Invisible but Dangerous: Understanding Concussions and Strangulation in Women Victims of Partner Violence

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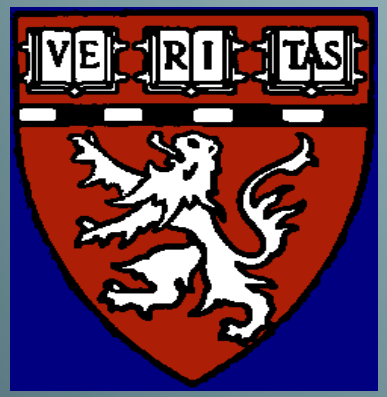


Intimate Partner Violence (IPV) is a public health epidemic

- Intimate partner violence is violence perpetuated by a current or former spouse, partner, significant other, boyfriend or girlfriend.
- IPV is the **leading cause of homicide** for women globally.
- It is the **most common form** of violence against women.
- Traverses **all socioeconomic** boundaries.
- But is it really that common??

1 in 3 women experience physical or sexual IPV

Daughters

Sisters

Mothers

Friends

Colleagues

Partners

Women endure violent abuse to the head with an estimated 80-90% of injuries to the neck and higher

Women who experience IPV report high rates of cognitive, physical and emotional problems

Cognitive	Physical	Emotional
Memory problems	Headaches/migraines	Anxiety/irritability
Taking longer to think	Fatigue and sleep problems	Depression/mood swings
Decreased concentration	Balance problems	Impulsive behavior
Impaired word finding	Dizziness	Restlessness
Impaired judgment	Nausea	Inappropriate behavior
Difficulty with initiation and follow through	Visual disturbances	Aggressive behavior

The majority of women experiencing IPV sustain IPV-related TBI

42,000,000

31,500,000

75% ≥ 1 IPV-TBI

21,000,000

50% repetitive IPV-TBI

(Valera and Berenbaum *JCCP* 2003; Valera et al *J Neurotrauma* In press)

IPV-related TBIs are associated with poor cognitive and psychological outcomes

- Having more TBIs was associated with:
  - Poorer performance on tests of memory, learning and mental switching abilities
  - Higher ratings of general distress, depression, worry, anxiety, and traumatic stress

- Was NOT accounted for by:
  - abuse severity
  - psychopathology
  - substance abuse

(Valera and Berenbaum, 2003)

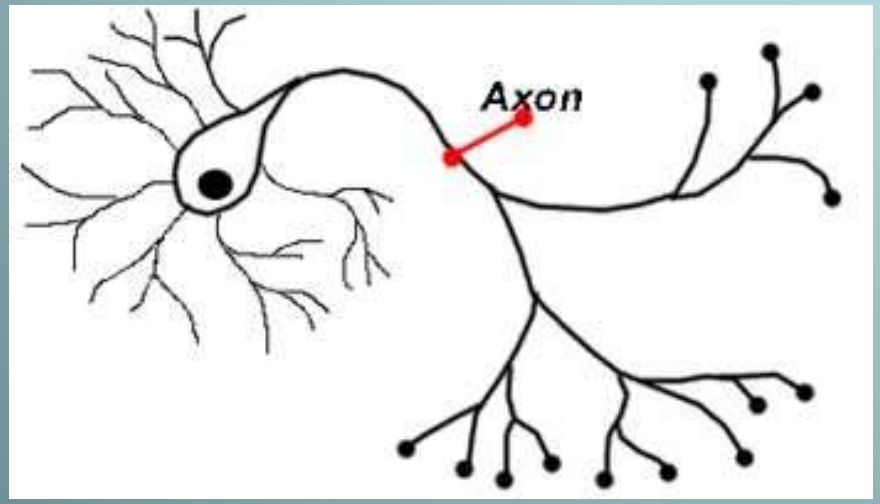
A TBI or concussion involves an external force to the brain and an alteration in brain function

- https://youtu.be/Sno_0Jd8GuA
- https://www.cdc.gov/headsup/basics/concussion_whatis.html)

Healthy functional and structural connectivity are critical for optimal thinking and behavior

- Functional connectivity provides information on inter-regional correlations of brain activity.
  - Is this brain region communicating with other brain regions?
  - To what degree are these brain regions communicating?
- Structural connectivity - axons connecting different brain regions

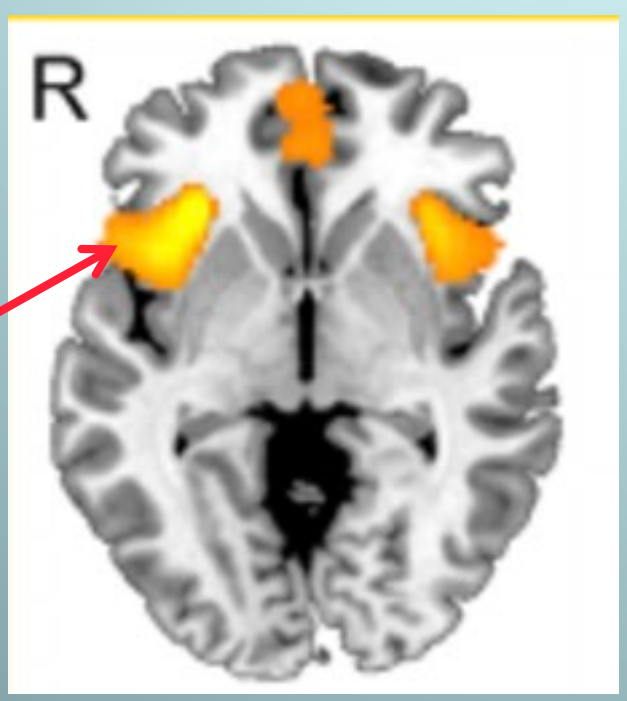
Diffuse axonal injury from TBI may affect functional and structural connectivity



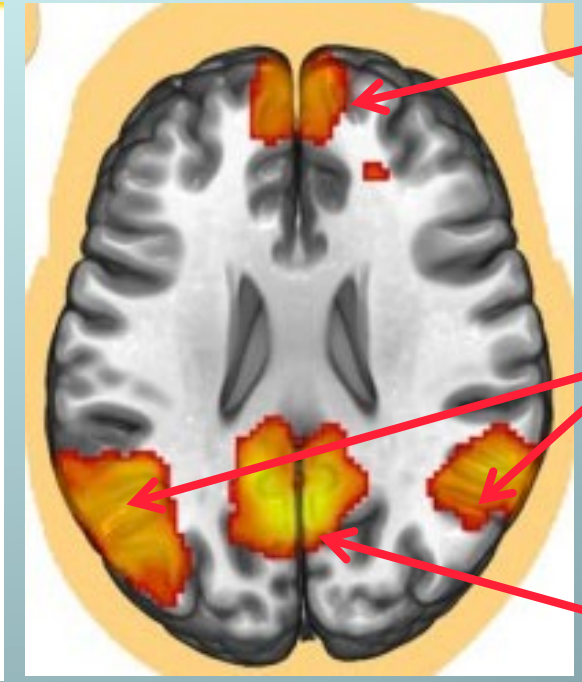
Traumatic shearing - occurs when head rapidly undergoes acceleration, deceleration, or rotational forces

Neuron can be injured - so neurons can not communicate with one another efficiently or at all.

Neural networks need to work together for efficient cognition



Anterior insula



Medial prefrontal cortex

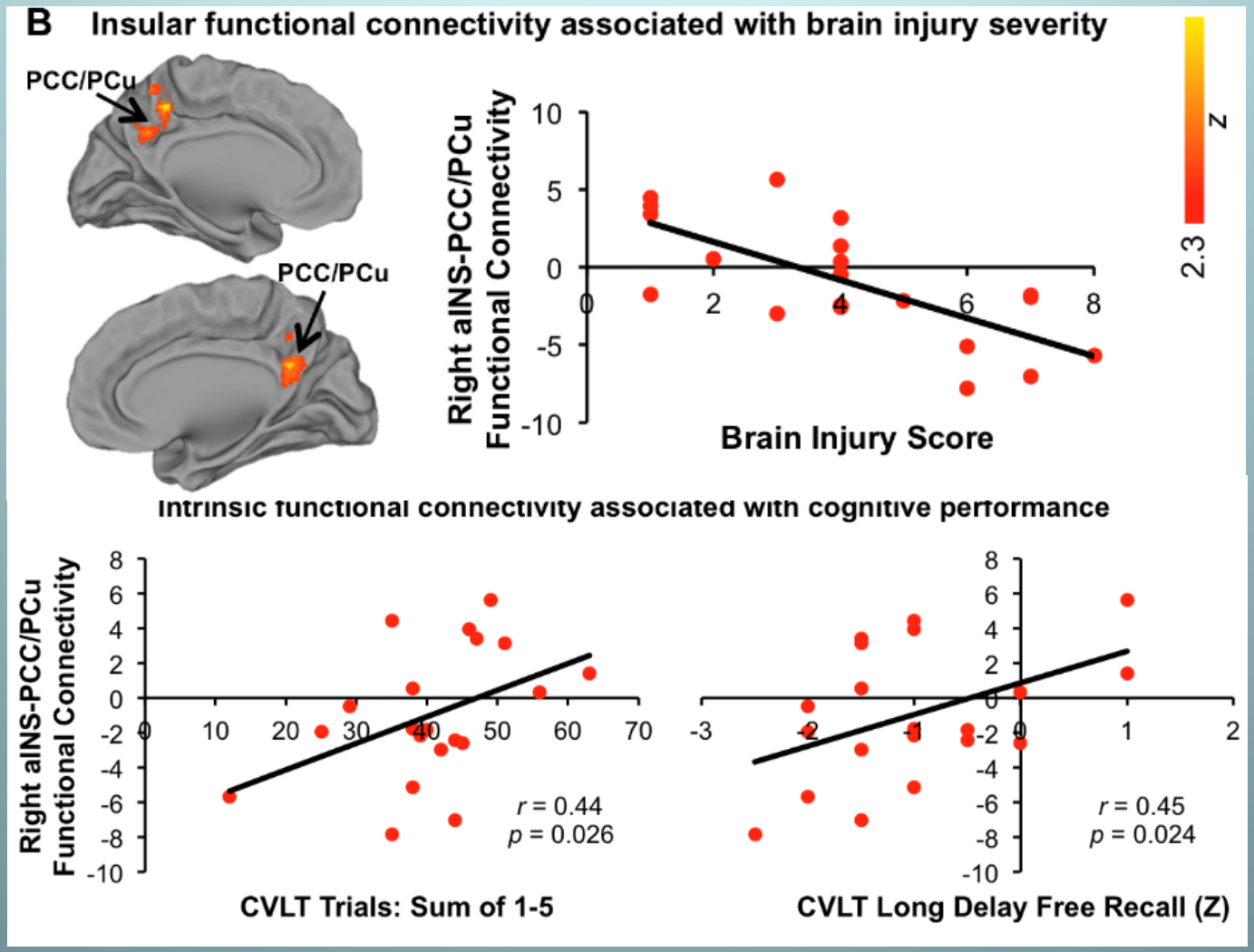
Posterior parietal cortex

Posterior cingulate/ precuneus

Salience Network Default Mode Network

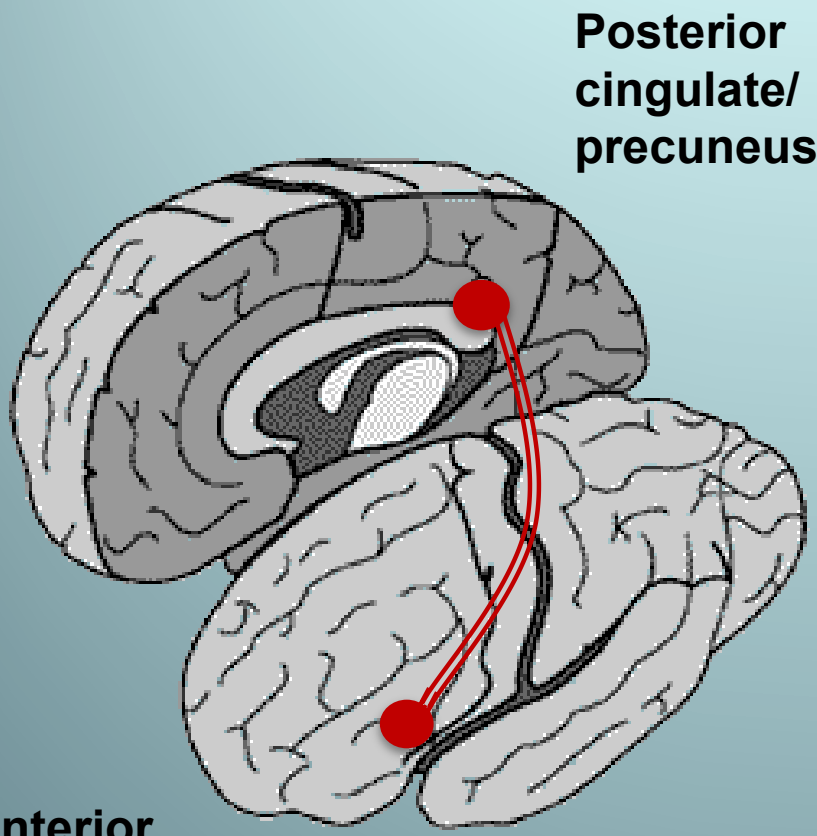
Anterior insula coordinates inter-network interactions

TBIs are associated with network connectivity which is associated with memory and learning



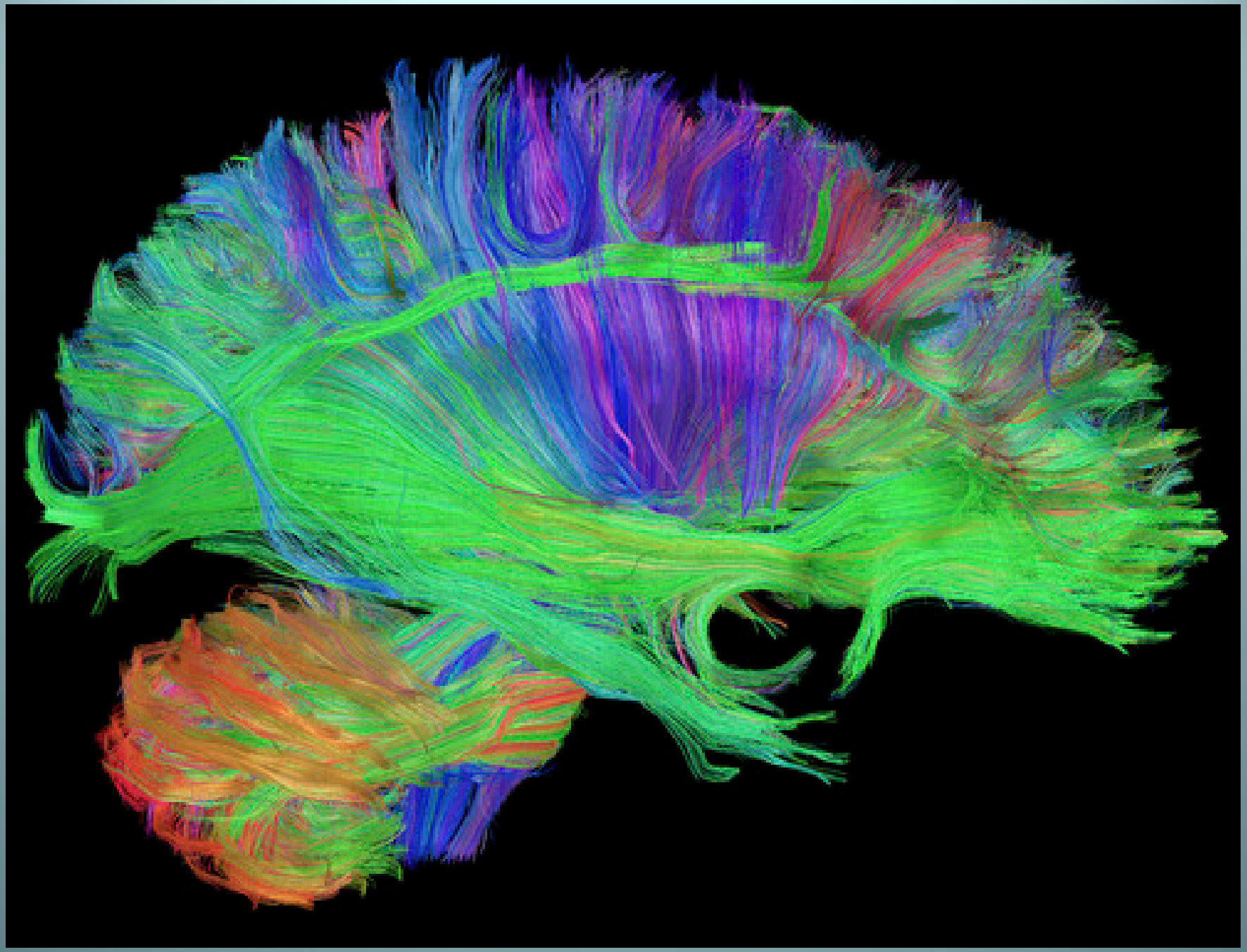
Valera & Kucyi *Brain Imag Behav* 2016

Network communication is associated with number of IPV-related TBIs and cognition

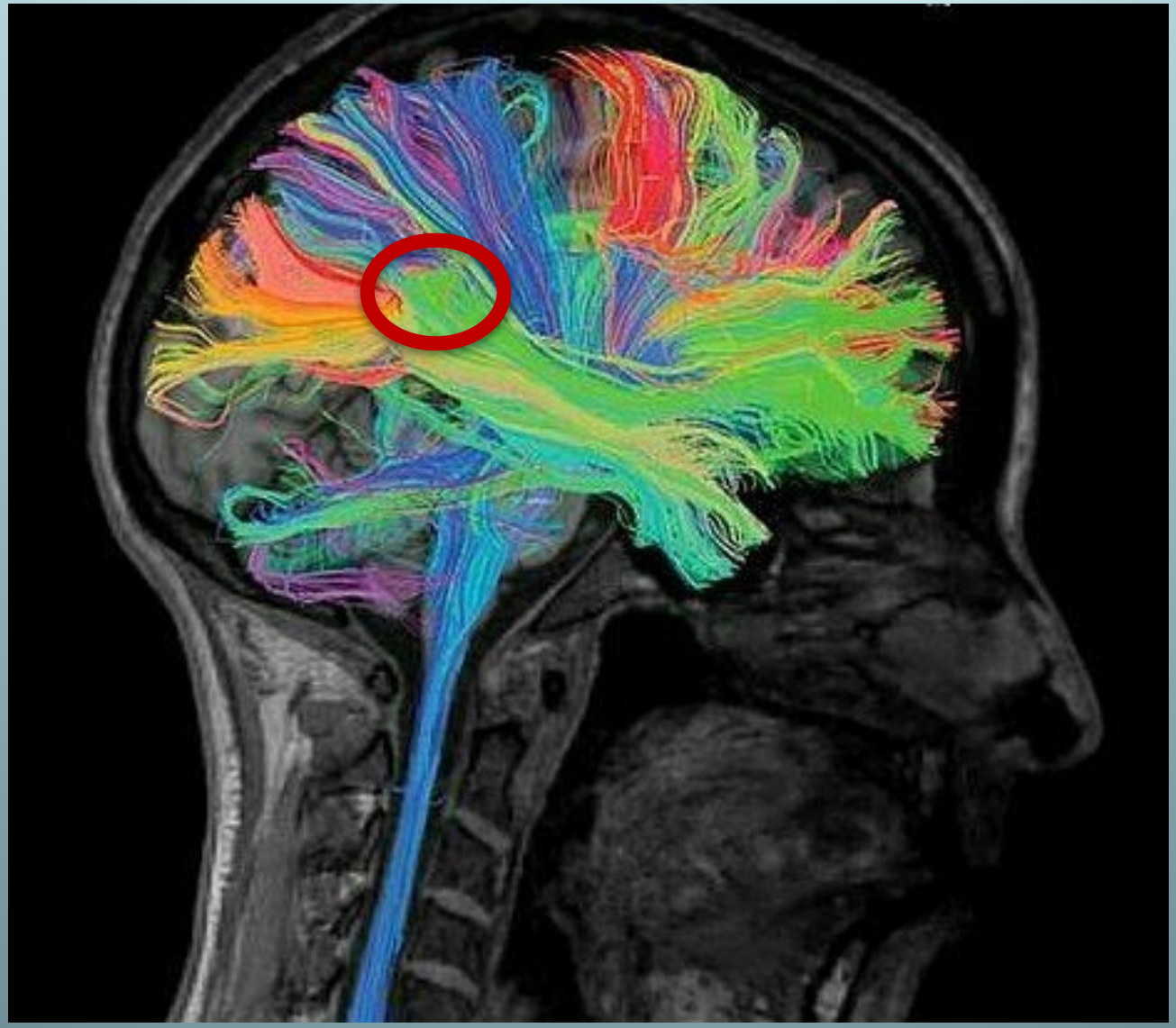


(Brain illustration by Eric Chudler)

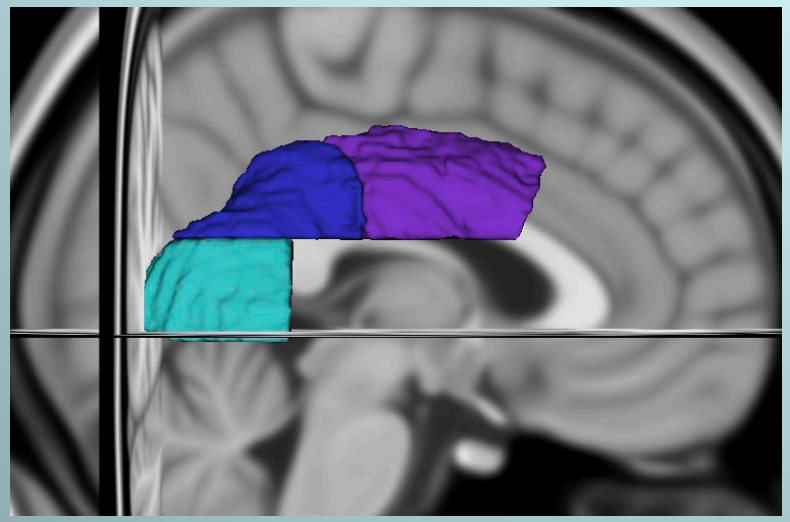
- The more recent and greater number of TBIs a woman had, the less positively these two brain regions communicated with one another.
- The less these two brain regions communicated with one another, the worse a women tended to be able to learn a list of words and remember them 20 minutes later.



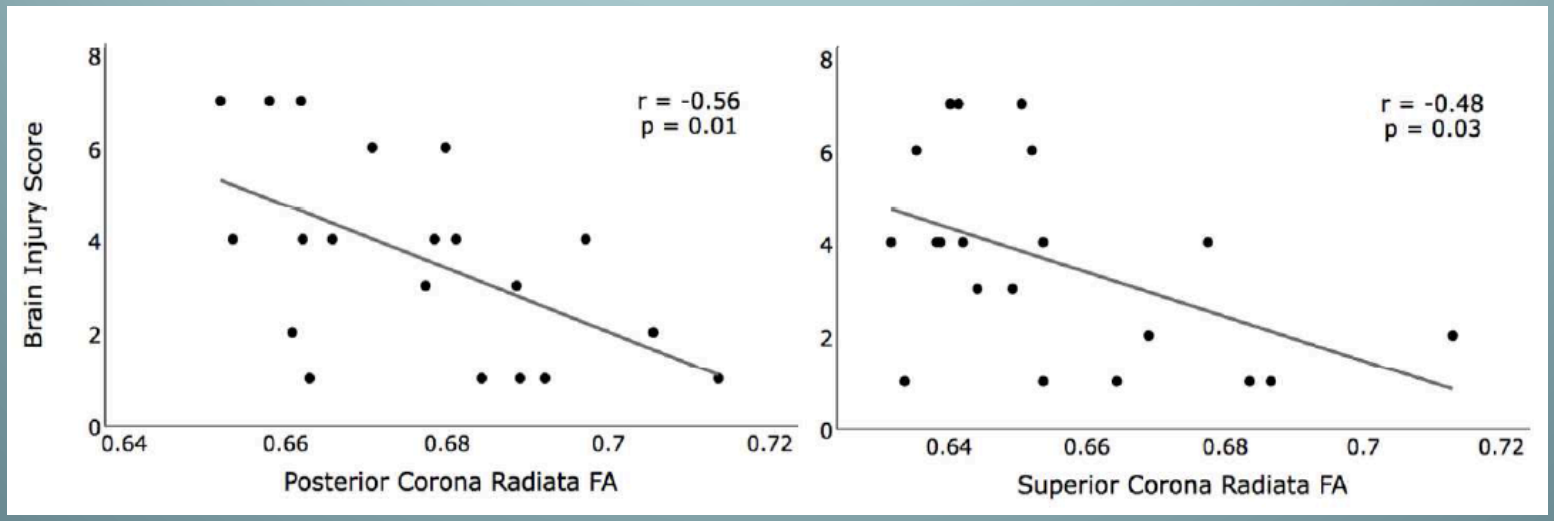
Long axonal fibers are susceptible to injury



IPV-TBIs are associated with structural connectivity in the posterior and superior corona radiata



Superior corona radiata: Purple
Posterior corona radiata: Blue
Posterior thalamic radiation: Cyan



Valera et al *J Neurotrauma* In press

Women subjected to IPV report a range of post-concussive symptoms

- Post-concussion syndrome is a complex disorder in which various symptoms (headaches, dizziness) last for weeks and sometimes months after the TBI
- Occurs within days
- Typically resolves within 3-6 months but may persist for a year or longer

Post-Concussive Syndrome is common in women subjected to IPV (of 99 women)

- 71% met criteria for at least mild PCS
- 43% met criteria for moderate-severe PCS
- Excluding women with MTBIs occurring within 4 weeks of assessment
  - 70% mild
  - 31% moderate-severe

Post-Concussive Syndrome is common in women subjected to IPV (of 20 women)

- 63% met criteria for at least mild PCS
- Most common symptoms
  - Feeling depressed or tearful (58%)
  - Headaches (53%)
  - Being “irritable or easily angered”, “frustrated or impatient”, restlessness (47%)
  - Poor concentration (42%)
  - “Sleep disturbances”, “forgetfulness, poor memory”, “taking longer to think” (37%)

Women experiencing IPV have poor TBI recovery factors

- Acute management of TBI
- Previous concussion
- Biological – other bodily injury, general health
- Psychological distress
- Acute intense stress
- General life stress
- Sex

Women sustaining concussive blows to the head tend to fare worse than men

- Still very little evidence BUT most tends to suggest that TBI for women:
  - Occurs more easily
  - Takes longer to resolve
  - Results in slightly different symptom presentation

  - Female axons were found to be consistently smaller and at greater risk for failure during trauma compared to male axons

TBIs can make it harder for a woman to survive, escape, or keep children

- Having a TBI might make it harder to:
  - Assess danger and defend herself against further abuse
  - Make and remember safety plans
  - Go to school or hold a job (financial dependence)
  - Leave abusive partner and live on her own
  - Access necessary services
  - Adapt to living in a shelter
  - Retain custody of her children
- Having a TBI does **NOT** = “unfit”!

Custody Dilemma? In an IPV situation, the children are likey safer with the non-abusing parent

two out of three of those reports result in an investigation. In 2004 alone, an estimated 872,000 children were victims of abuse or neglect as substantiated by CPS (U.S. Department of Health and Human Services, 2006). However, given that child abuse is underreported to authorities, actual rates of child abuse are likely higher.

Child abuse and IPV are quite likely to happen in the same families; the rate of overlap is estimated to be between one third and two thirds. In the majority of overlapping cases, it is a father or father figure abusing both the mother and child(ren) (Salcido Carter, Weitherorn, & Behrman, 1999; Stark & Flitcraft, 1998).

Although estimates do vary, between three and 10 million children witness IPV each year (Edleson, 1999). Many, but not all, of these children are also subjected to physical abuse or neglect. Currently, states, and even counties within states, differ in the policies that address the overlap between child maltreatment and IPV. For instance,

Take Home Points for IPV-Related TBI

IPV-related TBIs, especially repetitive mild TBIs occur at a high rate.

Recognize the strong potential for a TBI in every IPV case.

IPV-related TBIs have a negative effect on:

- **-cognitive functioning**
- **-psychological health**
- **-functional connectivity**
- **-structural connectivity**

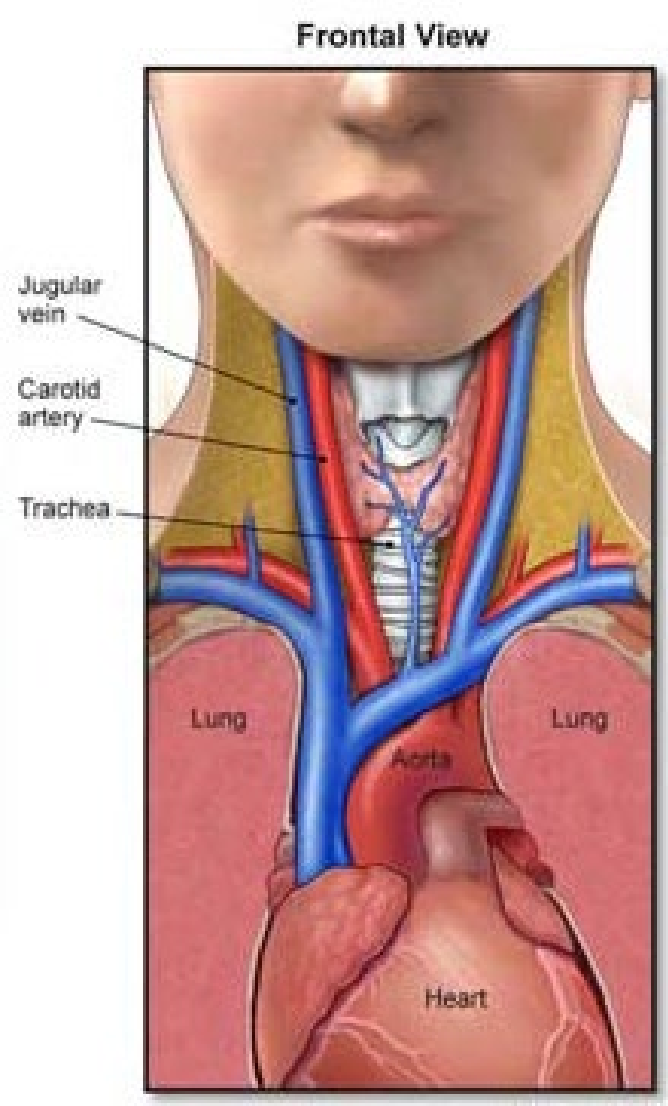
IPV-related TBIs can interfere with a woman's ability to escape a dangerous or lethal situation.

IPV-related TBI should be considered great bodily injury!

Strangulation is a serious form or abuse that can cause acquired TBIs

- NOT “choking”
- External attack on neck
- Asphyxia – depriving the body of oxygen leading the body to unconsciousness or death
  - Hypoxia: partial loss of oxygen to tissue
  - Anoxia: complete absence of oxygen to tissue
- Ligature or manual

Strangulation is a form of asphyxia from external pressure placed upon the neck



Such that there is an obstruction of:

1) Blood flow either from or to the brain (via the jugular vein/or carotid artery)

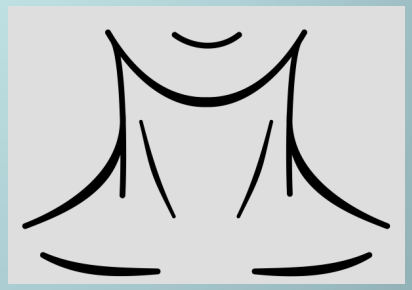
2) Airway

Blood buildup or lack of enough oxygen from strangulation can cause damage quickly

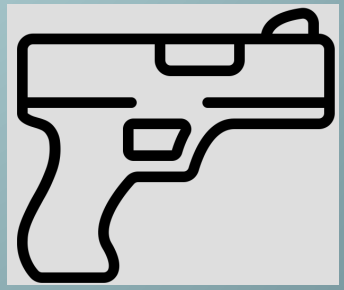
- Unconsciousness can result within 2 minutes from blood build-up
- Unconsciousness can result within 10 seconds from anoxia
- Strangulation can cause brain death in less than 4 minutes while leaving no external mark
- Damage may result in death weeks later (swelling, carotid dissection resulting in stroke, internal bleeding, respiratory problems and pneumonia)

Remarkably little force is required to render someone unconscious from strangulation

- **4.4** pounds of pressure (psi) to block the jugular
- **11** psi to block the carotid



- Compare to:
- **6** psi to fire a handgun



- **80-100** psi for average male handshake

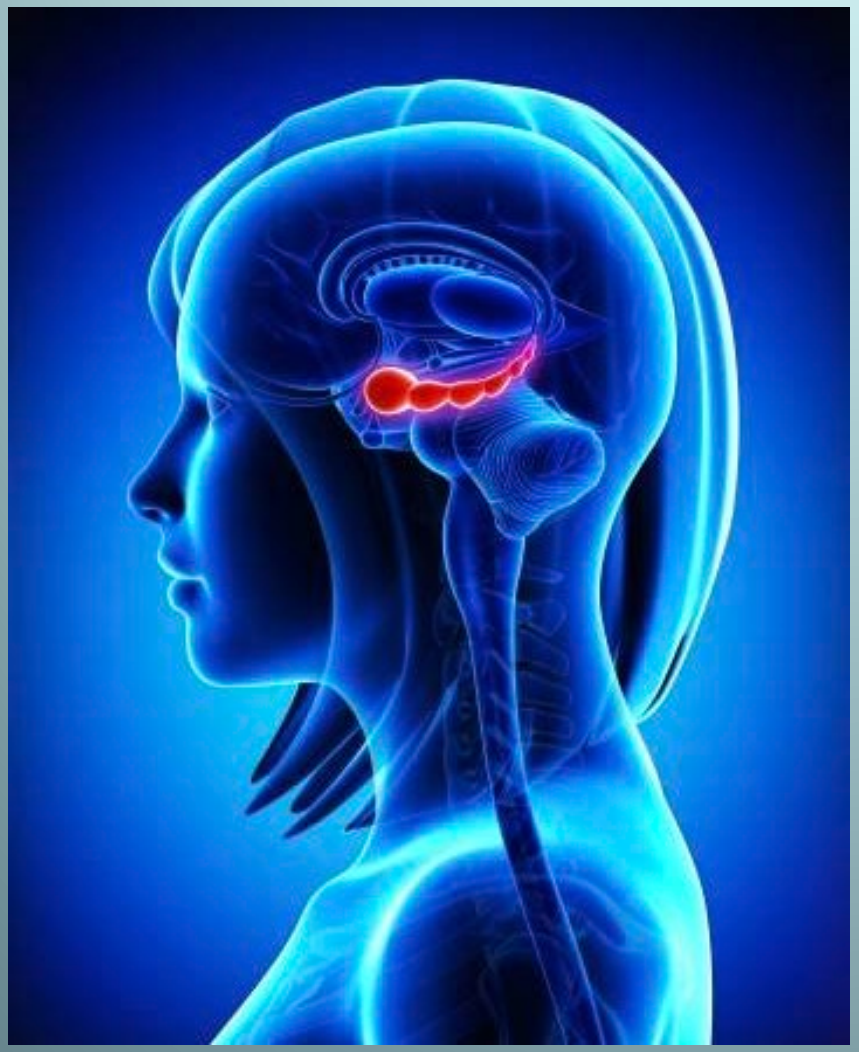
Strangulation is one of the best predictors of later homicide

7X

- The odds of becoming a homicide victim increased by about seven-fold for women who had been previously strangled by their partner

- Study of 57 murdered Chicago women: 53% were strangled in the year prior to being murdered

Strangulation with an alteration in consciousness is an acquired brain injury



- Hypoxia and anoxia kill brain cells
  - Hippocampus is particularly vulnerable and may result in memory loss for the incident
  - Other brain regions may also be affected depending on force, location, duration and previous history
- Exacerbates/interacts with other TBIs???

Strangulation with an alteration in consciousness occurs frequently

- 27% (27 out of 99; ½ from shelter, ½ non-shelter)
- 30% (6 out of 20; mostly shelter)
- 23% in another sample

Women do not leave because they can't!

Raising awareness everywhere is critical!

- First responders including police and paramedics
- Judges – custody, criminal, restitution
- IPV support staff
- Women themselves – understanding the potential impact of TBI and its sequelae on their lives
  - May be interfering with their ability to function
  - Hindering their ability to escape the abusive situation
  - Unaware of the possible long term effects and that they may be related to TBI; Chronic Traumatic Encephalopathy (CTE)

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IPV-related TBIs are a public health epidemic in desperate need of being understood

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