

# Chronic Traumatic Encephalopathies (CTE): A Neurodegenerative Disorder as a Result of Mild Traumatic Brain Injuries

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# Public Health Implications

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Annual participation of young adults in contact sports in the US: **30 million**

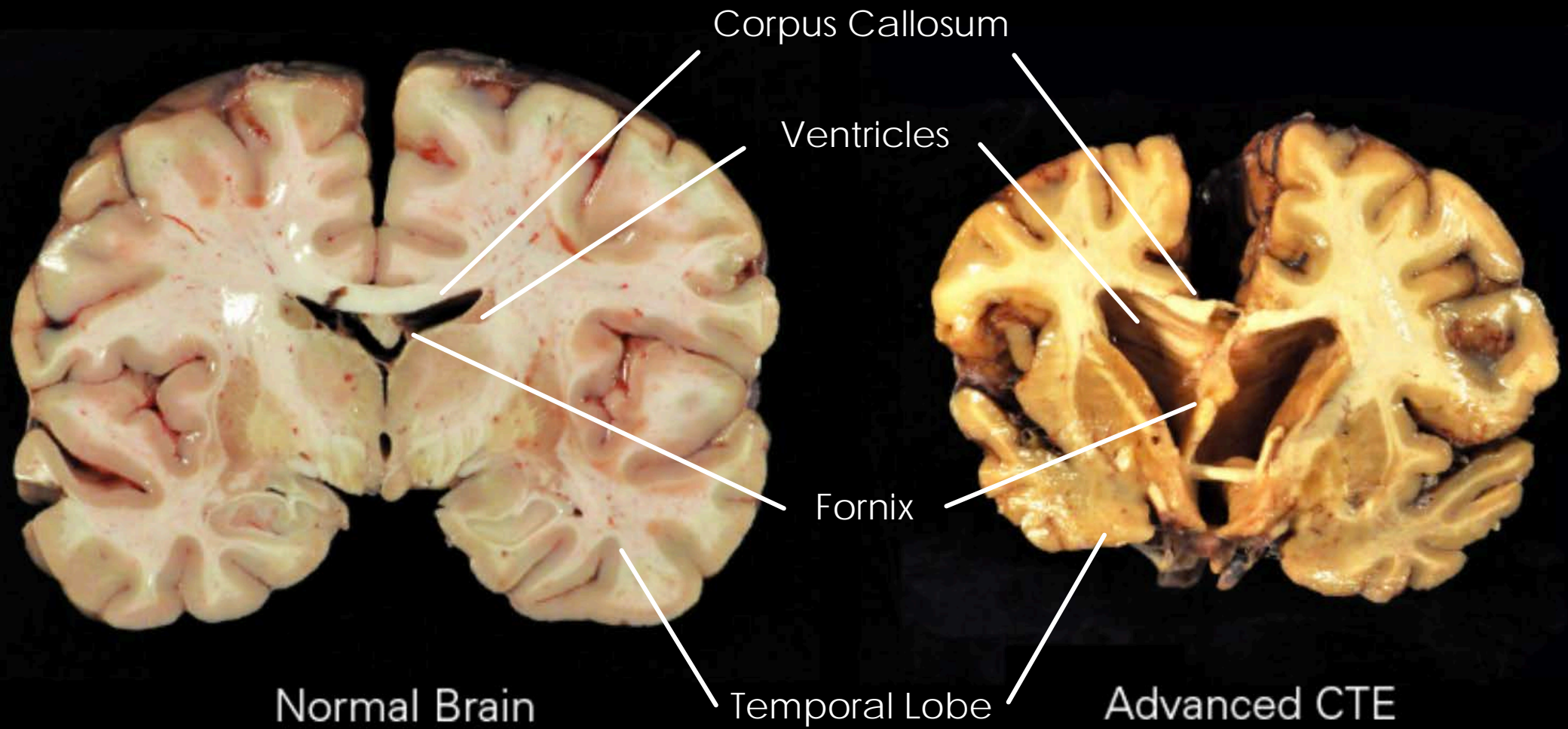
Number of sports-related concussions reported annually in the US: **3.8 million**

Number of deaths each year caused by TBIs: **52,000 deaths**

Americans living with TBI-related symptoms: **5.3 million**

Financial burden: **\$76 billion annually**







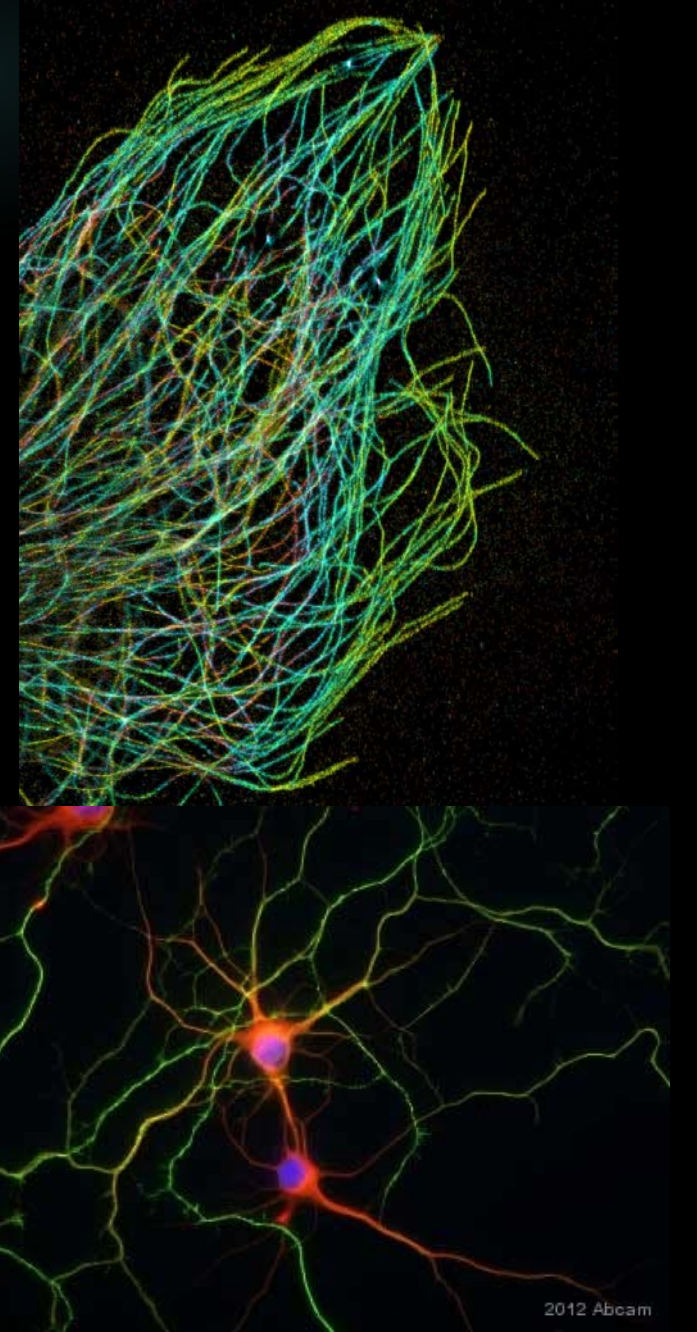
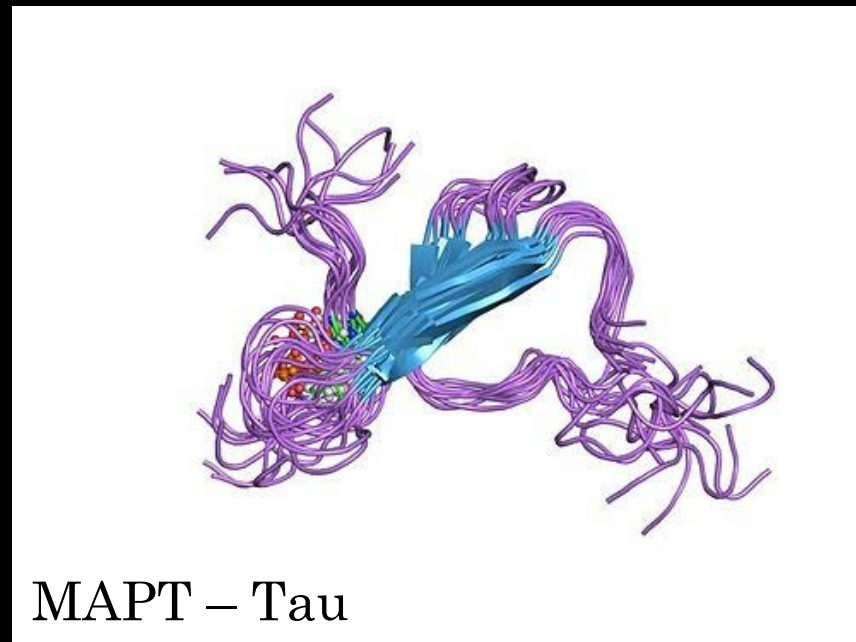
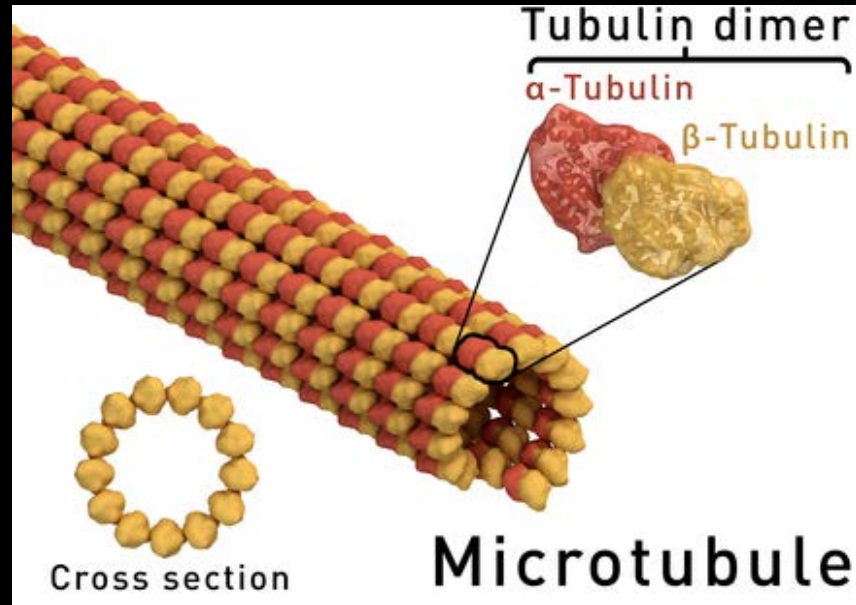
# Tau Protein

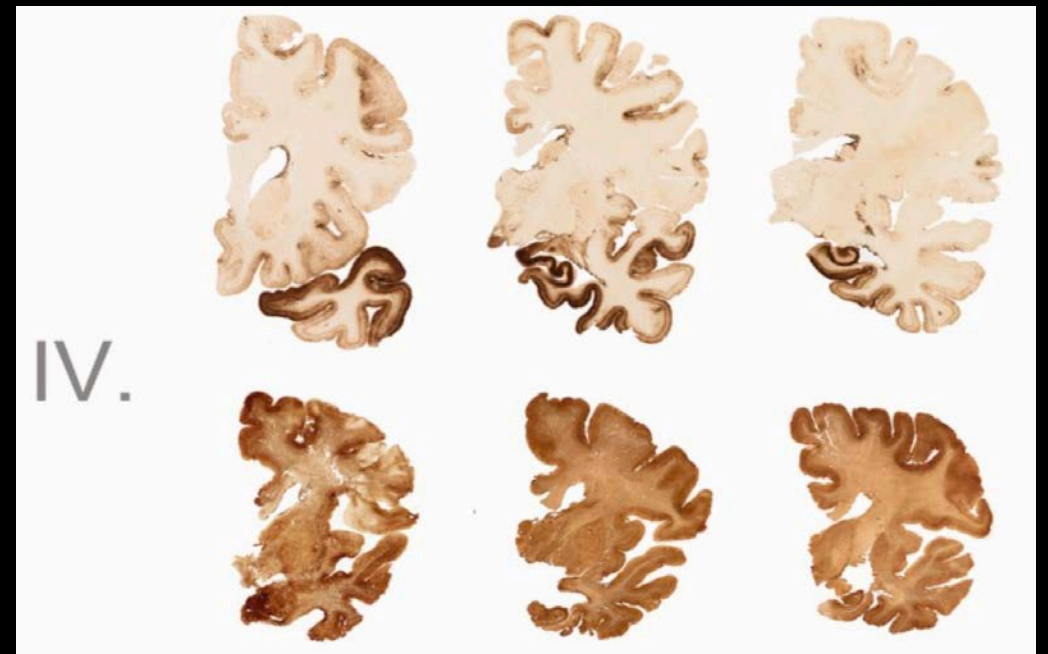
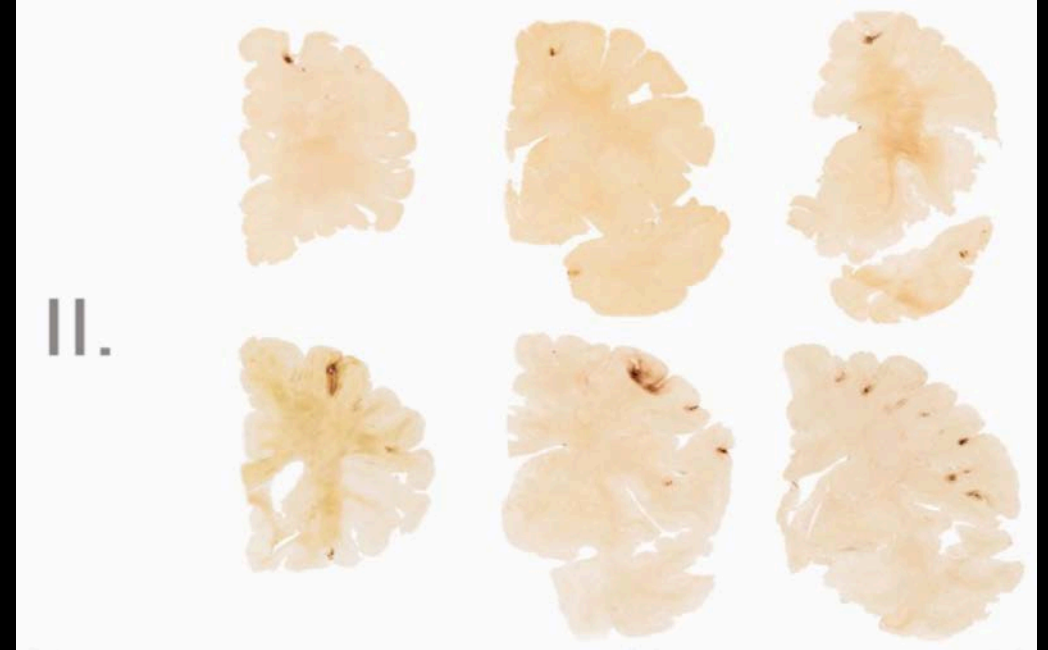
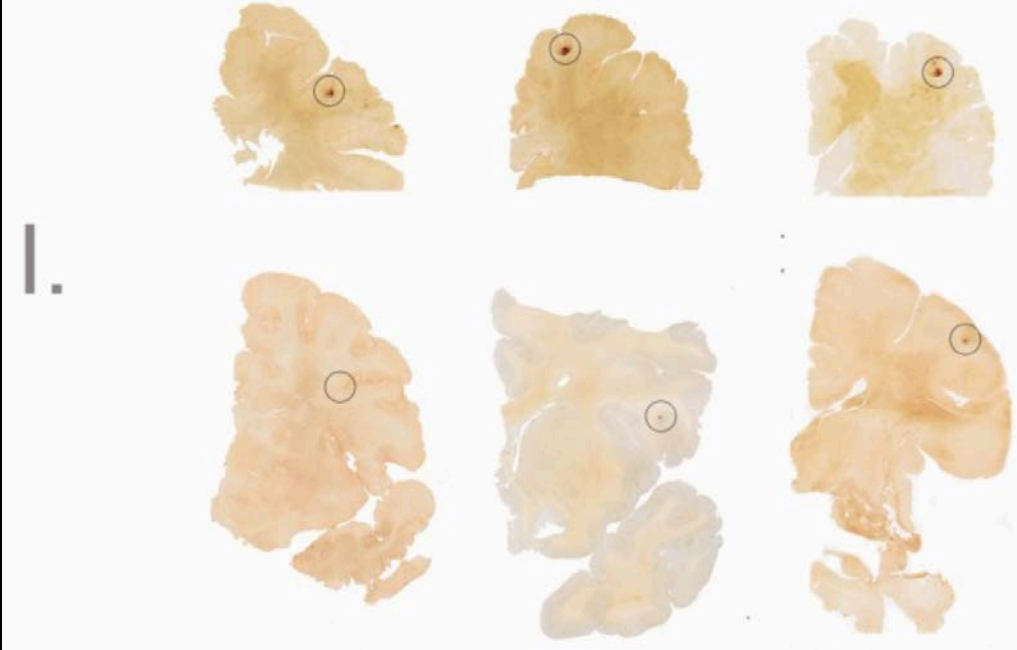
Microtubules – polymers that form cellular cytoskeleton

i.e.: support beams

Tau protein – stabilizers of microtubules

i.e.: screws that hold support beams in place







200 participants who played contact sports

117 (87%) tested positive for CTE

110 of 111 former NFL players tested positive for CTE

99% had pathological tau protein aggregates

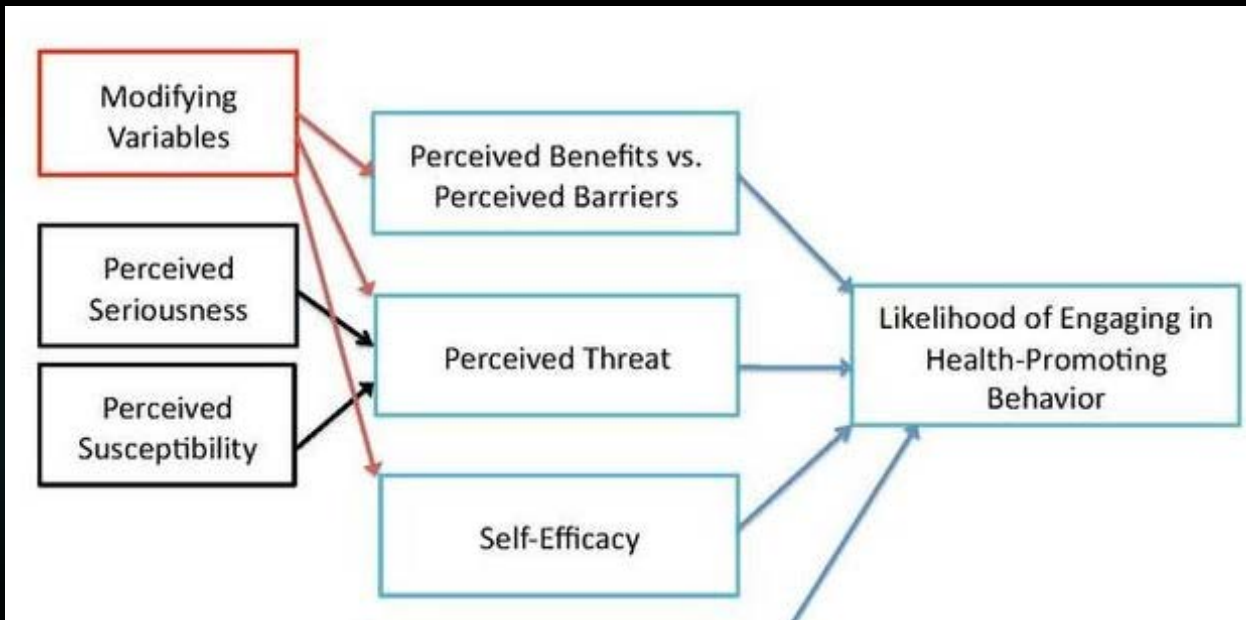
100% were symptomatic



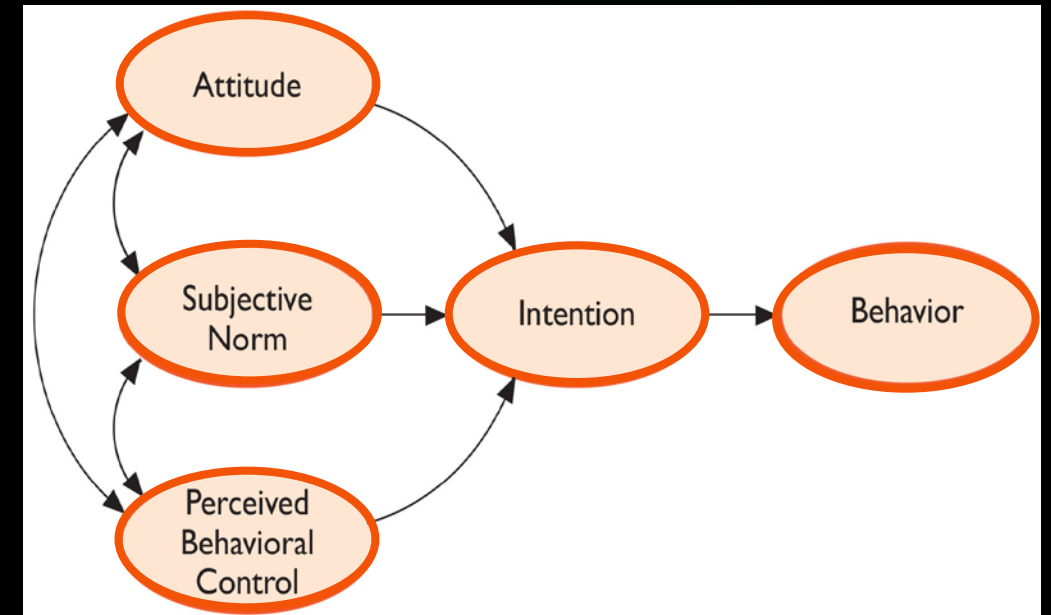
# Research Component #1: Psychosocial Health Theories

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## ► The Health Belief Model (HBM)



## ► The Theory of Reasoned Action (TRA)



# Methods

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- ▶ Sample and Participants
  - ▶ Single, cross-sectional survey
  - ▶ 58 participants
  - ▶ Contact sport athletes
- ▶ Data Gathering
  - ▶ IRB Approved
  - ▶ Social Media
  - ▶ Snowball Sampling
  - ▶ Qualtrics Software





# Results: Concussion History

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*Table 4: Descriptive Characteristics of Diagnosed Concussions (n = 58)*

Characteristic	Mean (SD)
<b>Number of Diagnosed Concussions (lifetime)</b>	
All	0.909 (1.159)
Male	0.931 (1.193)
Female	0.884 (1.142)
<b>Height</b>	
Under 5'0" – 5'3"	0.625 (1.188)
5'3" – 5'6"	0.688 (1.014)
5'6" – 6'0"	0.944 (1.110)
6'0" or Taller	1.308 (1.377)
<b>Years of Contact Sport Participation</b>	
0-3 Years	0.875 (1.356)
3-6 Years	0.667 (1.154)
6-9 Years	0.273 (0.467)
9-12 Years	0.500 (0.577)
12-15 Years	1.500 (1.517)
15 + Years	1.174 (1.230)

*Table 6: Descriptive Characteristics of Sample Athlete Population*

	Total Number of Athletes	Gender Breakdown	Average Number of times Returned to Play with a TBI/Concussion	Average Concussion Knowledge Score
Soccer	27	Male – 32.00% Female – 68.00%	1.0	8.0/9.0
Football	9	Male – 100%	1.4	8.1/9.0
Rugby	3	Male – 33.33% Female – 66.67%	0.7	7.7/9.0
Basketball	5	Male – 60.00% Female – 40.00%	1.2	7.8/9.0
Martial Arts/Boxing	2	Male – 100%	0.5	8.5/9.0
Other	8	Male – 40.00% Female – 60.00%	0.2	8.0/9.0
Total	54	Male – 46.00% Female – 54.00%	1.1	8.0/9.0

Table 1: Multiple Regression Explaining Factors that Affect Knowledge about CTE

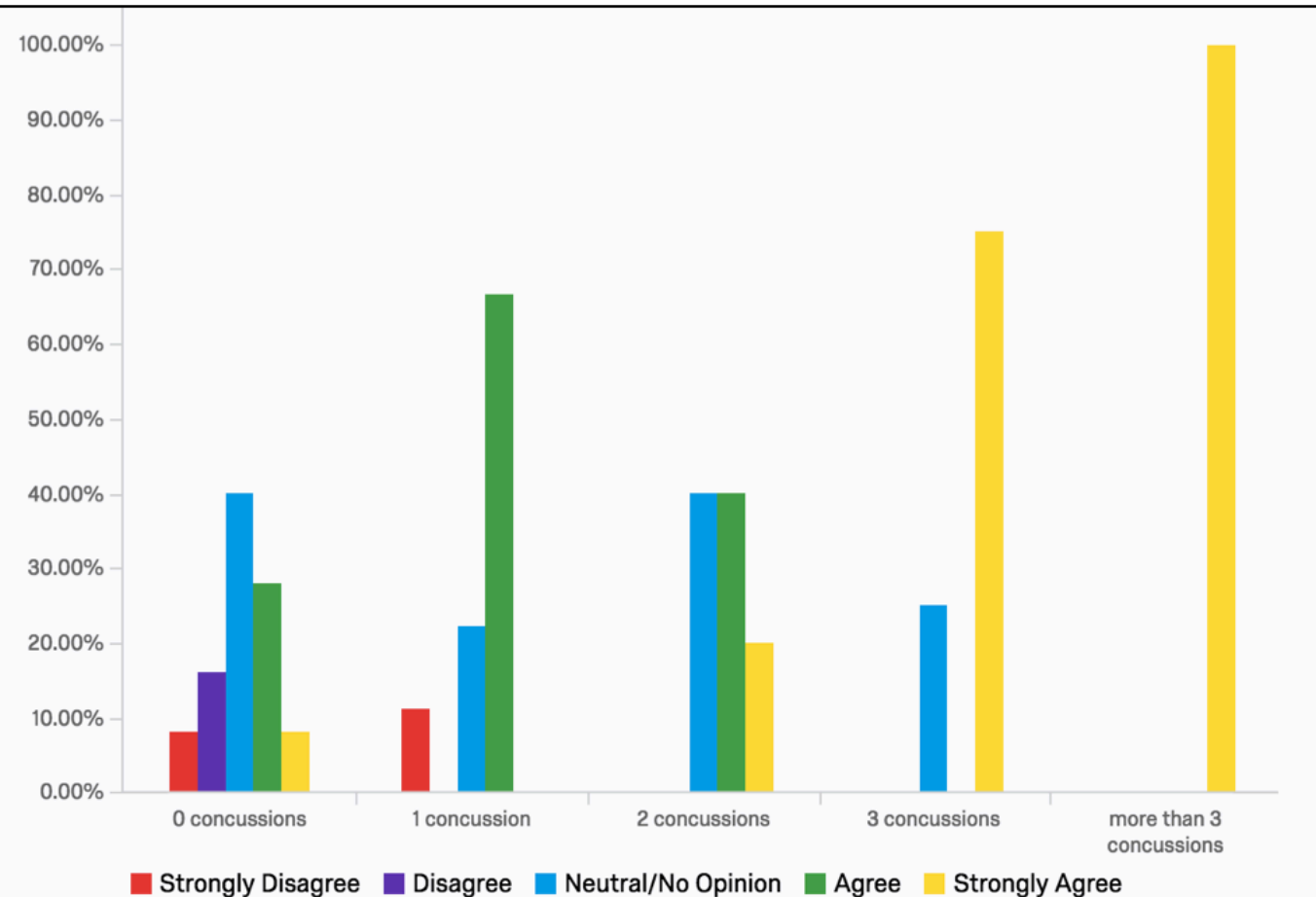


- General Knowledge
- Understanding Equipment Limitations
- Younger players more receptive

# Results & Discussion: Interesting Findings

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*Table 9: Perceived Susceptibility vs. Concussion History*



- ▶ Perceived Susceptibility was highly correlated with the number of concussions an athlete had sustained
- ▶ 100% of athletes who had sustained more than 3 concussions believed they were susceptible
- ▶ However, PS variable needs more conclusive data to prove link to reporting intentions

Table 8B: Results of logistic regression predicting intention to display preventative behaviors (n = 58)

Independent Variable	Model 1.1 <sup>A</sup>	Model 1.2 <sup>B</sup>	Model 2.1 <sup>C</sup>	Model 2. 2 <sup>D</sup>
	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
	Pr (>  z )	Pr (>  z )	Pr (>  z )	Pr (>  z )
Perceived Susceptibility	0.196 (0.044 - 0.869) 0.0319 ***	<b>0.343</b> (0.867 – 0.135) 0.0237 ***	0.00402 (1.082 – 0.115) 0.0686 *	<b>0.518</b> (1.123 – 0.238) 0.09579 *
Self-Efficacy	4.621 (32.691 – 0.653) 0.1252 **	<b>6.321</b> (26.508 – 1.507) 0.0117 ***	0.353 (44.279 – 1.097) 0.0396 ***	<b>6.205</b> (24.206 – 1.591) 0.00858 *****
Benefits vs. Barriers	3.357 (19.806 – 0.569) 0.1810 **	<b>2.142</b> (7.010 – 0.654) 0.2081	2.775 (12.704 – 0.606) 0.1885 *	<b>2.026</b> (6.262 – 0.656) 0.21998
Team Norms	0.476 (14.658 – 0.015) 0.6711		0.406 (6.825 – 0.024) 0.5314	
Coach Relationship	2.147 (8.286 – 0.556) 0.2674		1.585 (5.162 – 0.487) 0.4446	
Gender	0.619 (15.486 – 0.024) 0.7701		0.919 (12.716 – 0.066) 0.9499	
Years of Participation	1.370 (2.514 – 0.747) 0.3089		1.204 (1.921 – 0.754) 0.4373	
Height	0.843 (2.179 – 0.326) 0.7247		1.056 (2.364 – 0.472) 0.8938	
Weight	0.874 (1.552 – 0.492) 0.6462		0.908 (1.502 – 0.549) 0.7082	
Concussion Knowledge	1.039 (2.633 – 0.410) 0.9360		1.169 (2.621 – 0.521) 0.7055	

<sup>A</sup> Bivariate analysis of Intention to Report Concussions<sup>B</sup> Bivariate analysis of Intention to Report Concussions with only significant variables from Model 1.1<sup>A</sup><sup>C</sup> Bivariate analysis of Intention to Make Safe Removal-from/Return-to-Play Decisions<sup>D</sup> Bivariate analysis of Intention to Make Safe Decisions with only significant variables from Model 2. 2<sup>C</sup>

\* = p &lt; 0.1

\*\* = p &lt; 0.2

\*\*\* = p &lt; 0.05

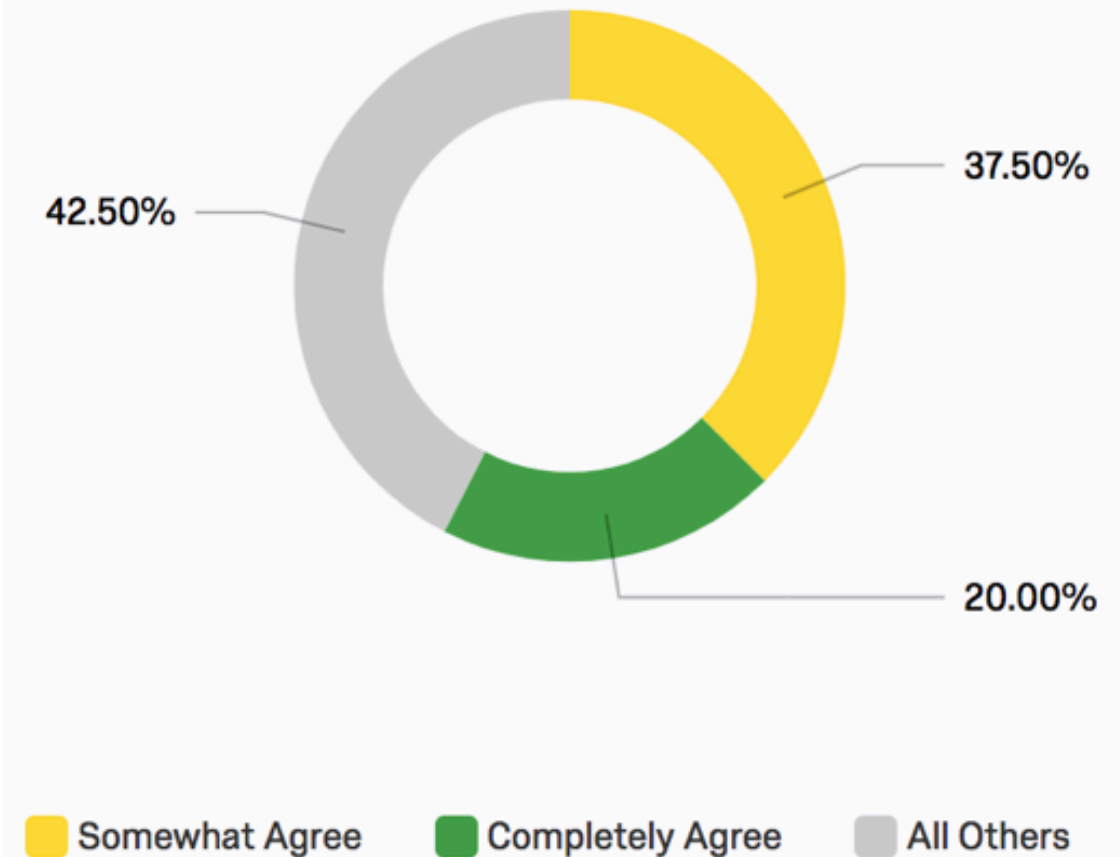
\*\*\*\* = p &lt; 0.01

# Peer Attitudes and Beliefs

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- ▶ Most athletes would not think less of a teammate who chose to report a possible concussion
- ▶ 46% reported low Self-Efficacy in removing themselves from a game that their teammates felt was important/would hurt team performance
- ▶ 57% said their peers would feel a peer should continue playing if their symptoms “weren’t that bad”

*Table 11: TRA Q60: “My Teammates feel that a fellow athlete should continue playing if their symptoms weren’t severe”*



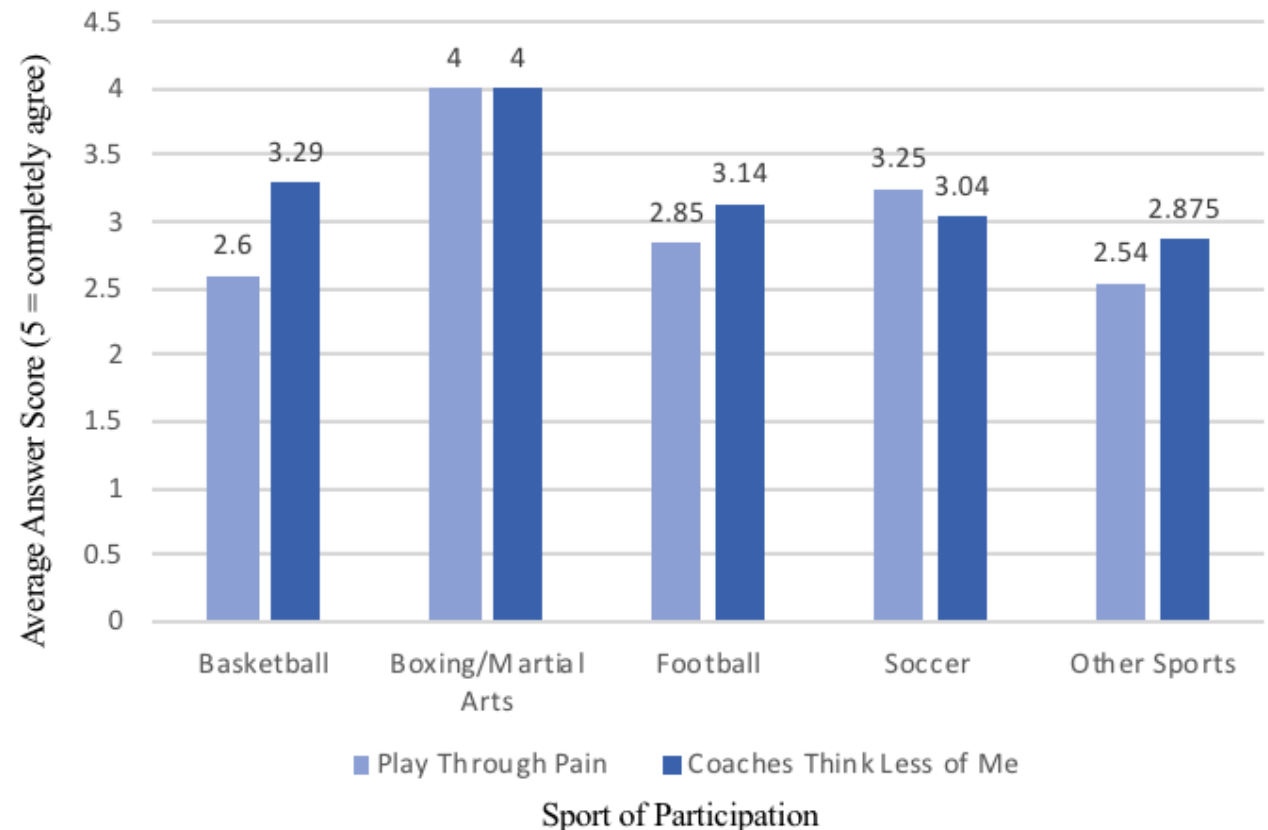
# Coach-Athlete Relationship Findings

►  $r = 0.8268$

(The closer  $r$  is to 1, the more positively correlated the two variables are)

► This indicates that athletes who perceived that their coaches would think less of them, if they falsely reported a concussion, were more likely to report feeling like they were expected to “play through the pain”

*Table 13: Average Score by Sport of Perceptions About Coaches' Attitude*



# Research Component #1: Summary of Findings

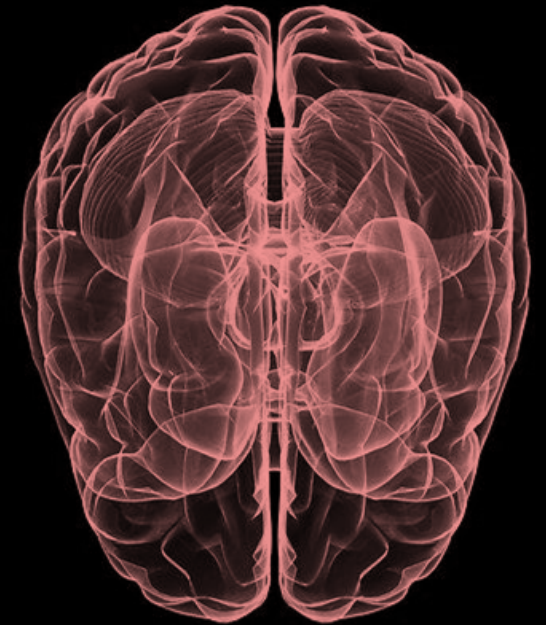
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- ▶ Knowledge about concussions does not relate to safety decisions
- ▶ Football players were most likely to return to play while experiencing what they suspected to be a concussion or TBI
- ▶ Self-Efficacy is a crucial indicator of reporting and safety behaviors
- ▶ Athletes who fear negative perceptions from their peers and coaches are less likely to make safe decisions



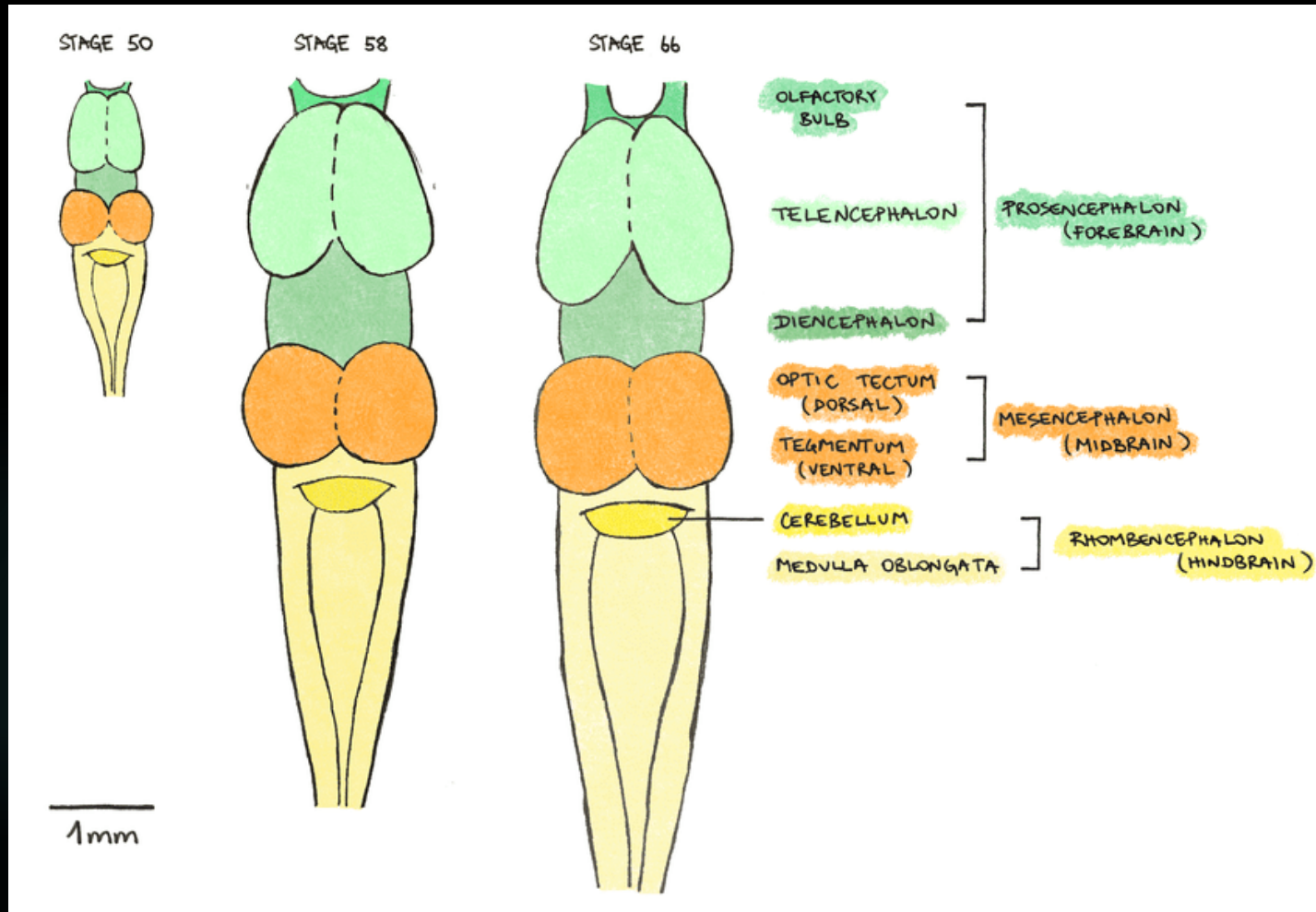
# Research Component #2: Behavior and Neuropathology

- ▶ Injury number and severity correlates positively with negative behavioral sequelae (Petraglia, Plog, Dayawansa, et al., 2014)
- ▶ Injury studies' translational ability limited in mammals
- ▶ Does movement and behavior irregularity correlate with pathological markers of CTE?







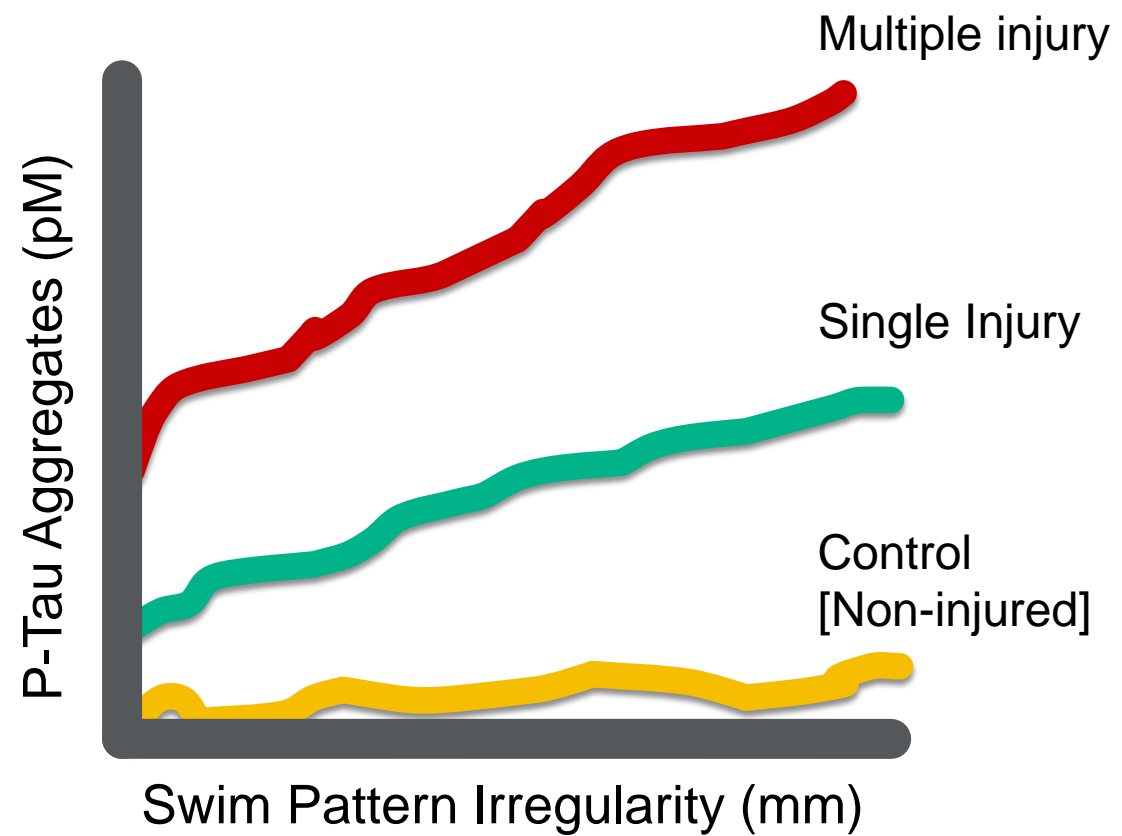
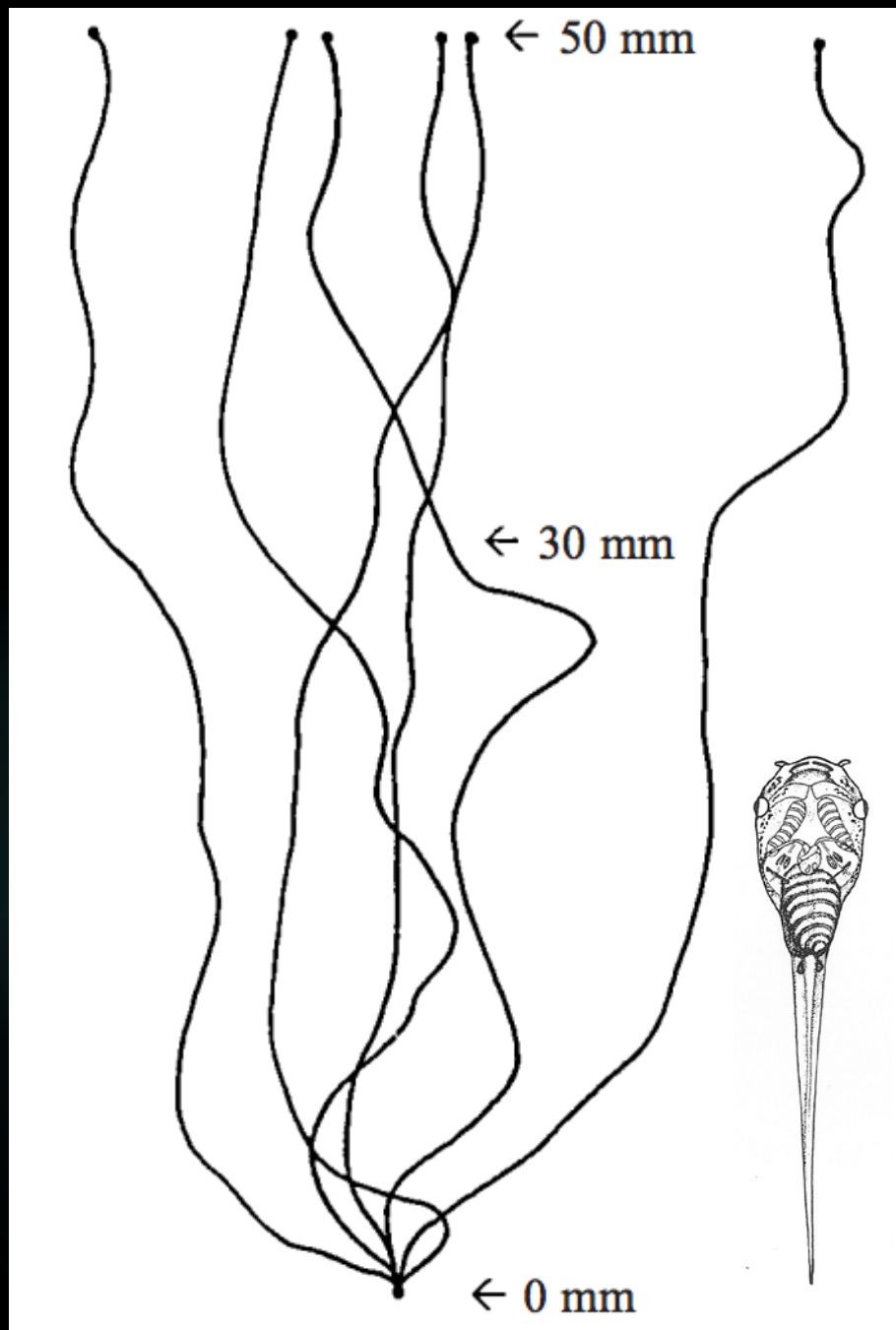


- Forebrain responsible for reflexes, sight, motor functions
- Midbrain helps with stimulus identification, visual processing
- Hindbrain may finalize voluntary motor commands, process info

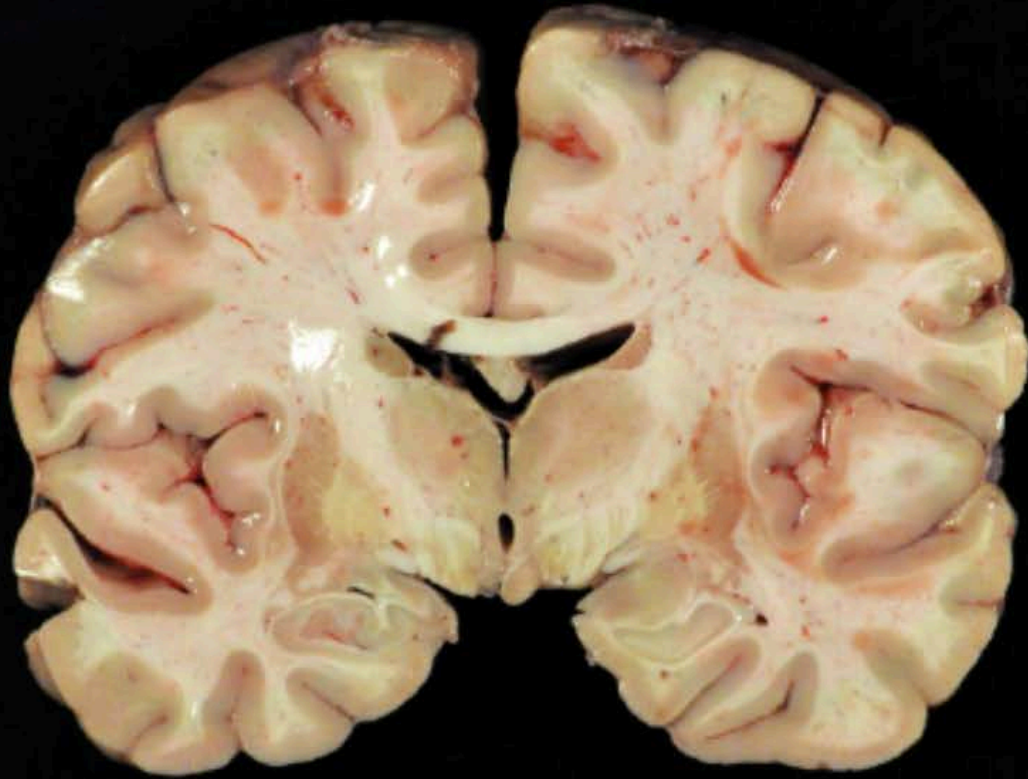
# C-Start Reflex

- ▶ Avoidance behavior
- ▶ Mediated by forebrain and midbrain
- ▶ Simple quantifiable behavior
- ▶ Modified as a result of injury









Normal Brain



Advanced CTE

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