



NEURO  
INSTITUTE

Continuing Education for Rehabilitation Professionals



# Traumatic Brain Injury, Risky Substance Use and Substance Use Disorders

John D. Corrigan, PhD

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Director, Ohio Brain Injury Program

## NeuroRestorative's COVID-19 Response



- We are committed to protecting the health and safety of the individuals we serve, our staff, and the community. Our services are considered essential, and we are taking precautions to minimize disruption to services and keep those in our care and our team members safe. In some programs, that has meant innovating our service delivery model through Interactive Telehealth Services. We provide Interactive Telehealth Services throughout the country as an alternative to in-person services. Through Interactive Telehealth Services, we deliver the same high-quality supports as we would in-person, but in an interactive, virtual format that is HIPAA compliant and recognized by most healthcare plans and carriers.
- You can learn more about our COVID-19 prevention and response plan at our Update Center by visiting [neurorestorative.com](https://neurorestorative.com).

# No Financial Conflicts of Interest

- I receive funding from the National Institute on Disability Independent Living and Rehabilitation Research (NIDILRR), the Administration on Community Living (ACL) TBI State Partnership Program and the National Institutes of Health (NIH).
- With Jennifer Bogner, PhD, I created the Ohio State University TBI Identification Method (OSU TBI-ID) which is available for free.

# 4 Questions Will Be Addressed

1. What is an acquired brain injury?
2. What are the effects of TBI and other acquired brain injuries?
3. Why would brain injury be associated with behavioral problems?
4. How can you determine if a person has had a TBI or other brain injuries?

1. What is an acquired brain injury (ABI)?

# What is Acquired Brain Injury

An acquired brain injury (ABI) is an injury to the brain that is not hereditary, congenital, degenerative, or induced by birth trauma:

- Cerebrovascular Accident (CVA; e.g., stroke, TIA, aneurysm)
- Infections & encephalopathies
- Tumors
- Toxic/metabolic (e.g., drugs, metals, toxins, ketoacidosis)
- Anoxic/hypoxic brain injury (e.g., respiratory arrest [including opioid overdose and strangulation], heart attack, drowning)
- Traumatic brain injury (TBI)

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# Acquired Brain Injury (ABI) vs Traumatic Brain Injury (TBI)

## ABI

An injury to the brain that is not hereditary, congenital, degenerative, or induced by birth trauma:

- Strokes/cva
- Infectious diseases
- Tumors
- Anoxia & hypoxia
- Traumatic brain injury

## TBI

Disruption of brain function caused by an external force

- Effects can be temporary or permanent
- A concussion is a TBI
- Vary greatly in severity



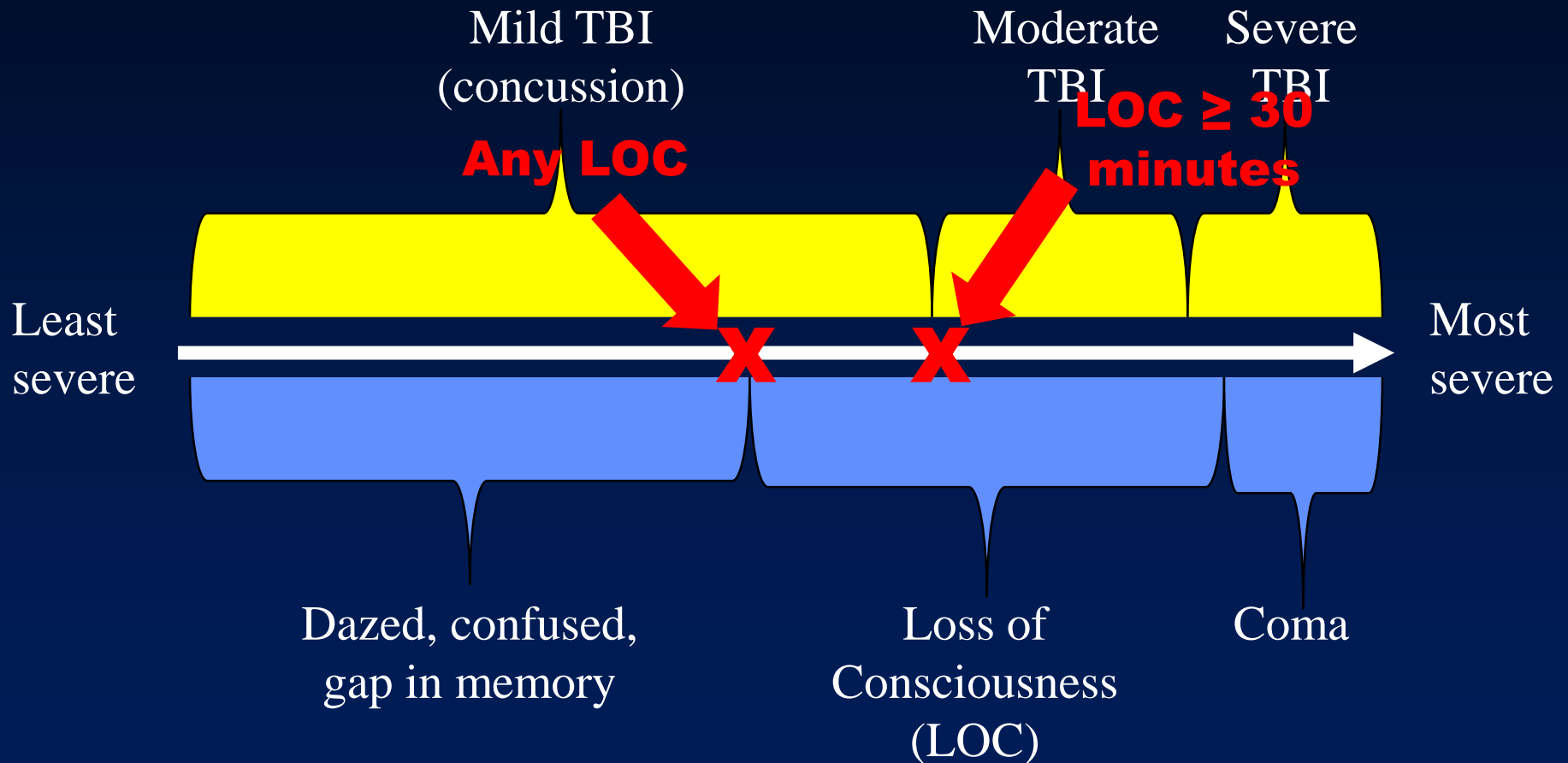
## Poll Question\*

TBI is...

- A. A life altering injury for survivors and their families, profoundly impacting the patient's functional status.
- B. A very common injury that is essentially inconsequential to the individual's functional status following recovery.
- C. Both A and B and everywhere in between.

\*Thanks D. Arciniegas & H. Wortzel for this slide

# Continuum of TBI Severity



# Not Just Severity of Injury

- Cumulative effects from multiple TBIs even when they are mild
  - number and/or spacing?

# TBI due to Blasts—the “signature injury” of combat in Iraq and Afghanistan

- Can blast forces alone cause mild TBI?
- If so, is it the same pathology as TBI caused by mechanical forces?
- What about multiple blasts?

# Groups Who May Have Multiple Mild TBI's

- Military personnel, particularly those with combat deployment in OEF/OIF
- Contact sports athletes, for example boxers, football players & hockey players
- Victims of intimate partner violence and childhood physical abuse
- People who engage in risky substance use
- Other vulnerable populations (e.g., those with psychiatric disorders, who are homeless or incarcerated)

# Not Just Severity of Injury

- Cumulative effects from multiple TBIs even when they are mild
  - number and/or spacing?
- Age at injury
  - childhood but also with normal aging
- How recent
- When combined with other neurological conditions

# Re-cap

- ABI is an injury to the brain after birth
- Except for TBI and hypoxic/anoxic injuries, most ABIs are diagnosed
- TBI occurs when an external force causes an alteration in brain function
- A concussion is a mild TBI
- TBIs range from mild to severe
- Mild TBIs may have cumulative effects or interact with normal development

2. What are the effects of TBI and other acquired brain injuries?

# Immediate Effects of TBI (including concussion)

- Headaches or neck pain
- Light-headedness, dizziness, or loss of balance
- Difficulty remembering or concentrating
- Feeling tired, having no energy or motivation
- Changes in sleep patterns (sleeping a lot more or having a hard time sleeping)
- Mood changes (feeling sad or angry for no reason)
- Increased sensitivity to lights, sounds, or distractions
- Blurred vision or eyes that tire easily

If symptoms do not resolve — “Post-Concussive Syndrome”

# Lifetime history of TBI with Loss of Consciousness

(Corrigan et al., 2017; Yi et al., 2018; Manchester et al., 2018; Bogner et al., 2019)

- More likely to have a disability (AOR=2.5)\*
- More likely depression in one's lifetime (AOR=2.1)
- More days of poor mental health (AOR=2.0)
- More likely to have fair or poor general health (AOR=2.0)
- More likely diagnosed with a chronic disease (AOR=2.0)
- More likely to engage in heavy drinking (AOR=1.7)
- More likely to smoke cigarettes (AOR=1.7)
- More likely to sleep < 7 hours per night (AOR=1.5)

\*All adjusted for sex, age and race/ethnicity

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# Lifetime Prevalence of TBI in Select Populations

Lifetime History of TBI:	Any TBI	TBI with LOC	Mod/Sev TBI
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LOC = loss of consciousness; Mod/Sev = moderate or severe

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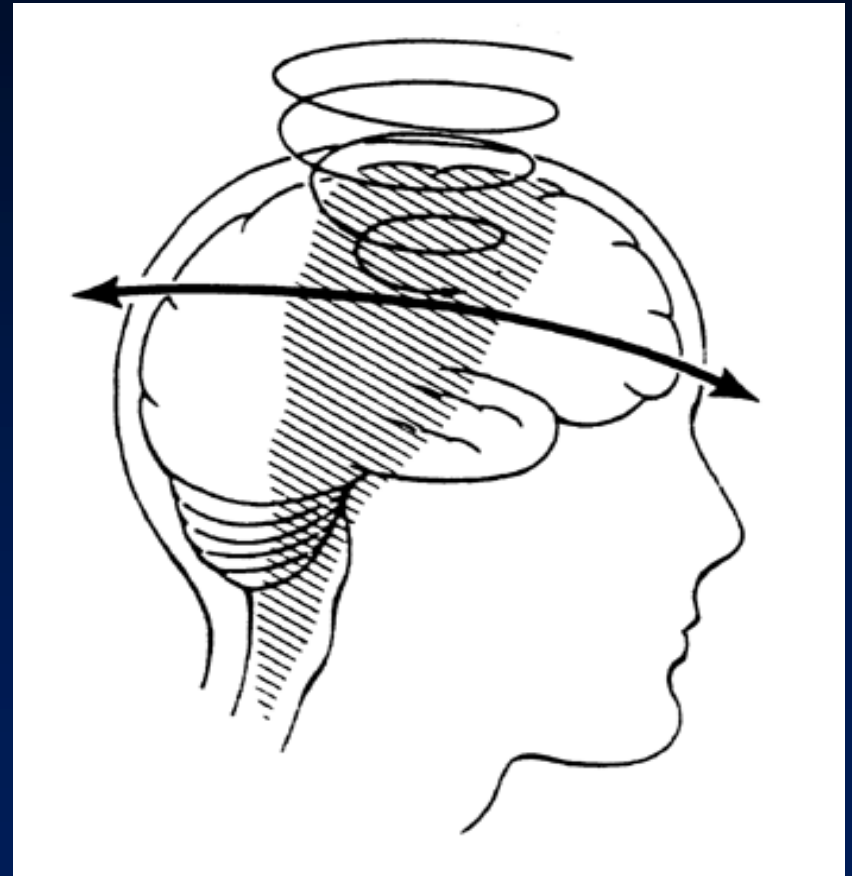
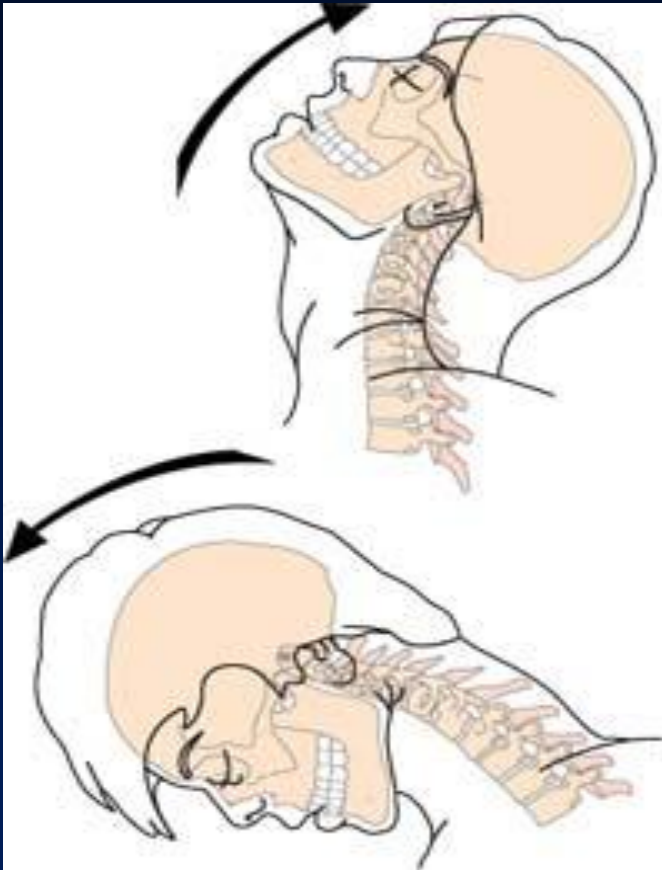
LOC = loss of consciousness; Mod/Sev = moderate or severe

3. Why would brain injury be associated with behavioral problems?

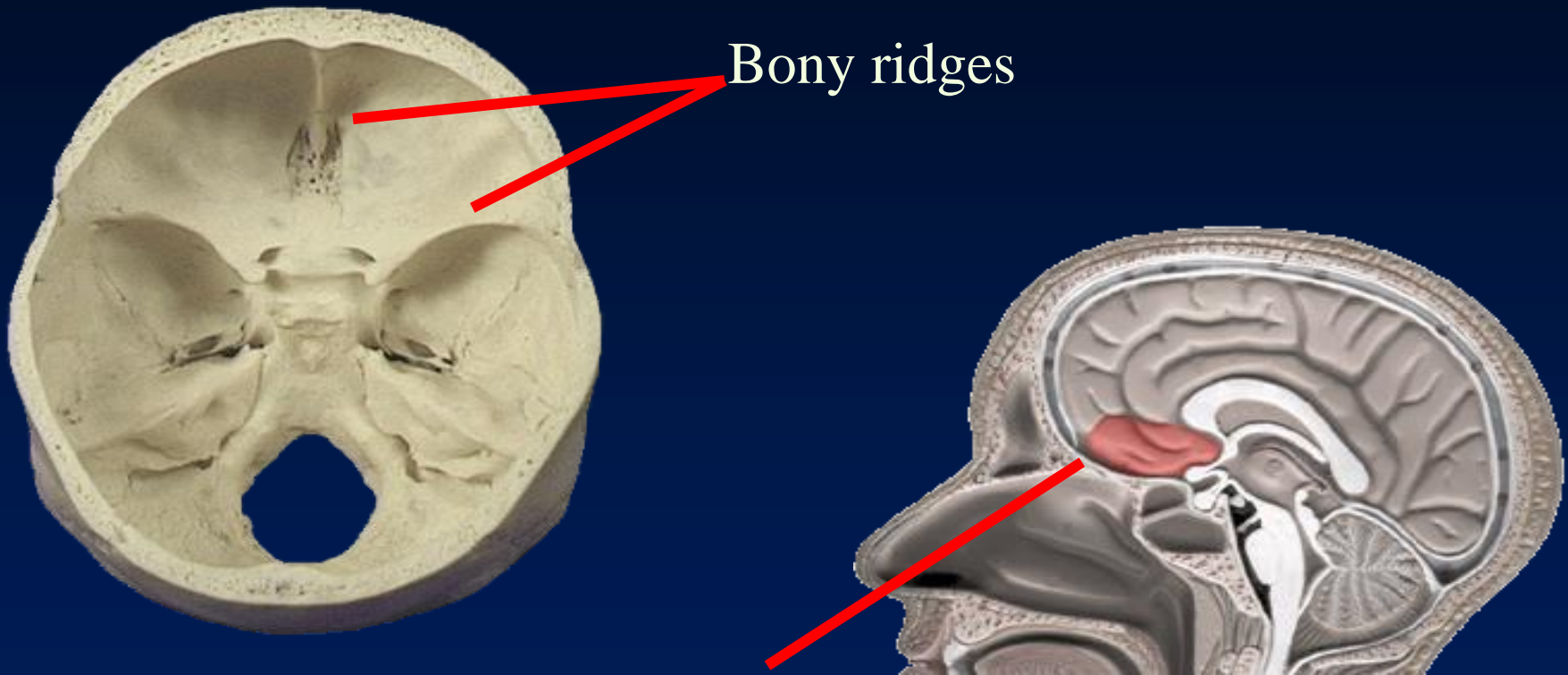
## The “Fingerprint” of TBI

Frontal areas of the brain, including the frontal lobes, are the most likely to be injured as a result of TBI, regardless the point of impact to the head

# The brain is set into motion along multiple axial planes



## Interior Skull Surface

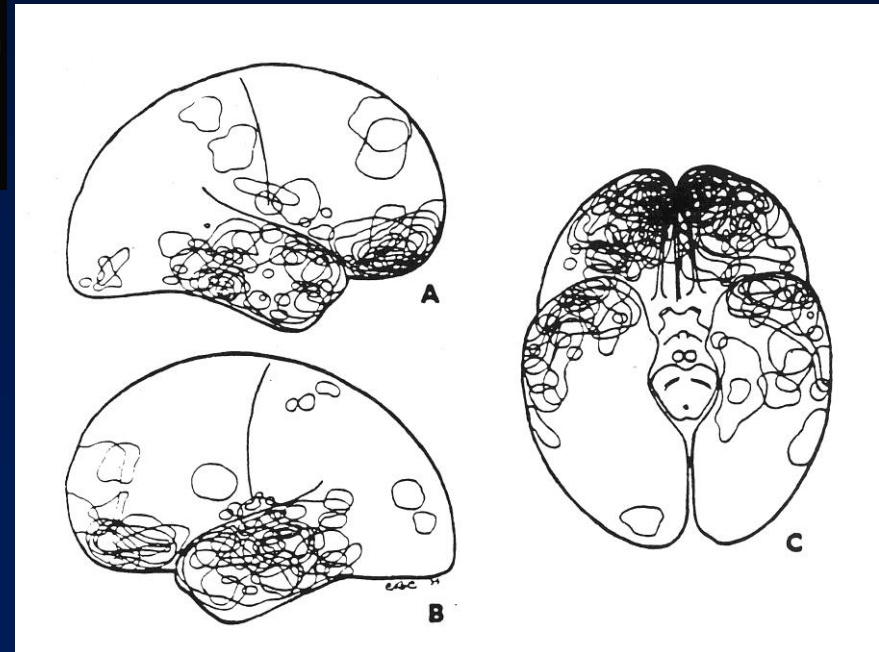


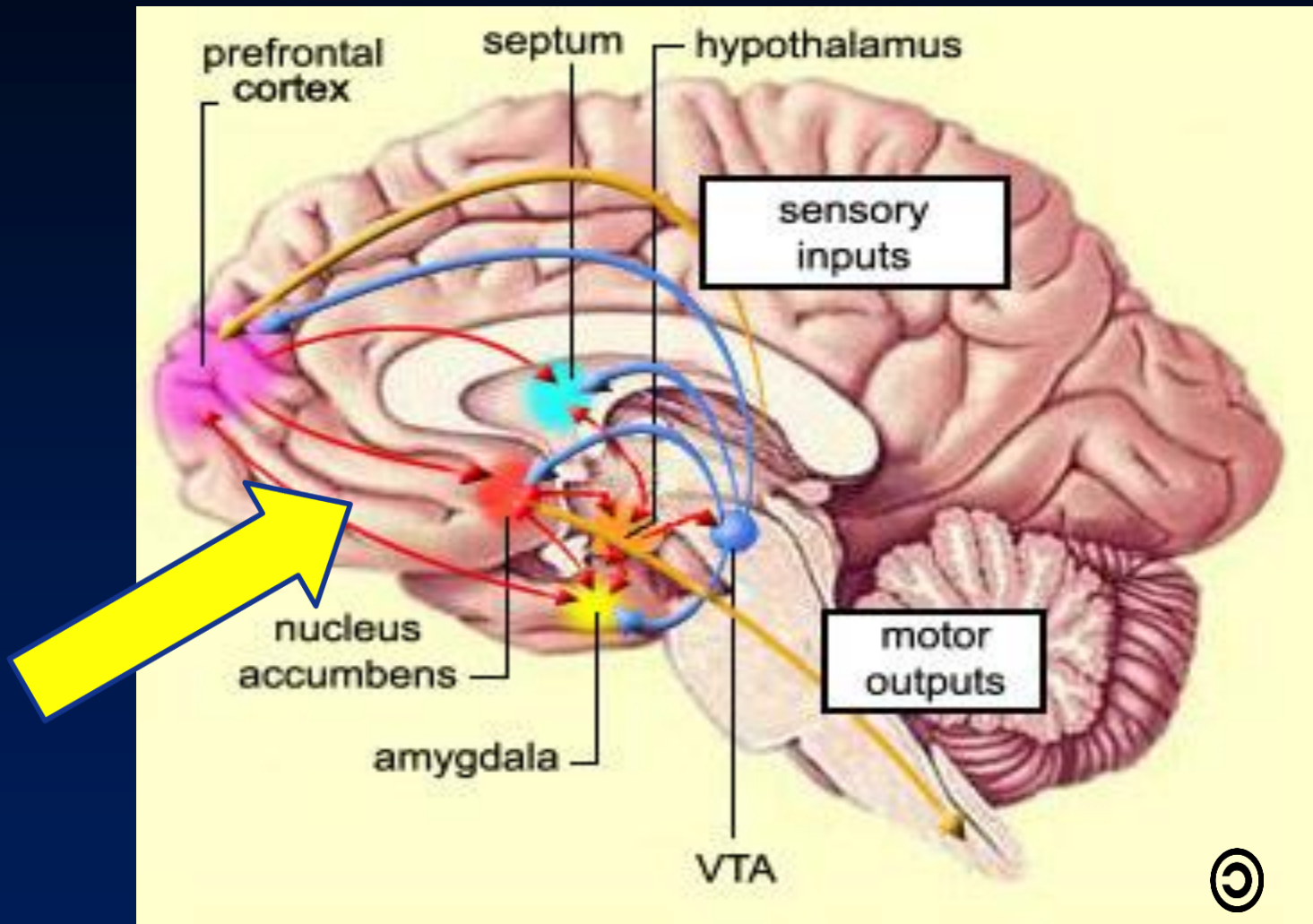
Injury from contact with  
skull

# Pathophysiology

Areas of contusion in  
(Courville, 1950)

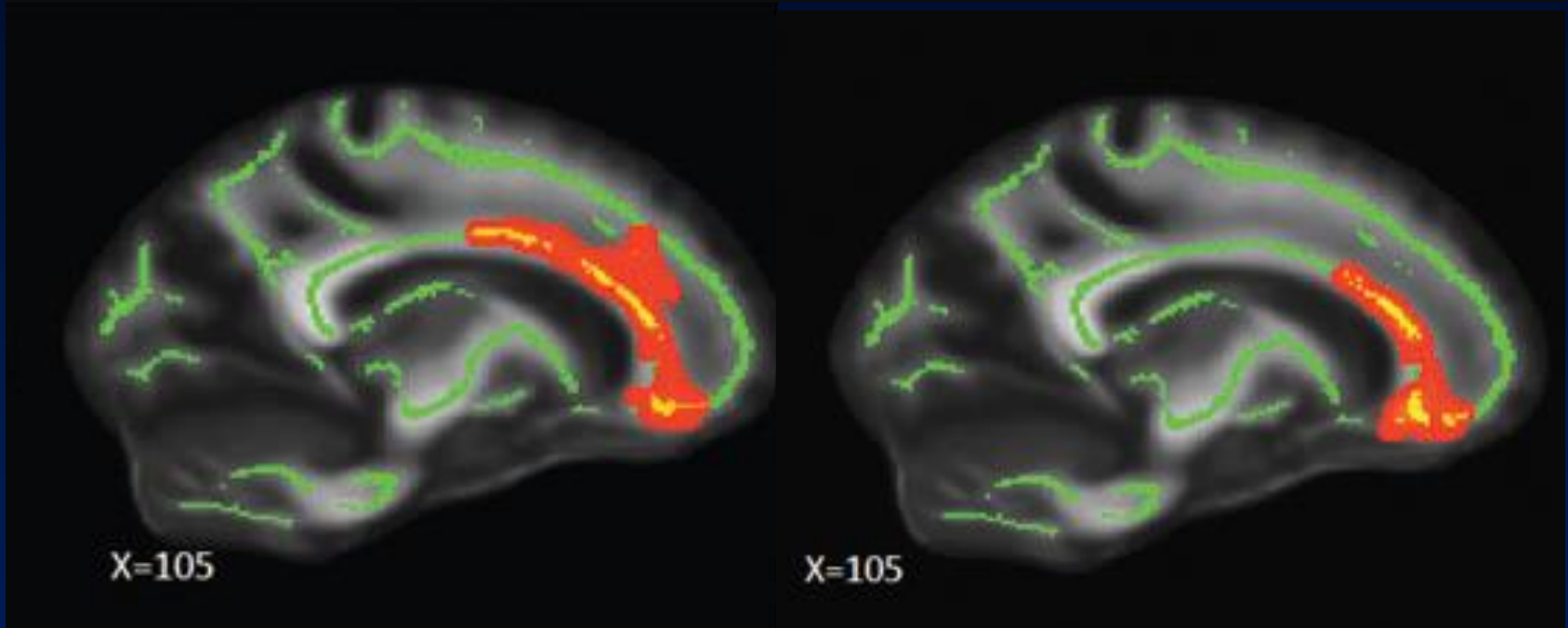
Loss of gray matter one  
year post-injury  
(Bigler, 2007)





# Diffusion Tensor Imaging

(Mustafi et al., 2018)



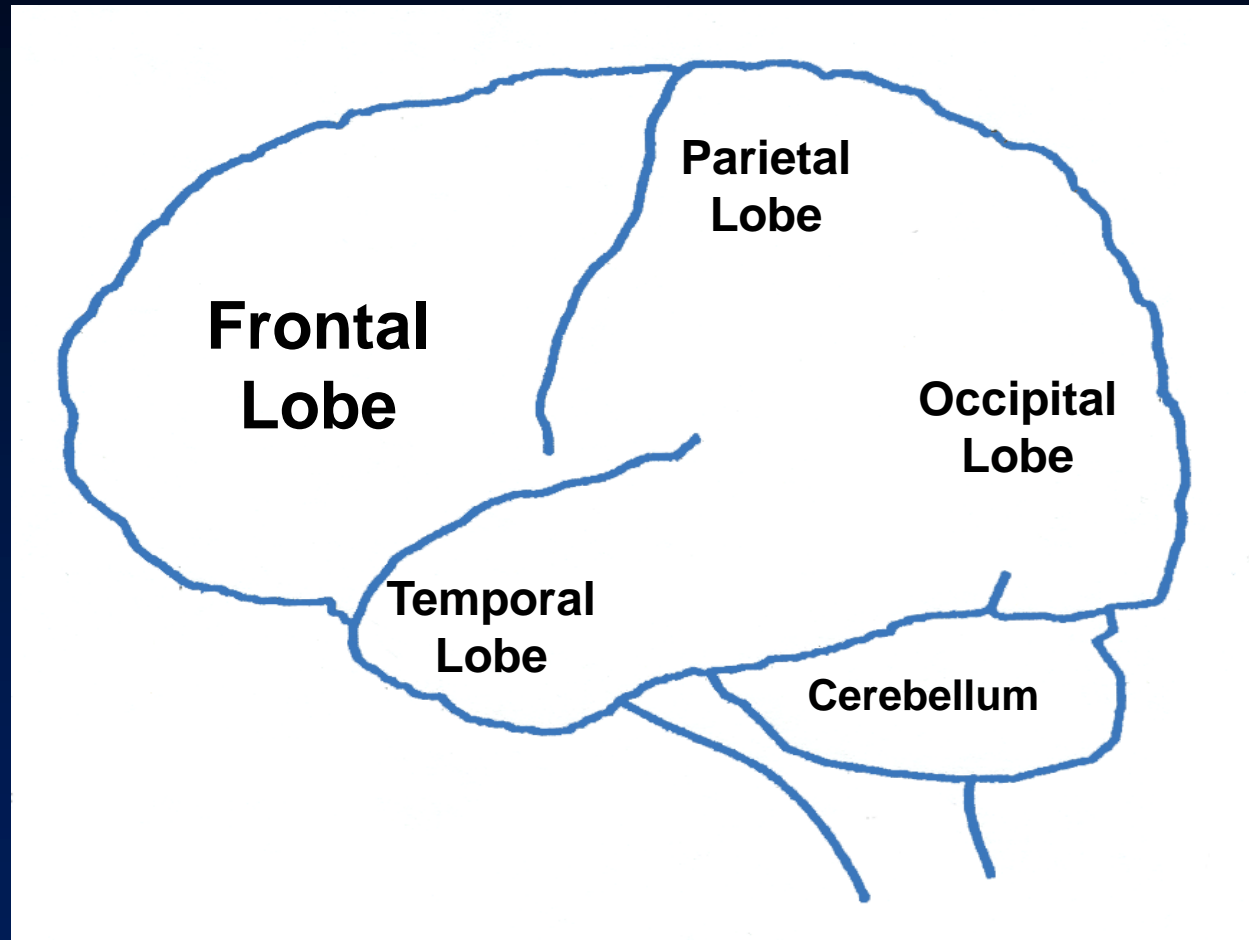
Axial Diffusivity

Mean Diffusivity

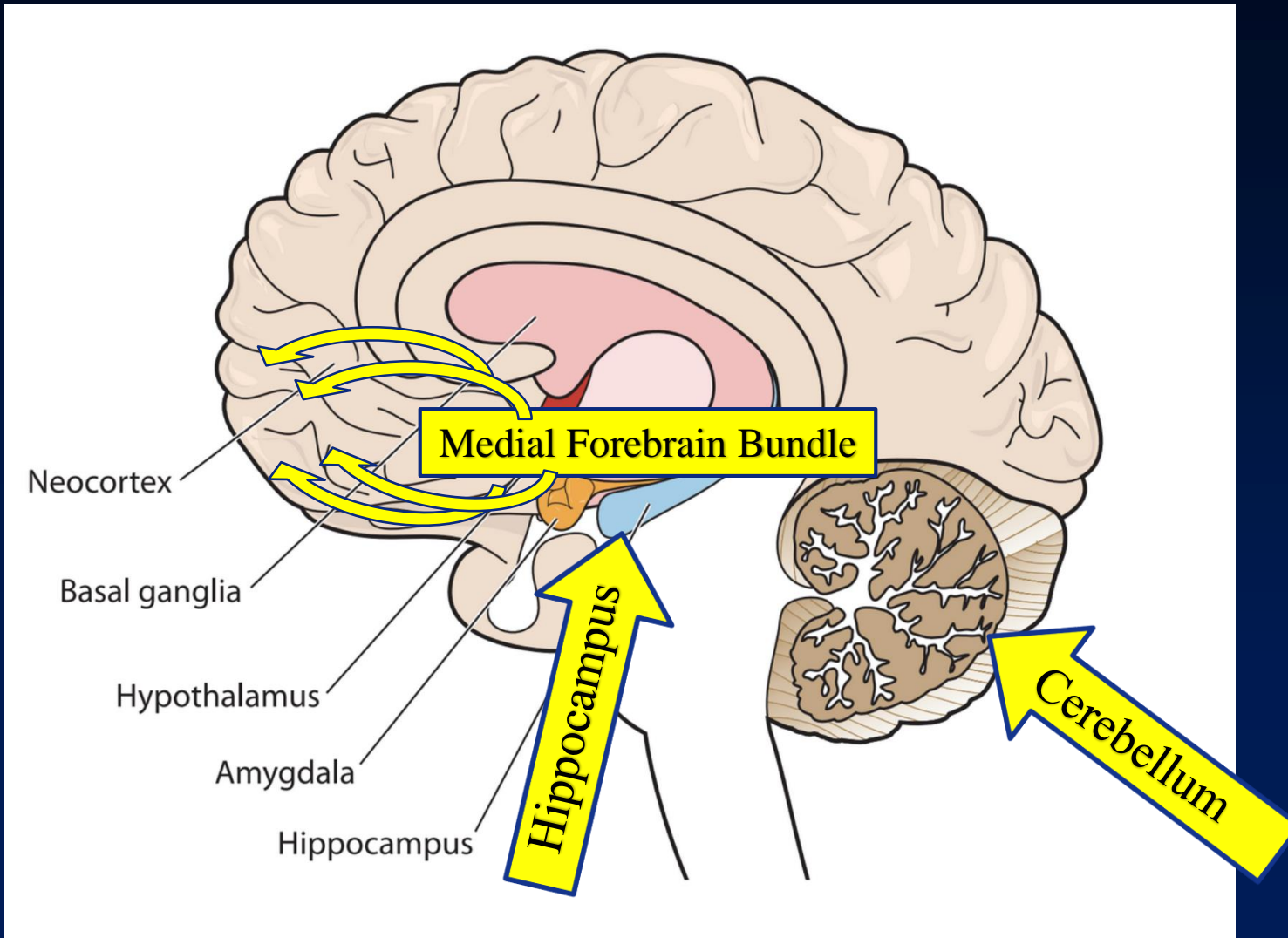
# Simplified Brain Behavior Relationships

## Frontal Lobes

- Initiation
- Problem solving
- Judgment
- Inhibition of impulse
- Planning/anticipation
- Self-monitoring
- Motor planning
- Personality/emotions
- Awareness of self
- Organization
- Concentration
- Mental flexibility
- Speaking

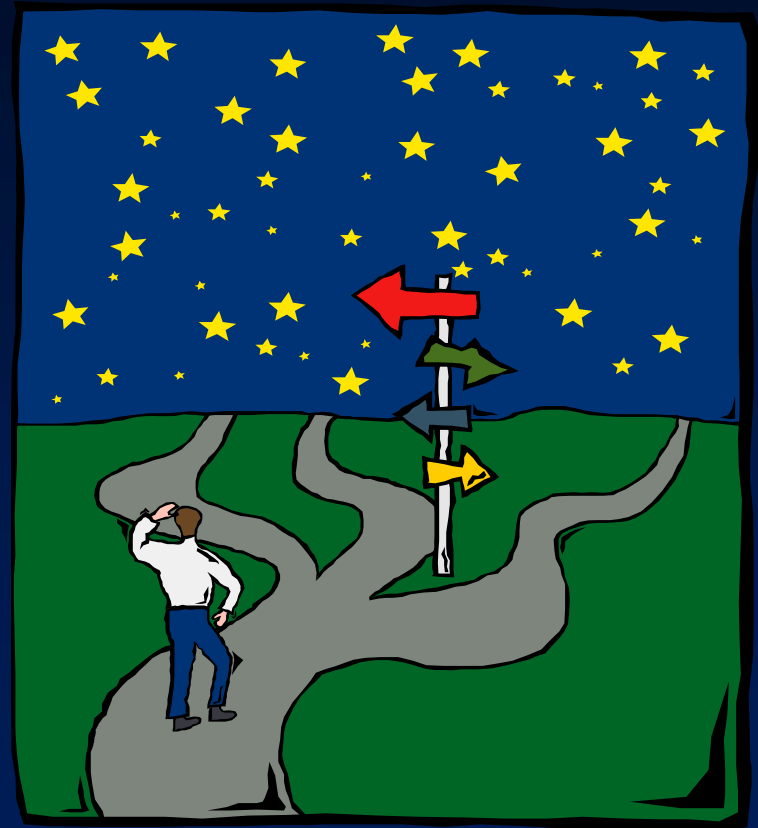


# Anoxic/Hypoxic Brain Damage



# Neurobehavioral Contributions

Behavioral  
problems as  
disorders in  
processing  
rewards and  
punishments

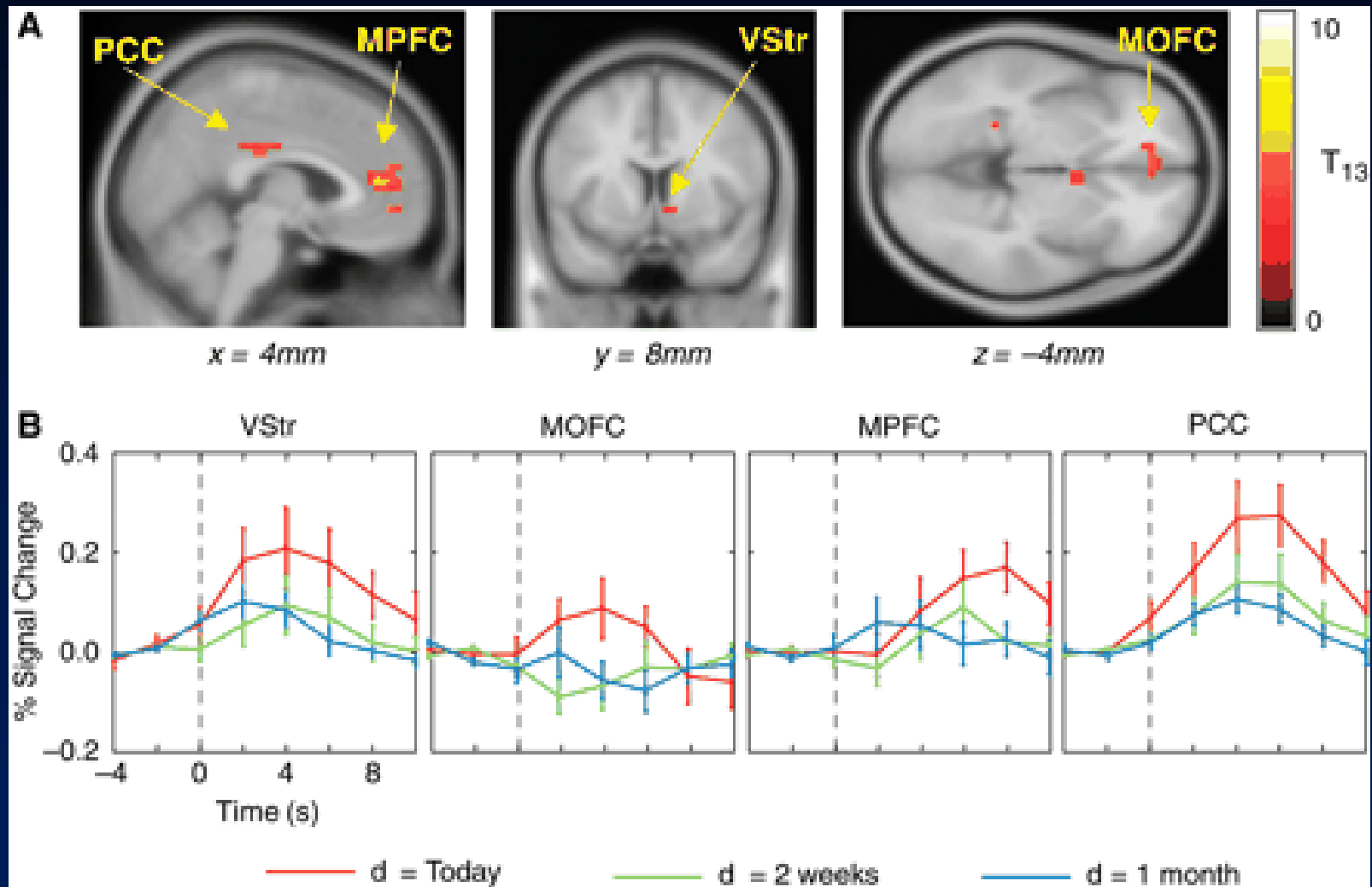


## Delay Discounting:



the value of immediate vs. delayed  
rewards

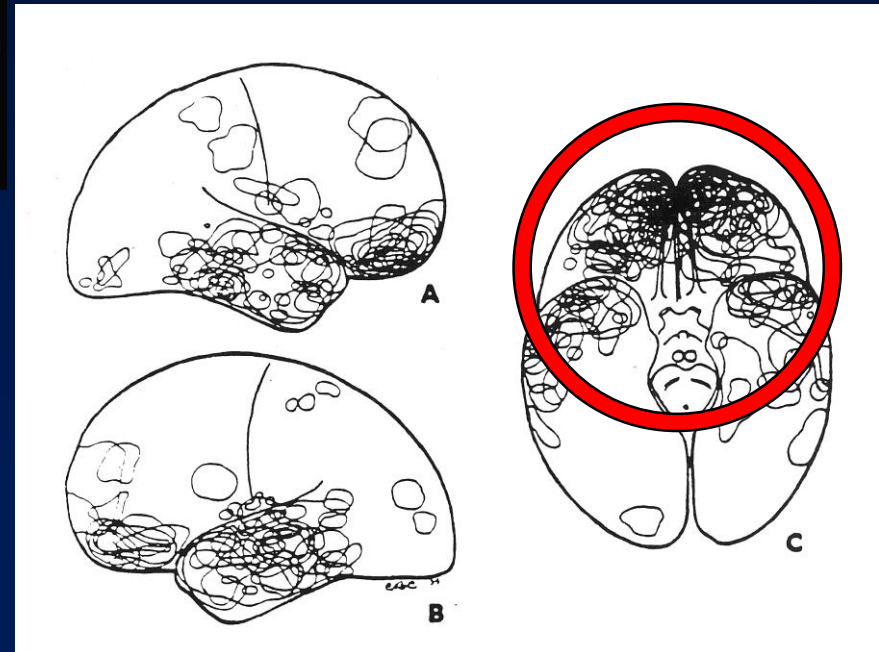
## Regions of greater activation processing immediate rewards



from McClure et al (2004). *Science* 306, 503-507.

# Pathophysiology

Areas of contusion in  
(Courville, 1950)



Loss of gray matter one  
year post-injury  
(Bigler, 2007)



# A "Cascade of Vulnerability" to Opioid Addiction

JOURNAL OF NEUROTRAUMA 36:1–6 (XXXX XX, 2019)  
© Mary Ann Liebert, Inc.  
DOI: 10.1089/neu.2019.6451

## Commentary

### Opioid Use among Individuals with Traumatic Brain Injury: A Perfect Storm?

Rachel Sayko Adams,<sup>1,2</sup> John D. Corrigan,<sup>3</sup> and Kristen Dams-O'Connor<sup>4,5</sup>



Contents lists available at ScienceDirect

Addictive Behaviors

journal homepage: [www.elsevier.com/locate/addictbeh](http://www.elsevier.com/locate/addictbeh)

#### Commentary

The intersection of lifetime history of traumatic brain injury and the opioid epidemic

John D. Corrigan<sup>a</sup>, Rachel Sayko Adams<sup>b,\*</sup>

## Persons with TBI more likely prescribed opioids

- Headache and orthopedic pain common with TBI
- Persons with persistent post-concussive syndrome more likely prescribed opioids
- 70% of patients receiving rehabilitation for TBI prescribed opioids

## Persons with TBI more susceptible to addictive influence of opioids

## Persons with TBI have more challenges for successful treatment

## Brief Re-cap

- Regardless where the impact is on the head, the frontal lobes are most likely injured
- Frontal lobes are critical to behavioral control and, in turn, success in society
- Greater impulsivity and disinhibition may result from changes in how rewards and consequences are processed
- Hypoxic/anoxic injuries also affect these executive functions of the brain.

Whether working in behavioral health, healthcare, criminal justice or other systems, it is worthwhile to know whether the person you are working with has a history of brain injury.

4. How can you determine if a person has had a TBI or other brain injuries?

# Issues Detecting a Lifetime History of TBI

- Capture from medical encounters
  - medical treatment often may not be sought
  - lifetime records not available
  - mild TBI often missed in Emergency Departments
- Biomarkers
  - imaging, neuropsych assessment specific but not sensitive
  - proteomics very acute only and sensitive but not specific
- Retrospective self-report
  - cannot self-diagnose
  - not aware of injury (“telescoping,” poor memory, too young)



# Challenges Eliciting Self-reports

- Public's limited or inaccurate knowledge
- Need to stimulate recall
- Injuries before age 5
- Concurrent sources of altered consciousness
- Periods of multiple blows to the head

# Methods of Eliciting Self-report

- DVBIC Brief TBI Screen (BTBIS; Schwab et al.)
- TBI Questionnaire (TBIQ; Diamond et al.)
- Brain Injury Screening Questionnaire (BISQ; Gordon et al.)
- OSU TBI Identification Method (OSU TBI-ID; Corrigan & Bogner)
- Boston Assessment of Traumatic Brain Injury Lifetime (BAT-L; Fortier et al.)

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# Initial Reliability and Validity of the Ohio State University TBI Identification Method

*John D. Corrigan, PhD; Jennifer*

**Objectives:** Evaluate the psychometric properties of the Ohio State University TBI Identification Method. **Participants:** Convenience samples of men ( $N = 119$  (study 1) and  $N = 103$  (study 2)). **Measures:** Summary indices of the Ohio State University TBI Identification Method elicited via a structured interview. **Results:** The Ohio State University TBI Identification Method was characterized by severity weighted composite scores of symptoms persisting, worst injury, time to loss of consciousness. Age at injury and sex were also examined. **Conclusions:** The Ohio State University TBI Identification Method has good reliability and validity of summary indices for screening, substance use disorders, trauma

# Reliability and Predictive Validity of the Ohio State University TBI Identification Method With Prisoners

*Jennifer Bogner, PhD; John D. Corrigan, PhD*

# The Reliability of a Computer-Assisted Telephone Interview Version of the Ohio State University Traumatic Brain Injury Identification Method

*Jeffrey P. Cuthbert, PhD, MPH, MSOT; Gale G. Whiteneck, PhD; John D. Corrigan, PhD; Jennifer Bogner, PhD*

**Objectives:** Provide test-retest reliability (>5 months) of the Ohio State University Traumatic Brain Injury Identification Method modified for use as a computer-assisted telephone interview (CATI) to capture traumatic brain

traumatic brain injury (TBI) and female ( $N = 105$ ) state prisoners. **Measures:** Summary indices of the Ohio State University TBI Identification Method elicited from data elicited via a computer-assisted telephone interview. Factor analysis showed that (1) onset, (2) combinations of symptoms, (3) combinations of effects. Age at injury, number of injuries, and sex were also examined. **Conclusions:** The Ohio State University TBI Identification Method has good reliability and validity of summary indices for screening, substance use disorders, trauma

# Altered amygdala connectivity in individuals with chronic traumatic brain injury and comorbid depressive symptoms

Neurological correlates of lifetime history of TBI from the OSU TBI-ID

## Kihwan Han<sup>1\*</sup>, Sandra B. Chapman Orbitofrontal cortical thinning and aggression in mild traumatic brain injury patients

## Plasma Anti-Glial Fibrillary Acidic Protein Autoantibody Levels during the Acute and Chronic Phases of Traumatic Brain Injury: A Transforming Research and Clinical Knowledge in Traumatic Brain Injury Pilot Study

liot Bueler<sup>2,3</sup> | Jace King<sup>1,2</sup> |

Kevin K. W. Wang,<sup>1,\*</sup> Zhihui Yang,<sup>1,\*</sup> John K. Yue,<sup>1</sup> Ava M. Puccio,<sup>4</sup> Ramon Diaz-Arrastia,<sup>5</sup> Hester F. Ling,<sup>6</sup> Alex B. Valadka,<sup>9</sup> Wayne A. Gordon,<sup>9</sup> David O. Okonkwo,<sup>10</sup> Investigators (including Shelly R. Cooper,<sup>2,3,6</sup> Kristen Darby,<sup>7</sup> Andrew I. R. Maas,<sup>10</sup> David K. Menon,<sup>11</sup> David M. Schnyer,<sup>12</sup> and the TBI Model Systems Research Network)

## Disrupted Intrinsic Connectivity among Default Mode, Dorsal Attention, and Frontoparietal Control Networks in Individuals with Chronic Traumatic Brain Injury\*

## Mean cortical curvature reflects cytoarchitecture restructuring in mild traumatic brain injury

Jace B. King<sup>a,b,c,\*</sup>, Melissa P. Lopez-Larson<sup>c,d</sup>, Deborah A. Yurgelun-Todd<sup>b,c,d,e</sup>

# OSU TBI Identification Method

- Structured interview designed to elicit lifetime history of TBI.
- Avoids misunderstanding about what a TBI is by eliciting injuries, then determining if altered consciousness occurred.
- Provides more information than simple “yes/no”

Training at: [www.ohiovalley.org](http://www.ohiovalley.org)

## Screening for Other ABIs

2. Have you ever lost consciousness from a drug overdose or being strangled or choked?

\_\_\_\_\_ Yes

\_\_\_\_\_ No (IF NO, GO TO QUESTION 3)

a. How many times from a drug overdose?

\_\_\_\_\_ # overdose

b. How many time from being strangled or choked?

\_\_\_\_\_ # choked

## Screening for Other ABIs (cont'd)

3. Have you EVER been told by a doctor or other health professional that you had any of the following?

\_\_\_\_epilepsy or seizures?

\_\_\_\_a stroke or a transient ischemic attack?

\_\_\_\_cerebral palsy?

\_\_\_\_brain cancer?

\_\_\_\_a brain infection like meningitis or encephalitis?

\_\_\_\_toxic exposure, like to lead or pesticides?

\_\_\_\_dementia, like Alzheimer's Disease?

\_\_\_\_a progressive disease like AIDS, multiple sclerosis, Parkinson's Disease or Huntington's Disease? (if yes, which one \_\_\_\_\_)

# Problematic History of Brain Injury

Due to cognitive and/or behavioral weaknesses that result from damage to the frontal areas of the brain, persons with a problematic history of TBI may have difficulty:

- knowing what problems they have;
- changing their behavior;
- accessing services; and/or
- remaining engaged in services.

# Accommodating the Symptoms of TBI

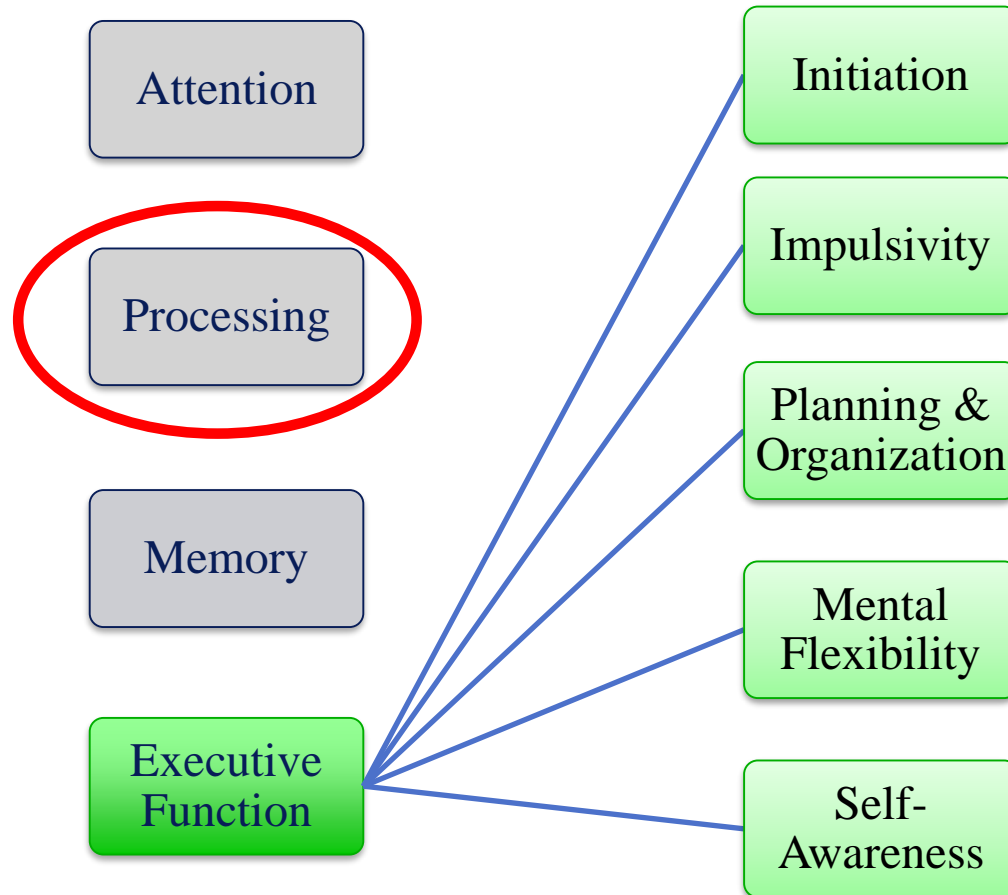
Presented by:

Ohio Valley Center for Brain Injury  
Prevention and Rehabilitation

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Services State Operated Services

Developed in part with support of a grant from the US Department of Health and Human Services, Health Resources and Services Administration (HRSA) to Ohio Rehabilitation Services Commission and The Ohio State University

# Neurocognitive Functions



## Problem = Processing

*The time it takes to think through and understand new information or concepts can be affected when a person has had a TBI. This does not mean they cannot understand – they may just need more time to understand.*

# What to Look For

Is PROCESSING a problem?

**Only picks up a portion of instructions or conversations**

**Has difficulty keeping up with a conversation**

**May tire easily**

**May appear to “zone out”**

**May appear passive or unmotivated**

**Is sometimes referred to as “lazy”**

# Accommodating Problems with Processing

## Keep it Simple

- It's easy for someone with processing problems to get lost in a conversation. Simplify information and provide one idea or task at a time

## Check In

- Frequently check for understanding by asking the person to repeat back instructions or ideas

## Slow it Down

- Make sure to provide sufficient time for the person to process and respond. Count silently to yourself after asking a question to allow extra time for the person to process the question

# Summary

1. Brain injury affects behavioral self-regulation which increases the likelihood of substance use disorders.
2. Brain injury is common among persons in substance use disorder treatment.
3. Brain injury presents unique clinical issues and treatment needs.
4. Behavioral health professionals need to know how to screen for history of brain injury.
5. Behavioral health professionals need to know how to accommodate for the effects of brain injury in their treatment.

# THANK YOU

## Further Resources

[www.SUBI.ca](http://www.SUBI.ca)

[www.OhioValley.org](http://www.OhioValley.org)

[www.BrainLine.org](http://www.BrainLine.org)