

# Traumatic Brain Injury in Australia

**Dr Sarah Hellewell**  
**Senior Research Fellow in Neurotrauma**  
**Curtin University and the Perron Institute**

**Brain Foundation Brain Awareness Week 2025**  
**Webinar**  
**Tuesday 11 March 2025**





# Agenda

- **What is Traumatic Brain Injury (TBI)?**
- **Preventing TBI**
- **Treatment and/or Rehabilitation**
- **Complications and long-term effects**
- **Research in Australia**



# Traumatic Brain Injury (TBI)



**Spectrum of injury**

# Traumatic Brain Injury (TBI)

Approximately  
**200,000**  
TBI in Australia  
each year

Up to **1 in 5**  
**children** will  
sustain some  
form of TBI  
by the age of  
**16**

**Severe TBI**  
Mortality Rate  
**30 - 40%**

**< 50%** return to full  
independence and  
productivity

**74 - 90%**  
of all TBI  
are  
**concussion**

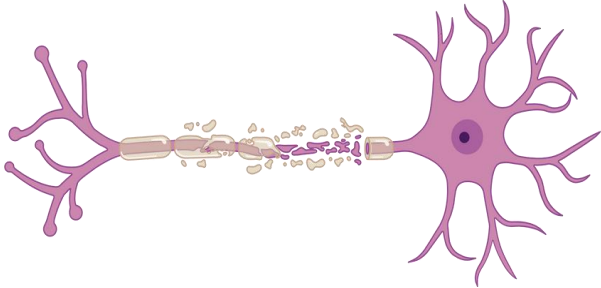
**\$2 billion +**  
in direct  
lifetime costs

# Common Causes

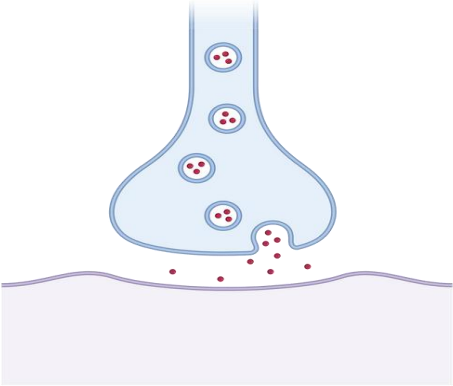
- TBI can occur as a result of:
  - Falls
  - Road traffic crashes
  - Sports and recreational activities
  - Workplace accidents
  - Assault (includes family and domestic violence)



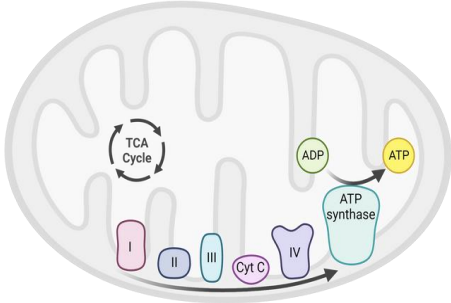
# What happens to the brain?



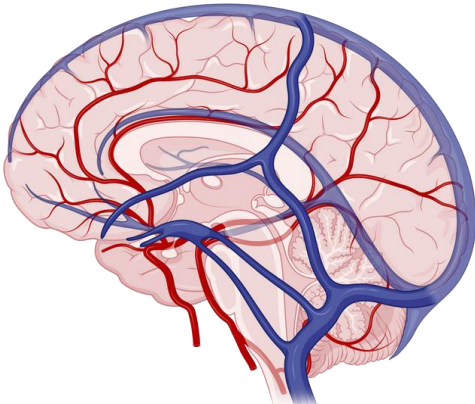
**Neuronal injury**



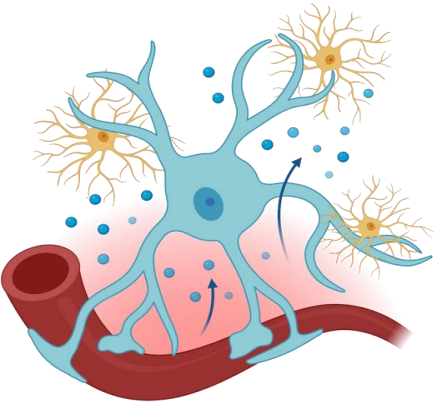
**Neurotransmitter dysregulation**



**Energy crisis**



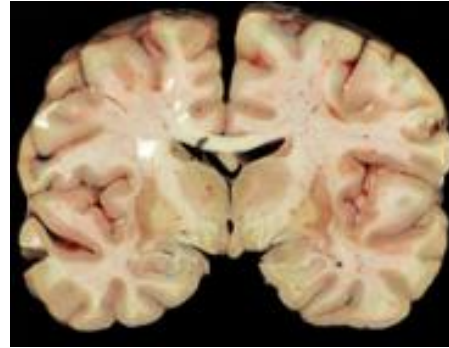
**Cerebral blood flow changes**



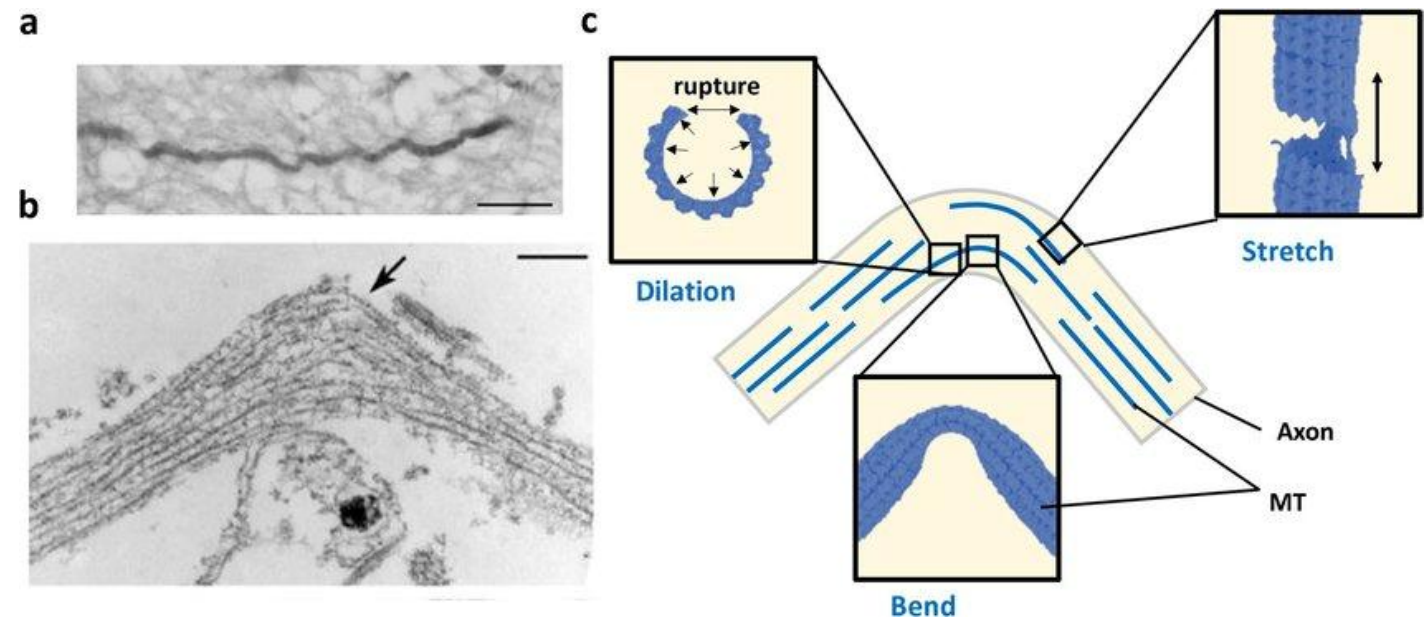
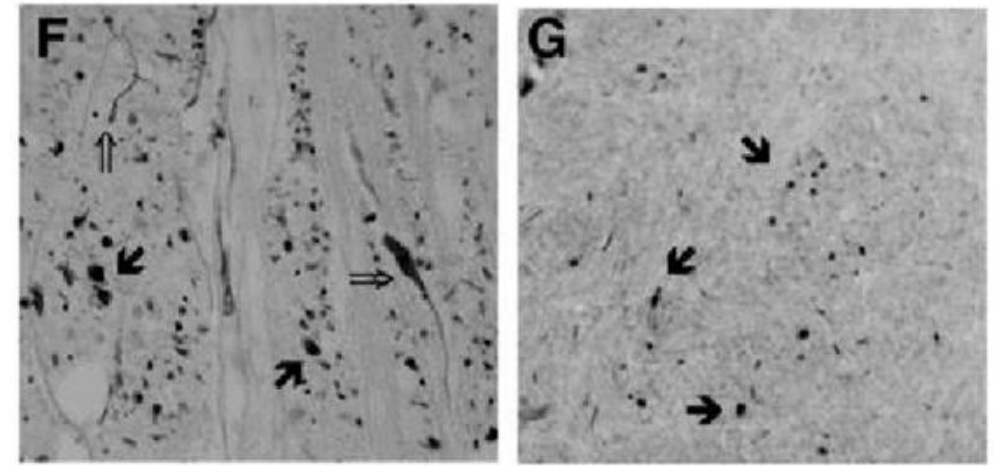
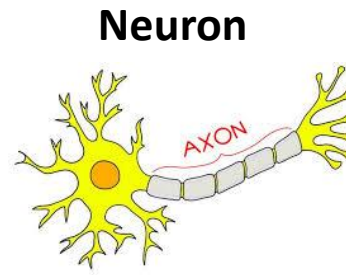
**Neuroinflammation**

—

# Cell damage

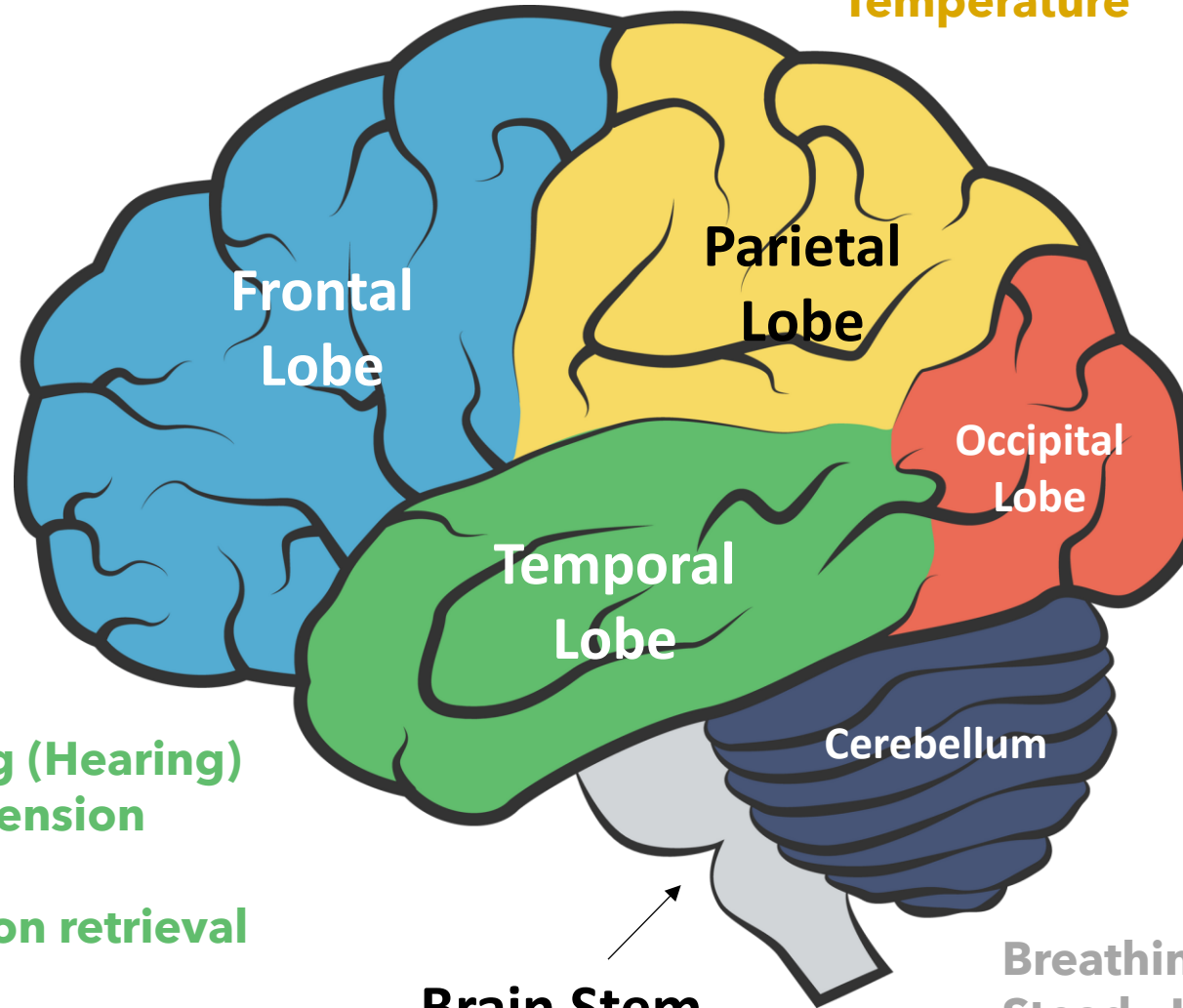


- Axons are stretched at the time of injury
- Sections of the axon may swell due to impaired axonal transport
- Appearance of beading and varicosities due to microtubule dysfunction
- Not uniform throughout damaged white matter



# Healthy Brain

Concentration  
Problem Solving  
Decision Making  
Speech Production



Sense of Touch  
Control of Movement  
Pain  
Temperature

Healthy Vision

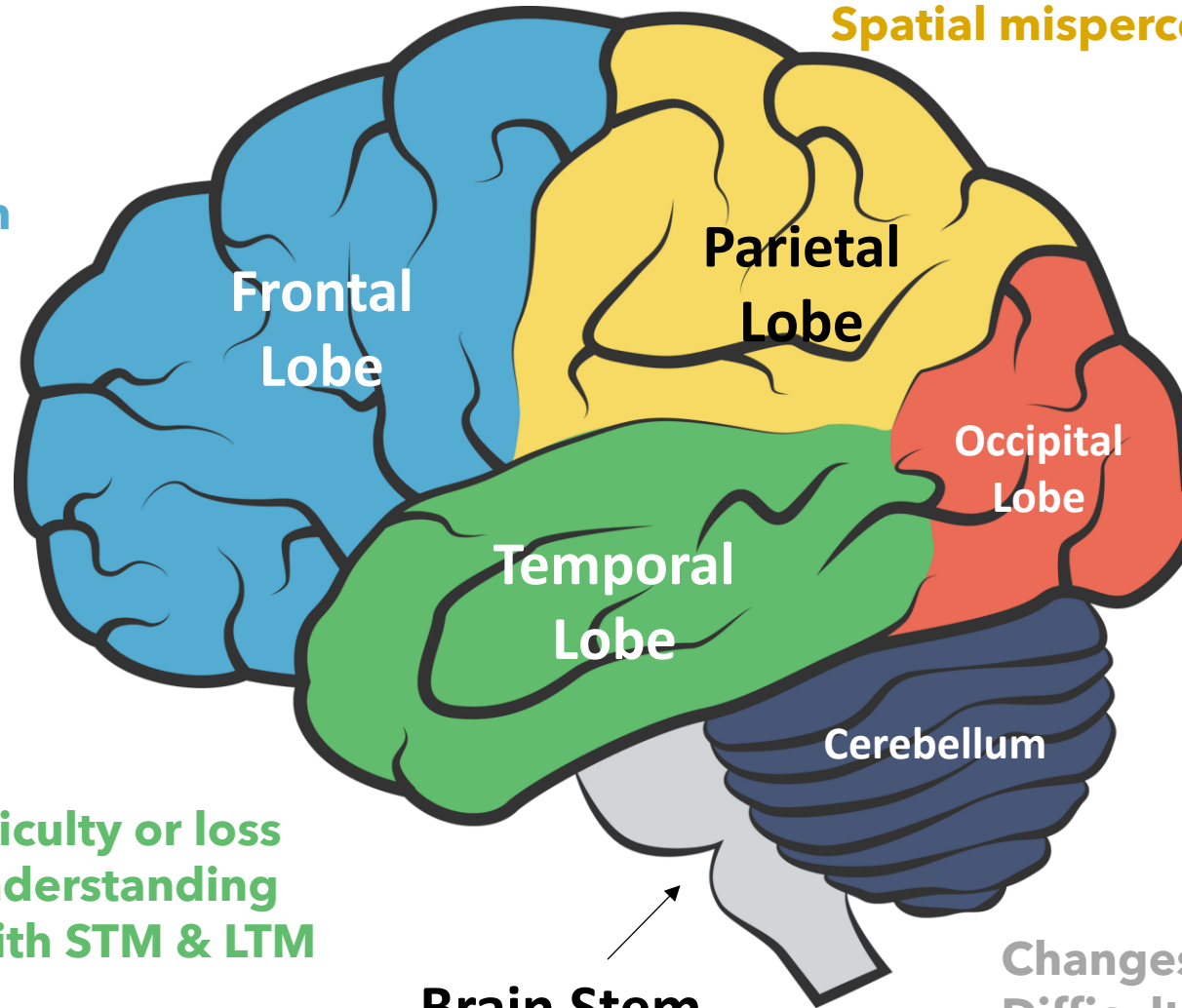
Auditory processing (Hearing)  
Language comprehension  
(understanding)  
Memory/ Information retrieval  
Faces recognition

Balance  
Coordination  
Reflexes

Breathing  
Steady Heart Rate

# Brain affected by TBI

Lack of Focus/Attention  
Irritability/Aggression  
Impulsivity  
Judgement  
Language difficulty  
Motivation



Sensory loss  
Inability to regulate body temperature  
Difficulty with reading  
Spatial misperception

Vision problems  
e.g. Blind spots,  
Blurred vision

Difficulty walking  
Slurred speech

Hearing difficulty or loss  
Difficulty understanding  
Problems with STM & LTM

Brain Stem

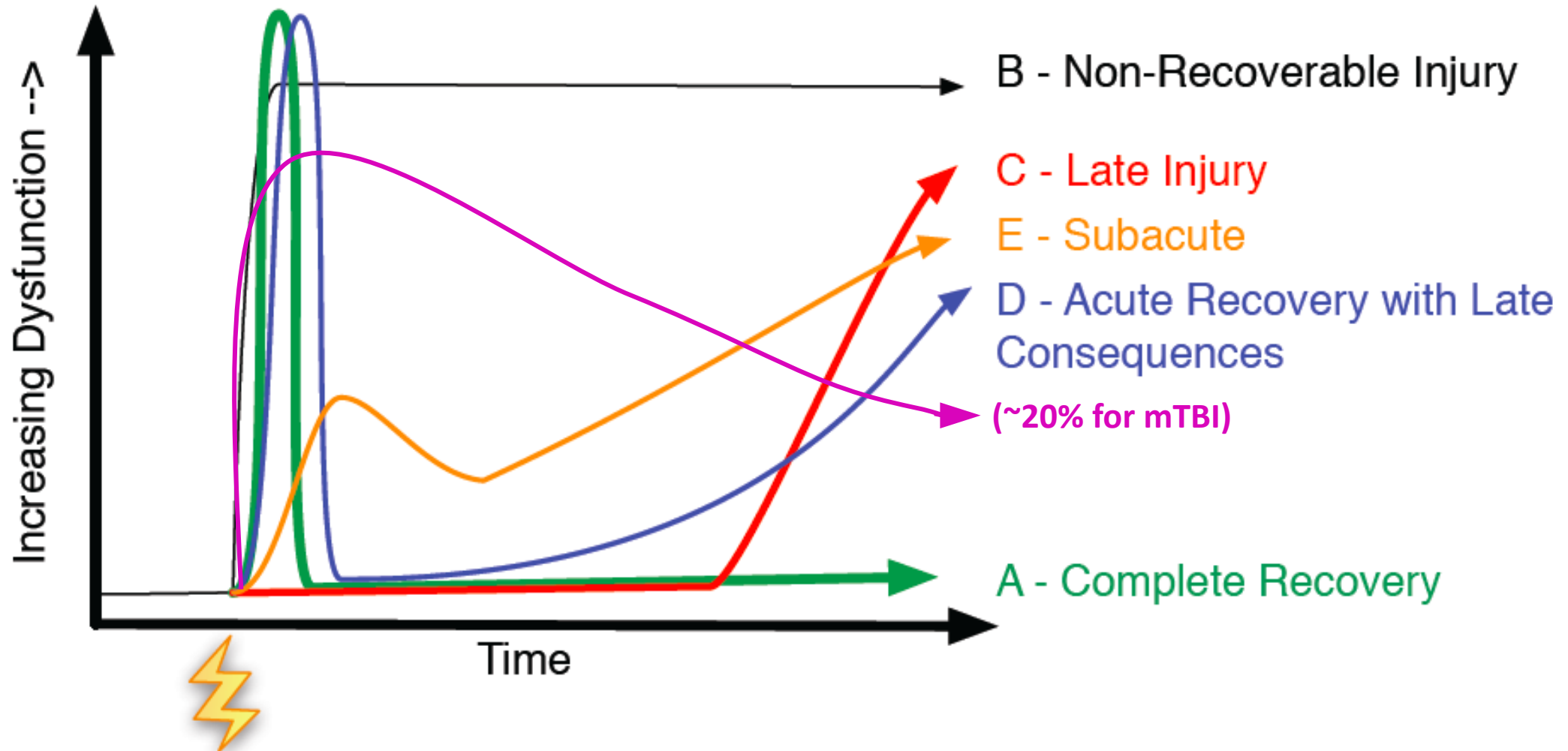
Changes in Breathing  
Difficulty swallowing

# Preventing TBI

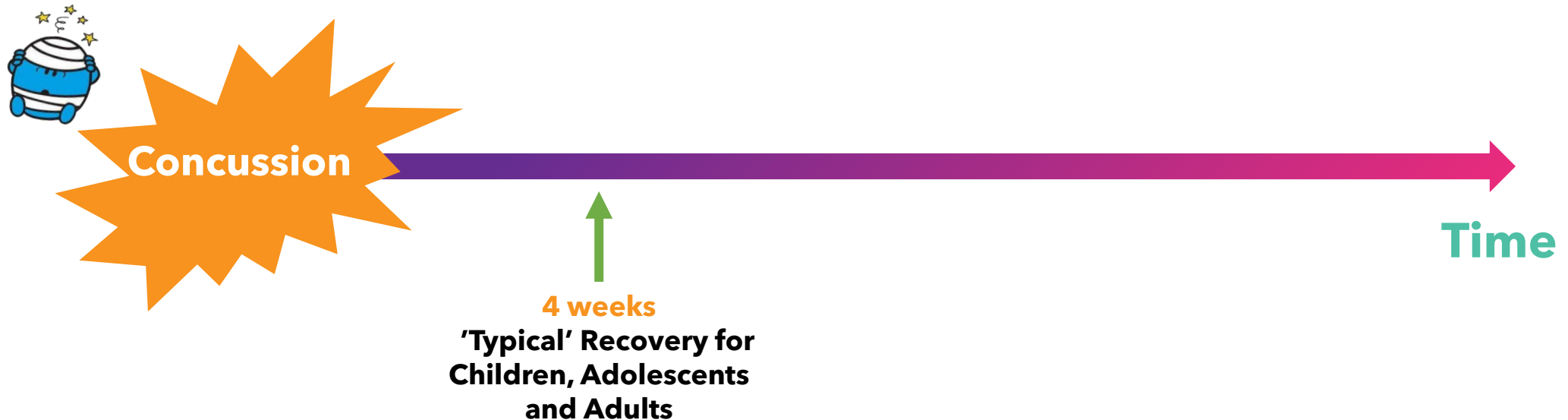
Actions that can help prevent TBI include:

- **Supervising young children** while using stairs/ramps and climb-on/bounce play equipment
- **Preventing falls in the home/workplace**
  - Removing or securing and loose mats
  - Installing and using aids such as ramp, railing, shower chairs, non-slip surfaces
- **Facilitating safe workplaces**
  - Adhering to safety protocols
  - Wearing appropriate and properly fitted safety equipment (e.g. footwear, harnesses etc.)
- **Respecting and following the rules** of the sport, especially rules in place to reduce hits to the head area
  - Training, practicing and playing in ways appropriate for one's skill level
- **Practicing safe driving techniques** (including use of seatbelts and properly-fitted child car seats)

# Recovery trajectories – not one size fits all



# Concussion Recovery and PPCS



- Some people **continue to experience concussion symptoms** beyond this 'typical' recovery time frame
- These individuals are said to be experiencing **Persisting Post-Concussion Symptoms (PPCS)**
- Currently **do not know who** will go on to develop PPCS
  - Lots of research currently underway to find ways to identify at-risk individuals

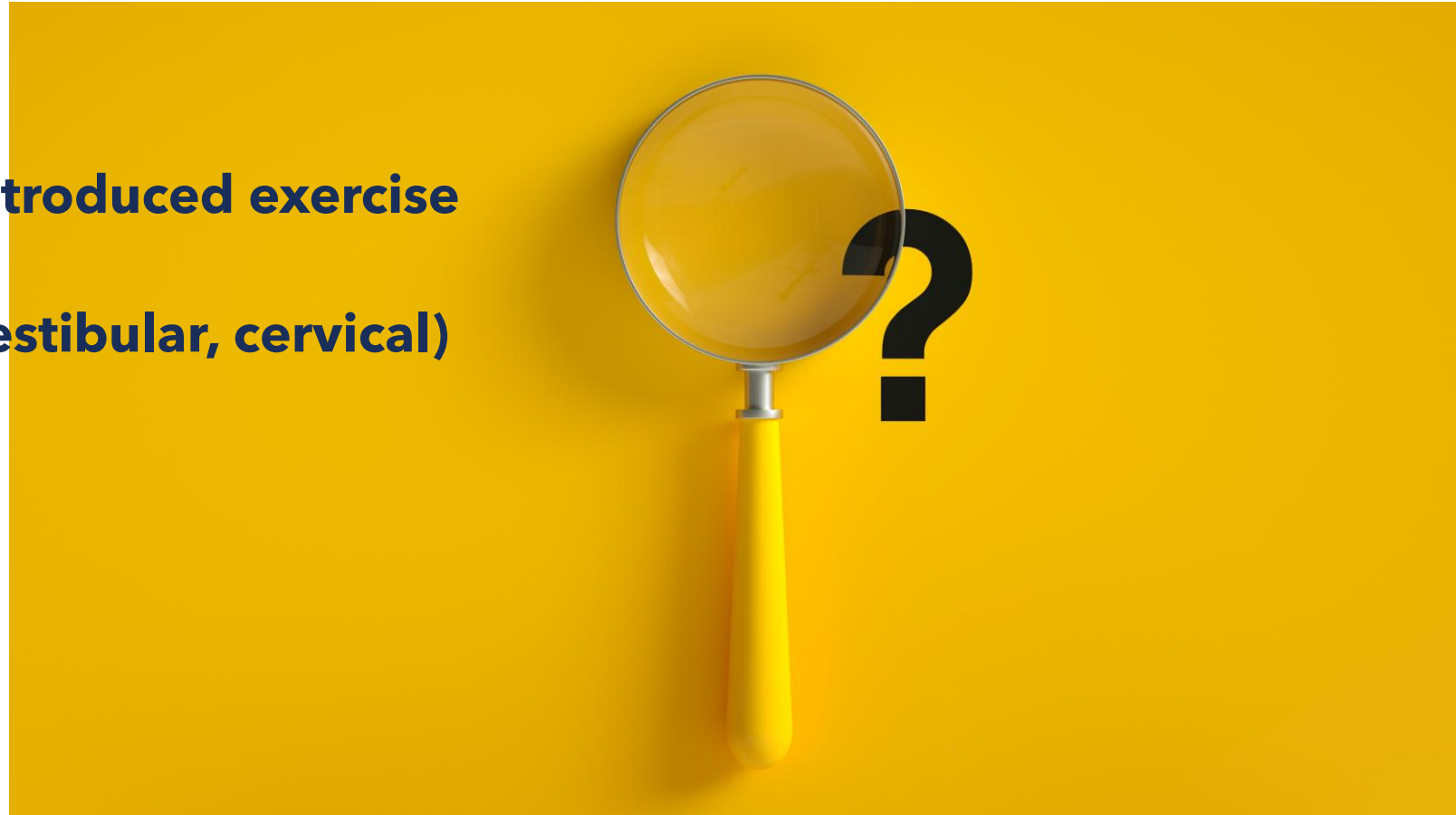
# Risk Factors for PPCS

- Female sex (esp. 15-18 years)
- Migraine
- Pre-existing mental health problems (e.g. current anxiety)
- Learning disability
- ADHD
- Psychoactive drug use
- Personality traits (high achievers, rigidity of thought)

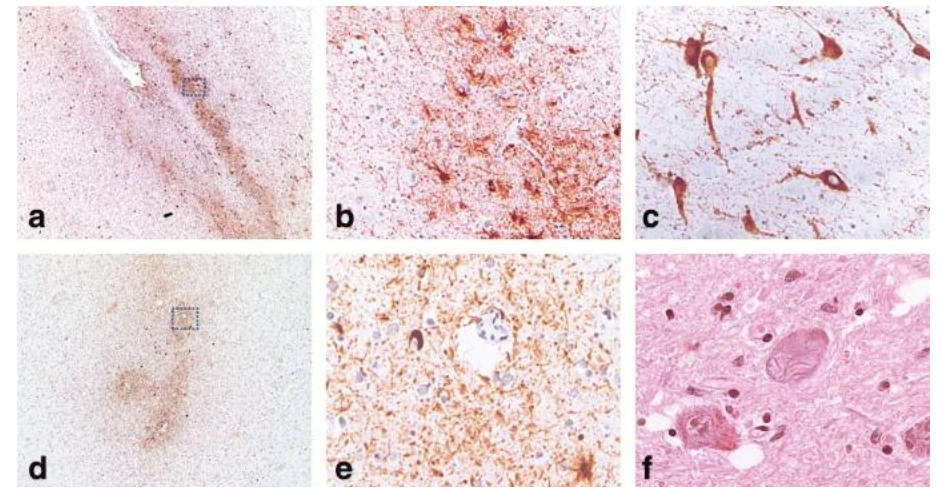


# Treatments for concussion & PPCS

- **Early rest**
- **Light & gradually introduced exercise**
- **Physical therapy (vestibular, cervical)**
- **Cognitive therapy**
- **Medication**
  - **Pain relief**
  - **Antidepressants**
  - **Anti anxiety**



# Chronic traumatic encephalopathy (CTE)



Buckland (2019) *Acta Neuropathologica Communications*

- Described for decades as “dementia pugilistica” or “punch drunk syndrome”
- Diagnosis only made on autopsy
- Linked to many clinical, psychological and cognitive features which overlap with TBI
- No consensus on phenotype
- Controversy over role of repetitive injury

## CHRONIC TRAUMATIC ENCEPHALOPATHY “Pugilistic dementia”



**Stage I:**  
Hot spots of tangled tau pop up isolated areas of the cortex

**Stage II:**  
Multiple hot spots of tangled tau appear in the cortical sulci and tau begins to migrate

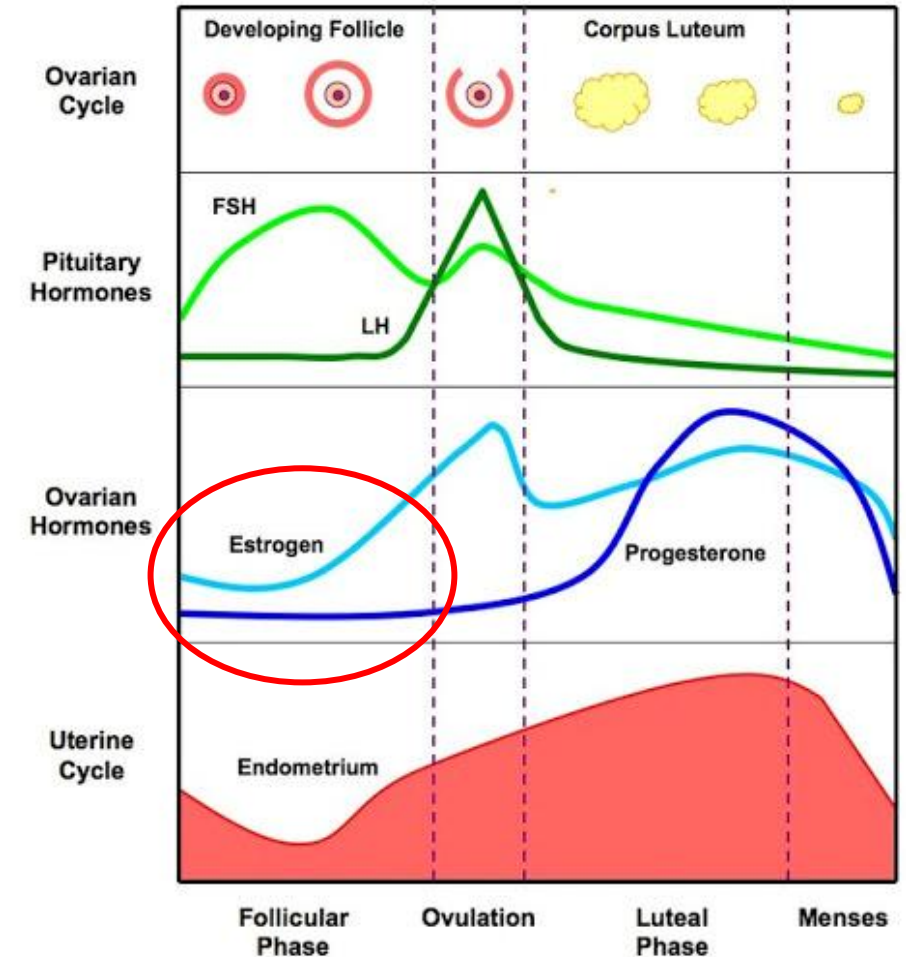
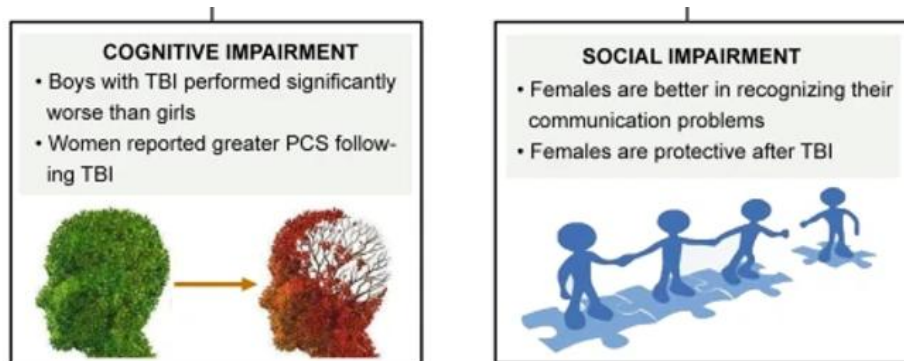
**Stage III:**  
Tau hot spots begin to blend with one another. Tangles appear more diffusely and collect in the hippocampus and amygdala.

**Stage IV:**  
Dense tau tangles cover the brain cortex and appear in most regions, including spinal cord.

Tau deposits deep in the sulci

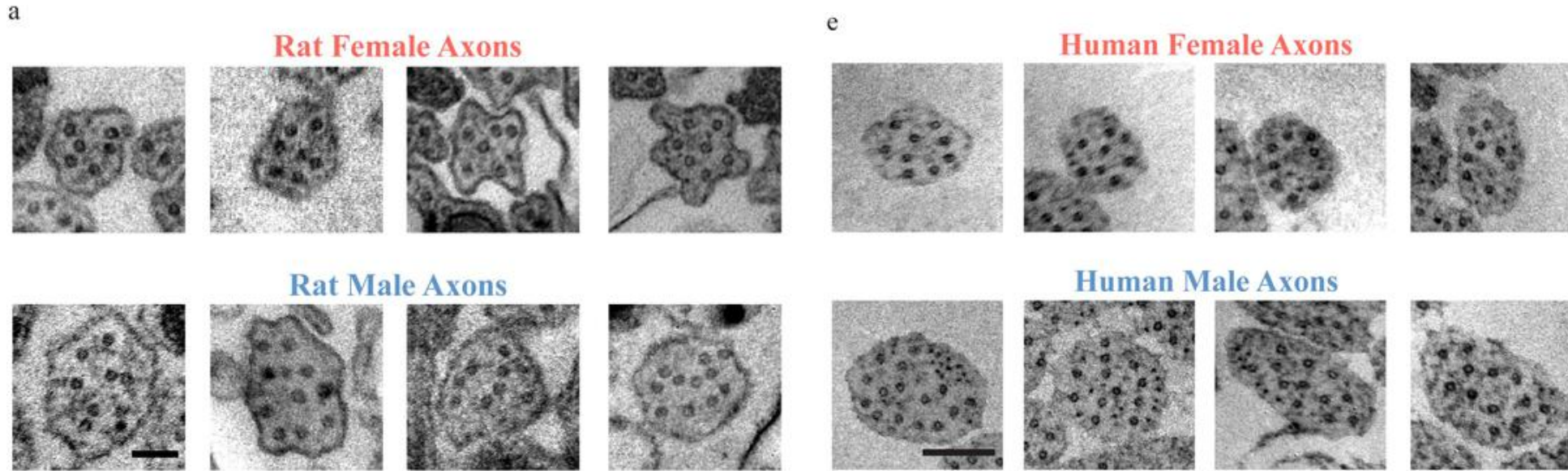
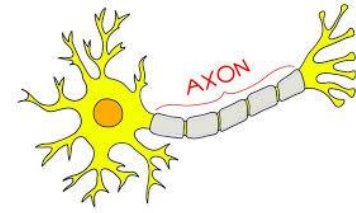
# Are males more likely to have brain injuries?

- Young adult males have traditionally been the most affected by TBI
- Males primarily studied Increase in contact sports and occupational exposures in females (military, mining, construction etc.)
- Complexity in females has been overlooked until recently
  - **Females are not just slightly different males!**



# Sex-specific differences in axons

Neuron



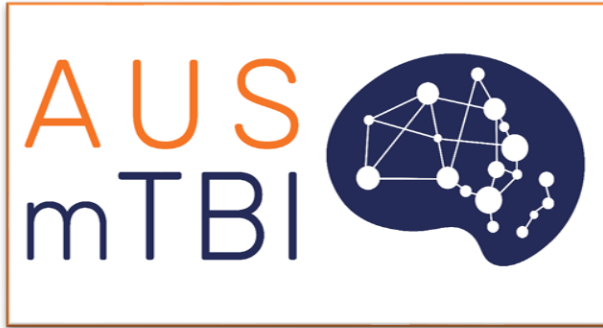
Electron microscope cross sectional views of axons containing microtubules

- Sex difference in axonal size and microtubule number in human axons
- Male axons are larger with a more complex cytoskeleton than female axons

# New Australian Research



# Research: Predicting recovery



## 1. App and online data collection

- Mobile phone app to track concussion recovery
- Online data collection, <14d post-concussion
- Follow up for 12 months or until symptom resolution
- 5000 people

## 2. 'Extend' data collection

- Recruitment from ED < 12h post-concussion
- WA, QLD, VIC sites
- 12m follow up
- 200 people

## 3. AUS-mTBI Registry

- Data kept beyond lifespan of project
- Enable future data linkage
- External research groups can apply to access deidentified data for other projects

# AUS-mTBI Extend



Concussion symptomatology  
Anxiety and Depression  
Quality of life

Demographics  
Medical history  
Injury circumstances  
Symptoms

**AUS**  
mTBI

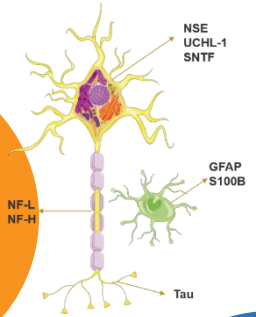
**MRI**

Balance assessment  
(BESS)

Vestibular  
Ocular Motor  
assessment

Cognitive  
assessment  
(Cogstate)

Blood and  
saliva-based  
biomarkers

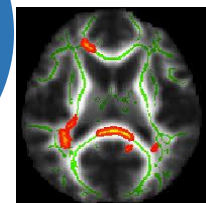
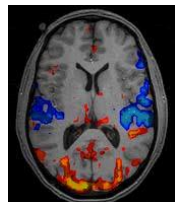
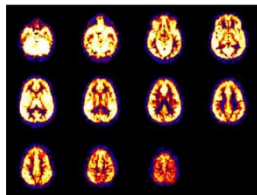
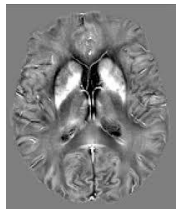


Vestibular-Ocular Motor  
Screening Test (VOMS)



**MONASH**  
University

 **Curtin University**



**TheAlfred**

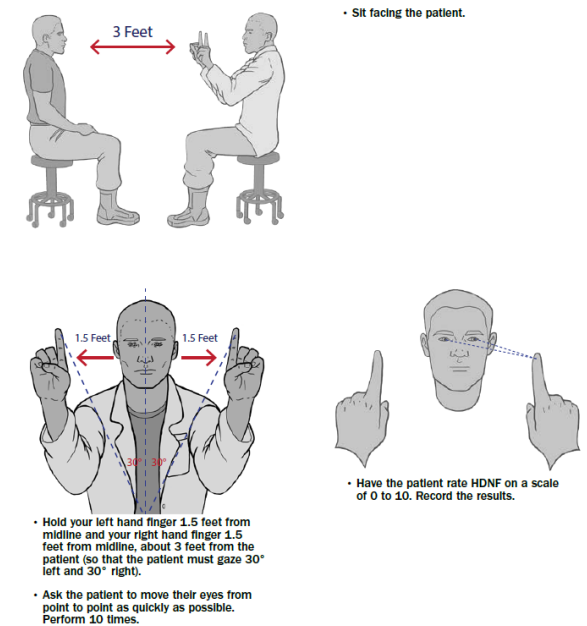
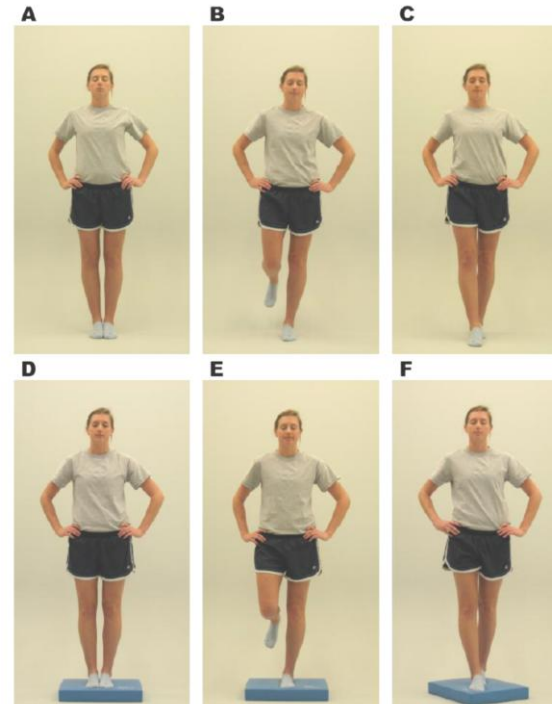
**RBWH**  
Royal Brisbane and  
Women's hospital

 **perron**  
institute  
for neurological and  
translational science

# Extend data collection

In-Person Assessment, <4 days post mTBI

Phone follow-up 1w, 2w, 1m, 3m, 6m 12m

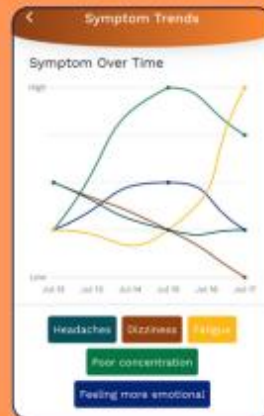


# Have you, or someone you care for, had a concussion?

Get recovery support and guidance on managing concussion while contributing to new Australian concussion research



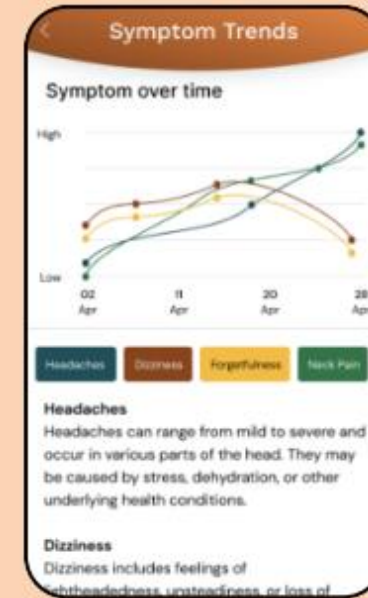
- Track & manage your symptoms
- Advice & support
- Information & resources



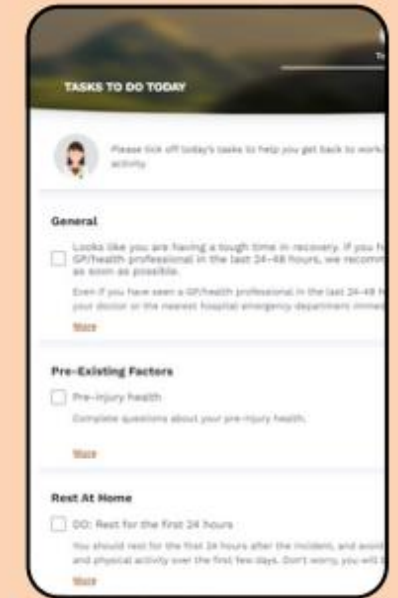
The AUS-mTBI Study aims to gather vital insights to predict long term outcomes following concussion.



- Track and manage your symptoms until they resolve
- Tips, information and resources to help your recovery
- Advice on returning to study, work or sport.



Symptom tracker

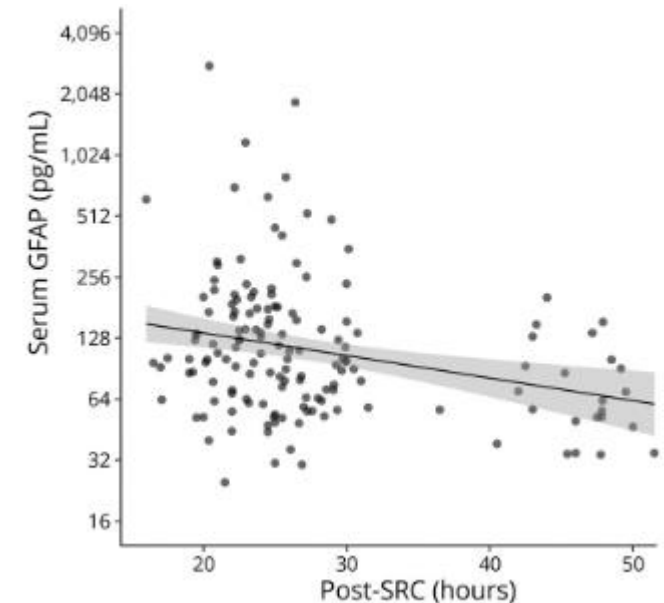
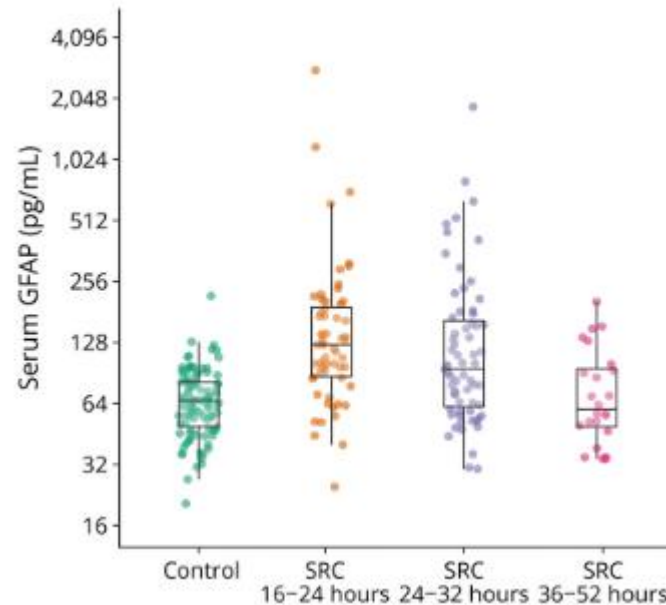


Daily recovery guide

- 5,000 participants Australia-wide
- Guided recovery
- Symptom trajectory, return to work/school, exercise
- Machine learning to develop prediction models

# Research - diagnosing sports concussions

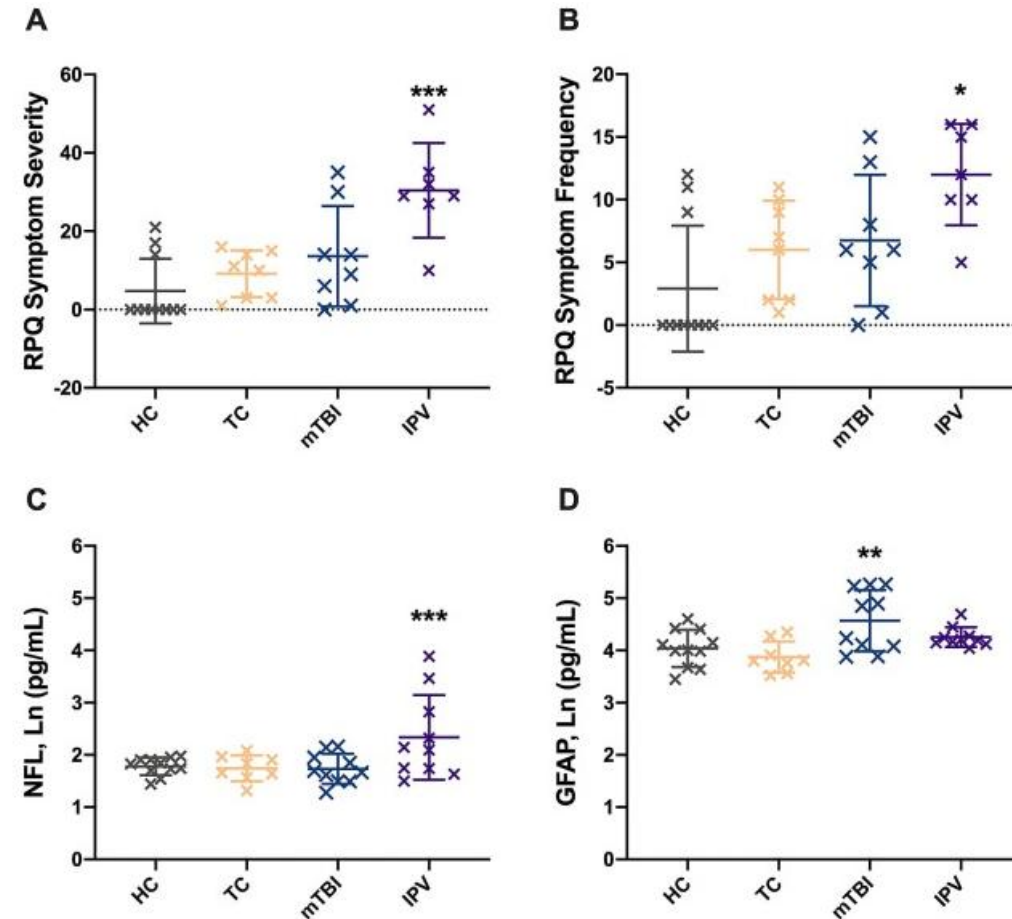
- Sports-related concussion (SRC) can be difficult to diagnose
- New **Monash University** research shows SRC can be accurately diagnosed using a blood test using GFAP as a marker
- BUT... must be measured 16-24 hours after suspected injury



William O'Brien, Sandy Schultz, Stuart McDonald

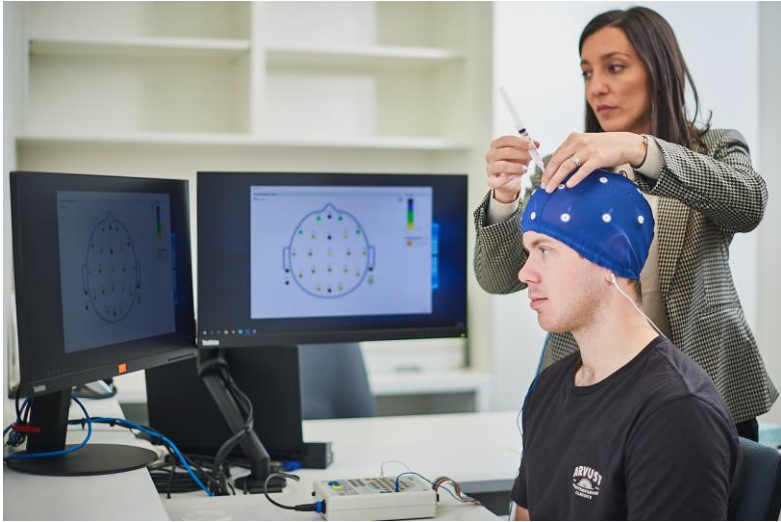
# Research - understanding brain injuries caused by domestic violence

- Brain injury resulting from domestic/interpersonal violence is very common but poorly understood
- New research from **Monash University** found that people with these injuries reported
  - More severe symptoms (A)
  - More frequent symptoms (B)
  - Higher blood levels of axonal injury markers (C)
  - Normal levels of GFAP (D)

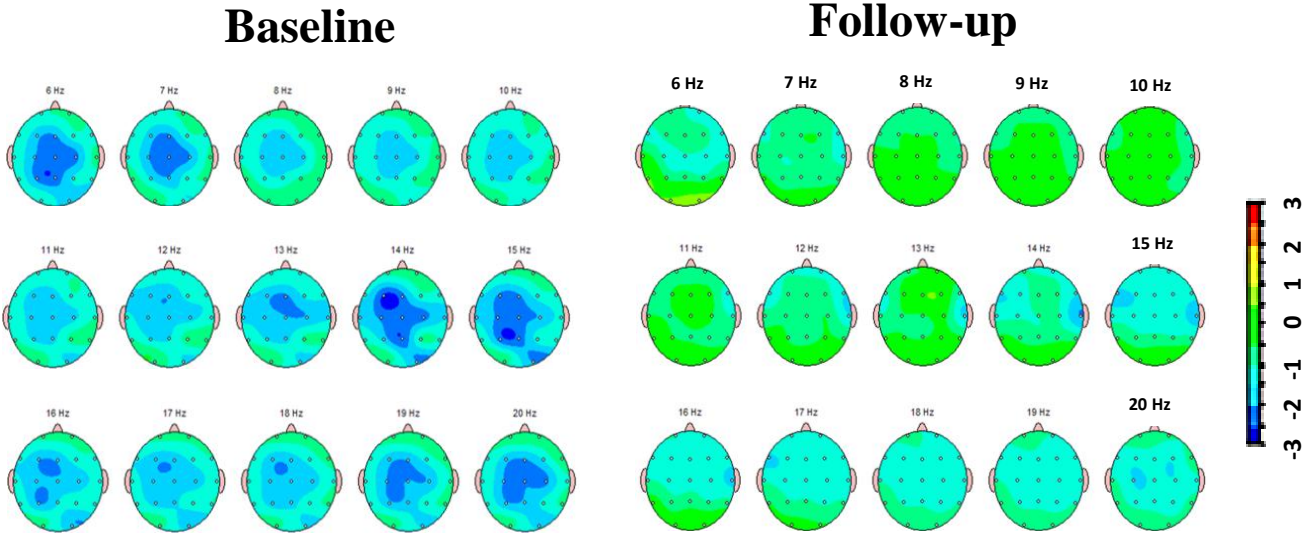


Mujun Sun, Georgia Symons, Sandy Schultz

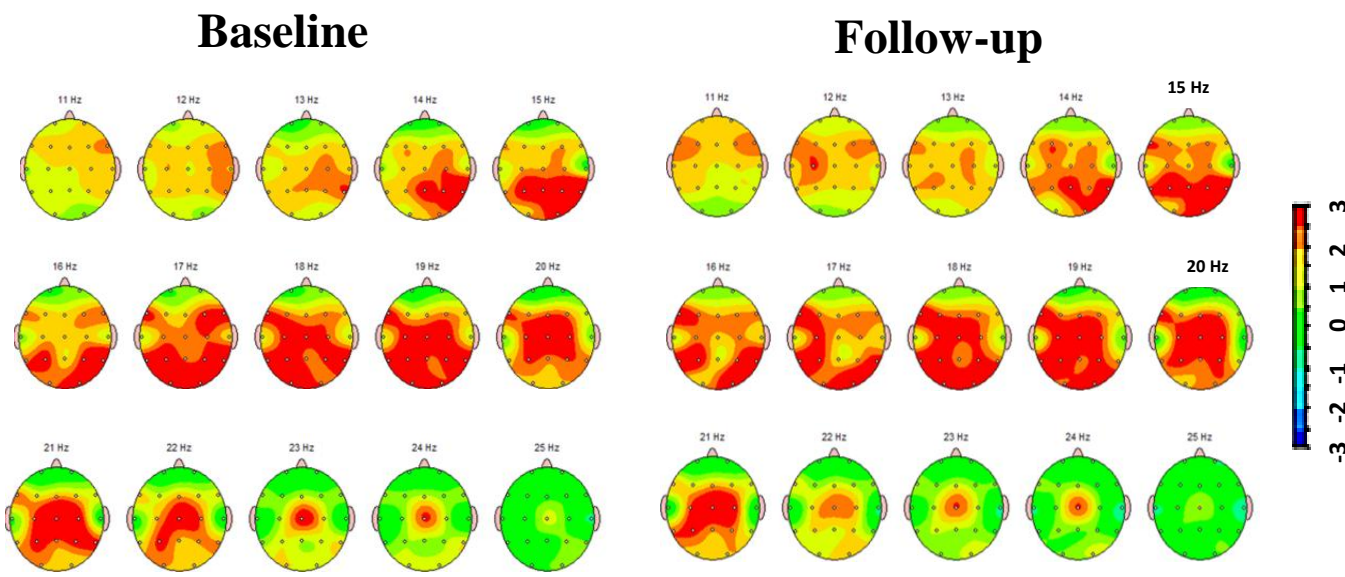
# Research - improving persistent symptoms



NEUROFEEDBACK TREATMENT



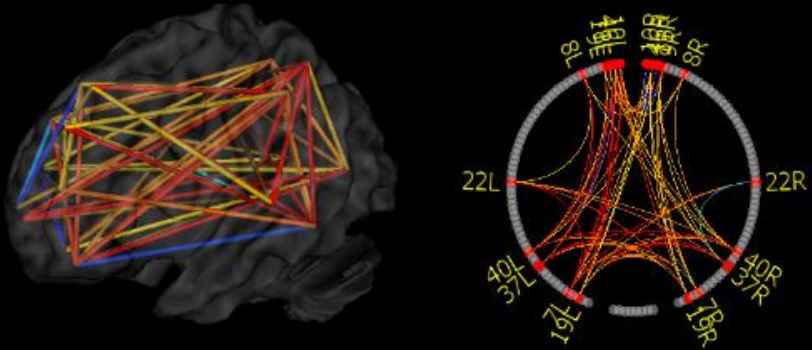
NO TREATMENT



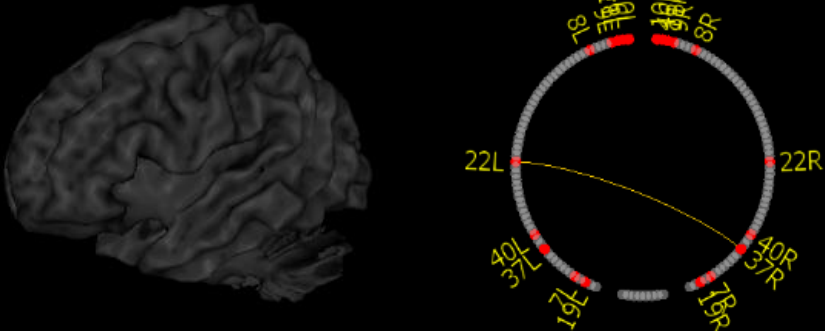
- **Curtin University** Study looking at whether neurofeedback can be used to treat PPCS
  - 3 sessions/week for 6 weeks
- Examining associations with MRI, cognitive, questionnaire and biomarkers (blood, saliva)

# Functional connectivity deviation of the central executive control network

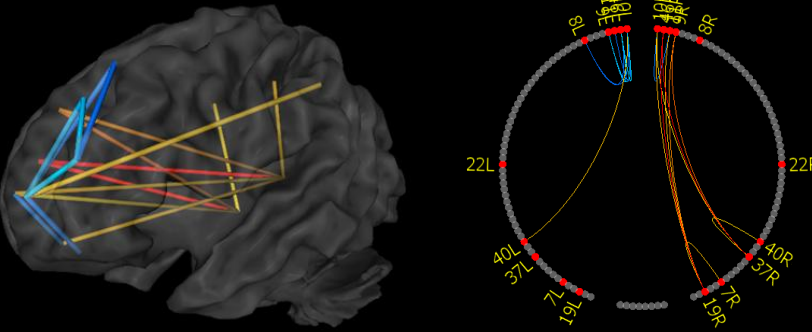
Baseline



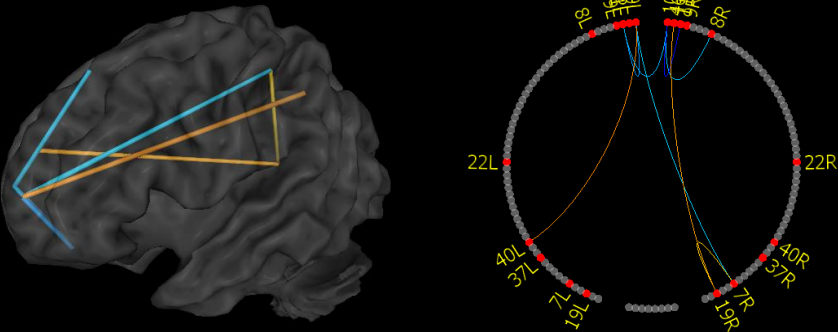
Follow-up




Baseline



Follow-up





Working to help  
improve the lives of  
people with  
Traumatic Brain Injury

A Traumatic Brain Injury  
occurs

# Connectivity Traumatic Brain Injury

**Helping to connect the  
community to Australian TBI  
research**

- **Lived Experience Advisory Group**
- **Connect to current Research Projects**

## Sport-Related Concussion Short Course

Sport-Related Concussion Short Course  
This course is a 15-minute interactive online course which educates coaches, umpires, staff, volunteers, parents and other interested people to recognise and manage a sport-related concussion injury. The course is self-paced, so you can enrol today...

[Find out more >](#)



## Concussion Short Course

Concussion Short Course ENROL IN FREE CONCUSSION SHORT COURSE  
Have you or someone you know suffered a concussion? Are you unsure what to do now, or unsure what to expect next? Or are you simply just interested to learn more...

[Find out more >](#)



## Concussion in Older Adults Short Course

Concussion in Older Adults Short Course  
The Connectivity Concussion in Older Adults Short Course is designed to provide those working within the aged care sector with the information they need to take an evidence-based approach when responding to and managing...

[Find out more >](#)



## Free Traumatic Brain Injury MOOC

Register to join this free online course on Understanding Traumatic Brain Injury that aims to raise awareness and build knowledge to reduce risk and improve management and rehabilitation outcomes for people who have experienced a TBI.

[Find out more >](#)





**Connectivity**  
Traumatic Brain Injury Australia

# Connect with Us



[www.connectivity.org.au](http://www.connectivity.org.au)



**Connectivity Traumatic Brain Injury Australia**



**ConnectivityTBI**



**ConnectivityTBI**



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**Connectivity Traumatic Brain Injury Australia**



Neurotrauma Research Laboratory

Prof Lindy Fitzgerald

Dr Jemma Keeves

Dr Chidozie Anyaegbu

Dr Brittney Lins

Dr Amanda Jefferson

Jacinta Thorne

Melissa Papini

Caerwen Beaton

André Avila

Ruby Gilroy

Rachel Singer

Kieran Edmunds

Grace Bliesner

Roley Myers

May Majimbi

Katherine Frazer

Kinta Pinchin-Yamada

Geena Gill

Dr Shaun Markovic

Dr Francesca Buhagiar

Dr Aleksandra (Ola) Gozt



STAN PERRON  
*CHARITABLE  
FOUNDATION*

[sarah.hellewell@curtin.edu.au](mailto:sarah.hellewell@curtin.edu.au)

 [@\\_hellewell\\_](https://twitter.com/_hellewell_) [@fitzgeraldgroup](https://twitter.com/fitzgeraldgroup)