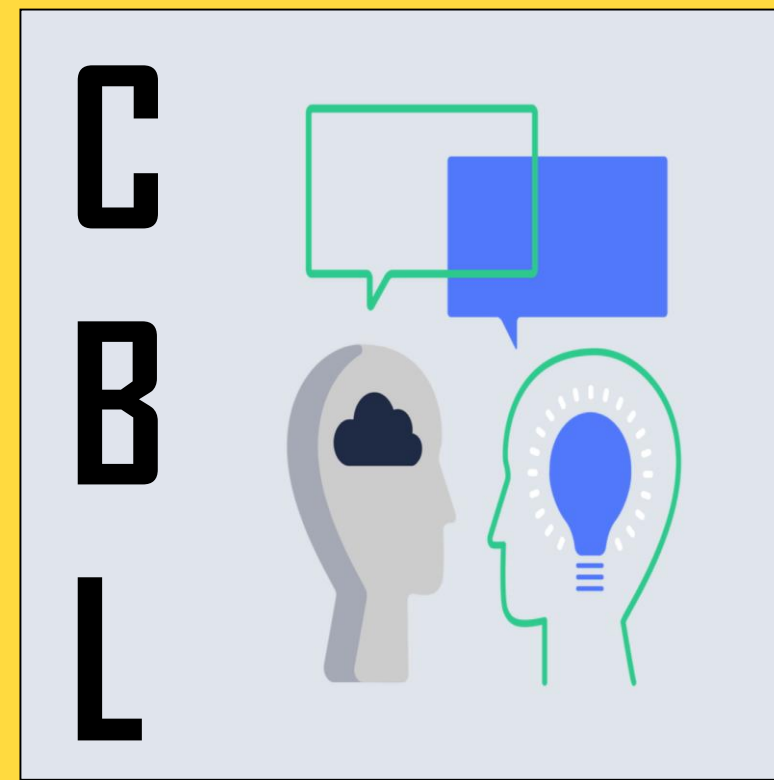


# The Effects of Concussion on Neural Markers of Language Comprehension: Preliminary Findings

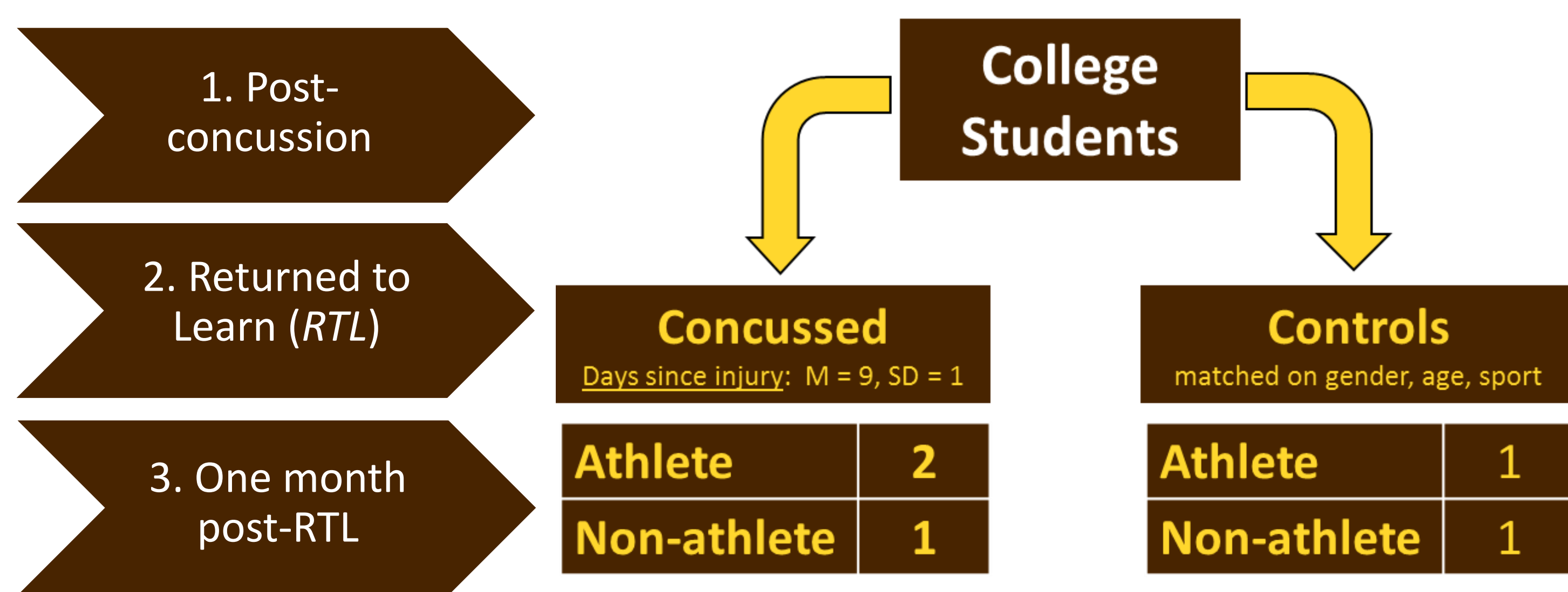
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## Introduction

Concussions produce immediate consequences to individuals' cognitive and mental status which can manifest as challenges in many aspects of their life. Given the substantial amount of brain injuries that occur each year, these injuries are understandably a growing concern. Estimates establish the total number of concussions between 1.6-3.8 million annually (Langlois et al., 2006, *J Head Trauma Rehabil*). Findings using evoked potentials (ERPs) suggest that concussions may alter the functional brain activity supporting attention (Ledwidge & Molfese, 2016, *J Neurotrauma*) and working memory (Hudac et al., 2018, *Int J Psychophys*). Recently, Ledwidge (2018, *Ann Behav Neuro*) theorized that sports-related concussions may also initiate a reorganization of structural and functional pathways within the language comprehension network. To further our understanding of this phenomenon, we are investigating the N400 ERP in an acute phase following injury to measure changes in the neurolinguistic systems throughout concussion recovery.

## Participants



## What is EEG and the N400 ERP?



- Electroencephalography ("EEG") is a brain recording technique that measures neurons' electrical impulses
- We record EEG while patients complete cognitive tests to examine event-related potentials ("ERP"), segments of the EEG that reflect distinct mental processes, such as perception, attention, and language
- In the CBL Lab, we use ERPs to examine how concussions affect these mental processes
- For example, the N400 ERP is a brain response marker of language comprehension, and we're using it to examine how concussions may alter language processing

## Research Design

Data Collection Method	Description
Case History Interview	To obtain medical case history and demographic information
Post-Concussion Symptom Scale	Evaluates severity of concussion like symptoms
Edinburgh Handedness inventory	Determines left or right hand dominance
EEG Recording	256 HydroCel electrode net with Netstation 5.3 acquisition software and 1000 Hz sampling rate
Sentence Verification ERP task ( <i>Lexical-semantic retrieval</i> )	Participants make semantic judgments on simple sentences briefly presented on a computer screen in which the last word is an anomalous or coherent sentence ending.
Go/No Go ERP task ( <i>Inhibition, self-control</i> )	Participants press a button to rapidly presented letters on the computer (e.g., "M") and inhibit responses to a different letter (e.g., "W")
Cognitive Linguistic Quick Test	Neuropsychological battery that assesses cognitive and linguistic abilities within the domains of attention, memory, language comprehension, executive functions, and visuospatial skills

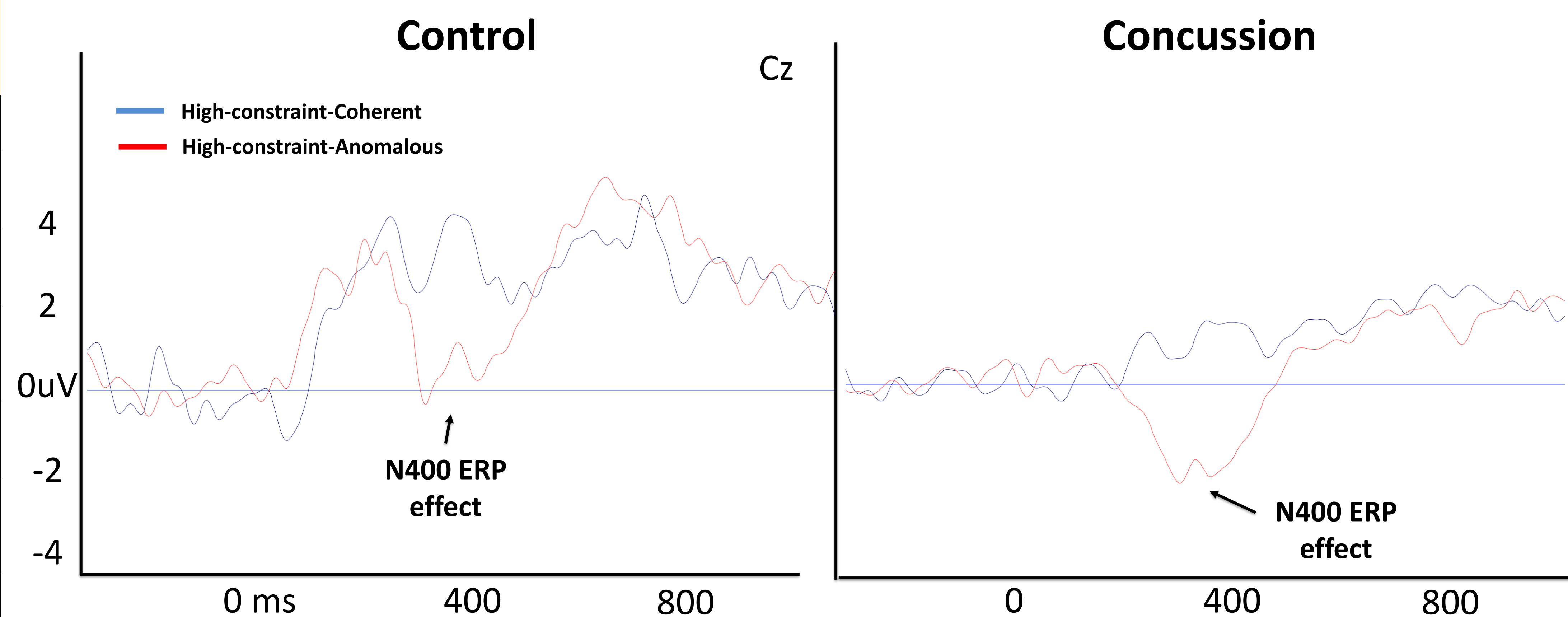
## Sentence Verification Task (SVT)

HIGH CONSTRAINT	COHERENT To spread the butter he used a <u>knife</u> .	ANOMALOUS To spread the butter he used a <u>chair</u> .
	LOW CONSTRAINT She went to the store to buy a <u>bag</u> .	She went to the store to buy a <u>gasp</u> .

## Preliminary Results: Post-Concussion

CLQT Results	Control		Concussion		
	P1	P2	P3	P4	P5
<b>Attention</b> (WNL 180-215)	208 ✓	209 ✓	203 ✓	206 ✓	197 ✓
<b>Memory</b> (WNL 155-185)	176 ✓	184 ✓	171 ✓	174 ✓	151 ✓
<b>Executive Functions</b> (WNL 24-40)	32 ✓	36 ✓	29 ✓	28 ✓	28 ✓
<b>Language</b> (WNL 29-37)	33 ✓	26 ✓	33 ✓	31 ✓	28 ✓
<b>Visuospatial Skills</b> (WNL 82-105)	100 ✓	100 ✓	92 ✓	98 ✓	97 ✓
<b>Clock Drawing</b> (WNL 12-13)	13 ✓	12 ✓	13 ✓	13 ✓	13 ✓
<b>Composite Severity</b>	WNL	WNL	WNL	WNL	WNL

\*WNL = within normal limits



- **N400-effect:** N400s were significantly larger to semantic anomalies than coherent words,  $F(1, 3) = 18.08, p = .024$ .
- **Concussion effect:** Both groups demonstrated the N400-effect,  $F_s(1, 3) > 8.57, p_s < .062$ . N400 amplitudes were more negative for the Concussion group ( $M = 0.0, SE = 0.70$ ) than the Control group ( $M = 1.93, SE = 1.94$ ), but this effect was not statistically significant,  $F(1, 3) = 4.05, p = .179$ .

## Conclusion & Future Directions

- Our preliminary findings indicate that the SVT paradigm is reliably eliciting the "N400-effect." The impacts of concussion on the neurolinguistic system warrant our lab's continued investigation with larger samples.
- To this aim, data collection for this project is ongoing in the CBL lab; we are also planning to extend this work to pediatric-TBI populations
- We hope that our future findings will help inform clinical best practices for managing and treating the cognitive-linguistic challenges associated with concussion recovery

The CBL Lab would like to thank the students and student-athletes who are participating in this study!