfather used to come into her bedroom at night and fondle her.
- ▶ She has nightmares of these events most every night. She feels “on edge” during the day, easily startled, anxious, and irritable.



# Treatments for Francine

- ▶ Explain that her pain arises, not simply from damage in the parts of her body that hurt, but from a pain system that is over-activated or sensitized by her trauma: fight-or-flight system that can't be turned off
- ▶ Target reduction of nightmares and hyperarousal with the alpha-blocker prazosin. Begin at 1mg qHS and advance by 1 mg per week until nightmares are gone (doxazosin, terazosin as alternatives)
- ▶ Offer evidence-based psychotherapy for her PTSD
  - ▶ PE, CPT, EMDR
  - ▶ Trauma-informed yoga

# Conclusions

- ▶ Psychological trauma is an important contributor to chronic pain
  - ▶ Can delay recovery and produce resistance to medical and physical treatment
  - ▶ This trauma can occur during the index injury, or years, or decades before
  - ▶ This trauma “resets” the sensitivity of the stress response (HPA) system, leading to peripheral and central sensitization
  - ▶ This trauma often, but not always, results in PTSD in the present
- ▶ Chronic pain care must address this general threat sensitization before recovery, or even focal pain treatments, can succeed
  - ▶ Nerve blocks, ESI, PT, CBT, ADs often do not work unless this is done