



# An Objective Method to Monitor Athletes Recovering from Traumatic Brain Injuries

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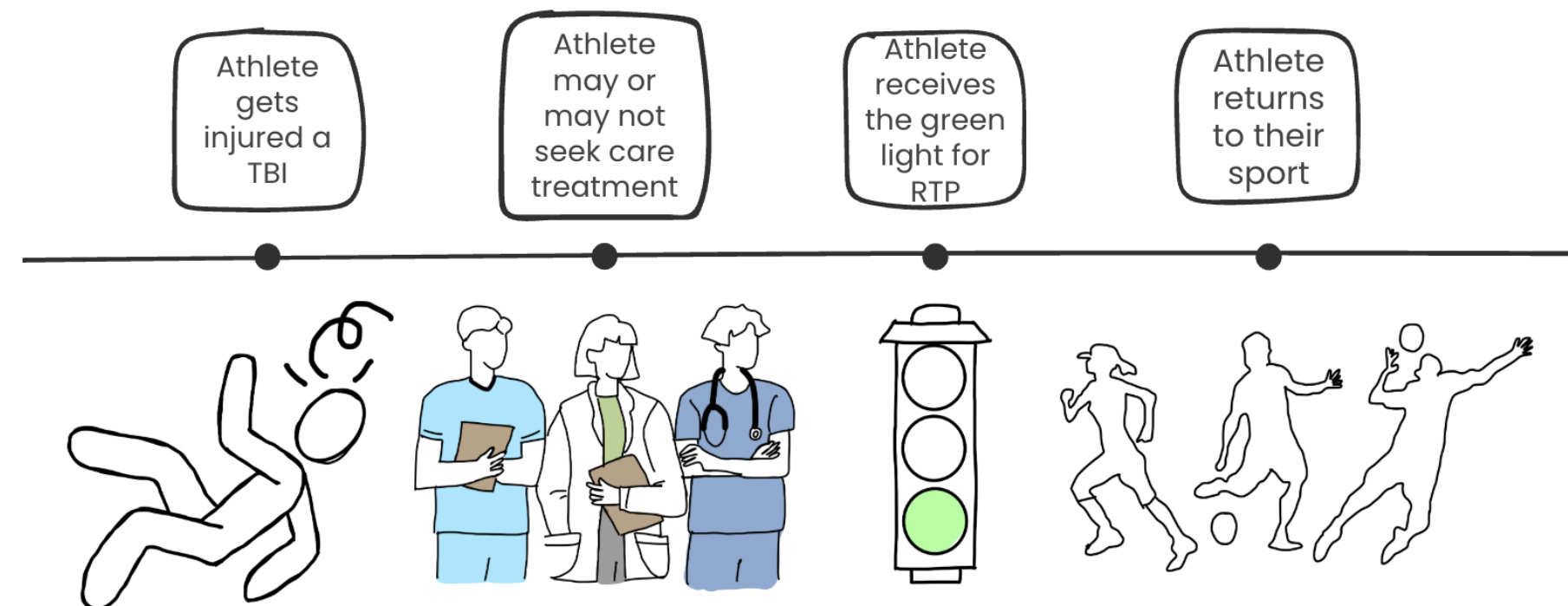
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## BACKGROUND

- Mild Traumatic Brain Injury (mTBI) poses a significant health risk, accounting for approximately 10% of all sports-related injuries annually.<sup>1</sup>
- Current diagnostic methods **lack objective biomarkers** to predict recovery and guide return to play decisions.
- Virtual Reality (VR)/Augmented Reality (AR)-based neuromonitoring** can prognosticate recovery from mTBI in athletes.

How can we be sure the athlete is symptom-free and ready to return to play?



## TEST BATTERY

- Smooth Pursuit:** Eye movement smoothness detects irregularities
- Saccades:** Sudden target elicits rapid gaze shifts; latency, speed, and accuracy measured
- Fixation:** Users fixate on a virtual object while distractions appear; micro-movements measured

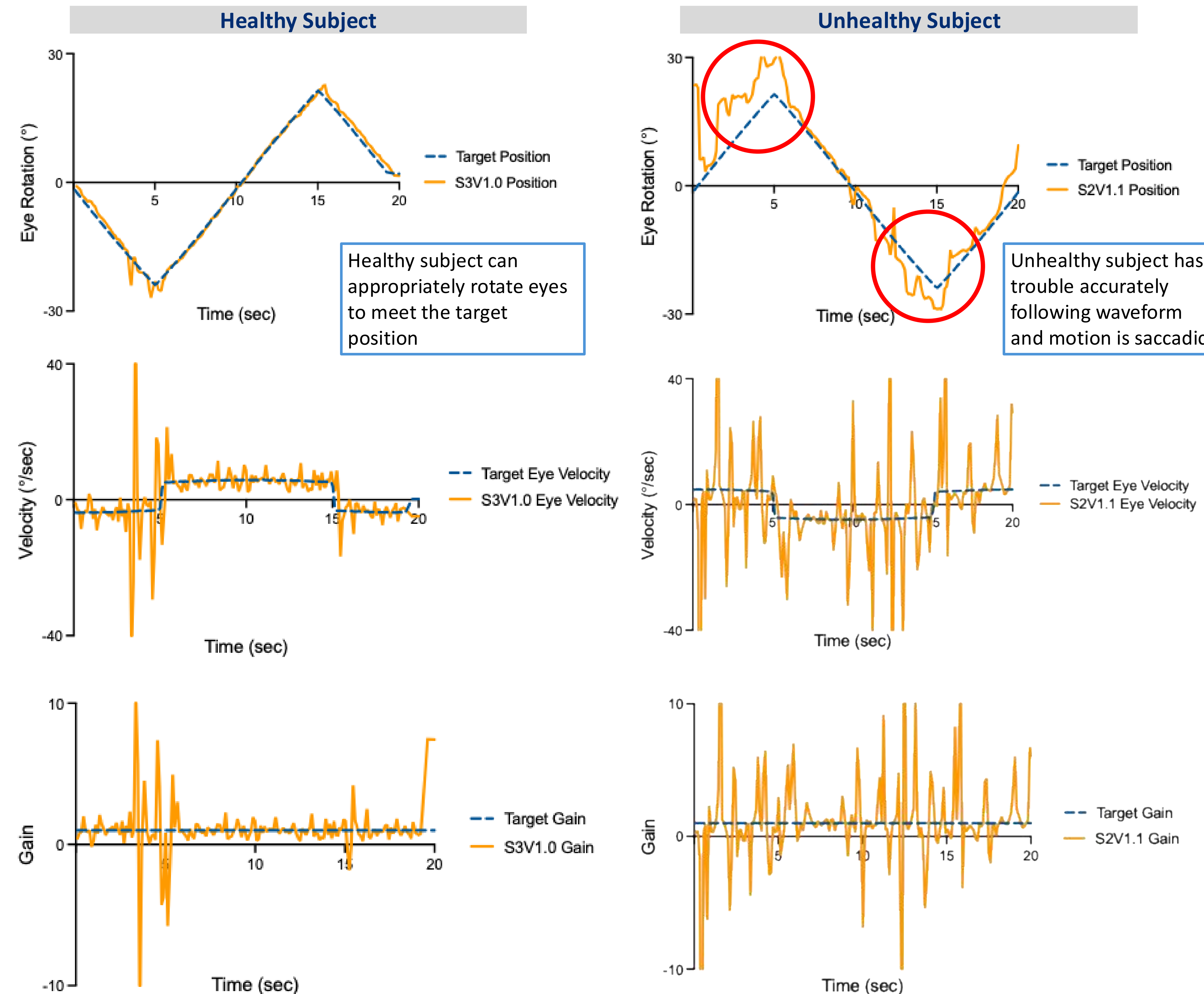
User view with tracking object in red:



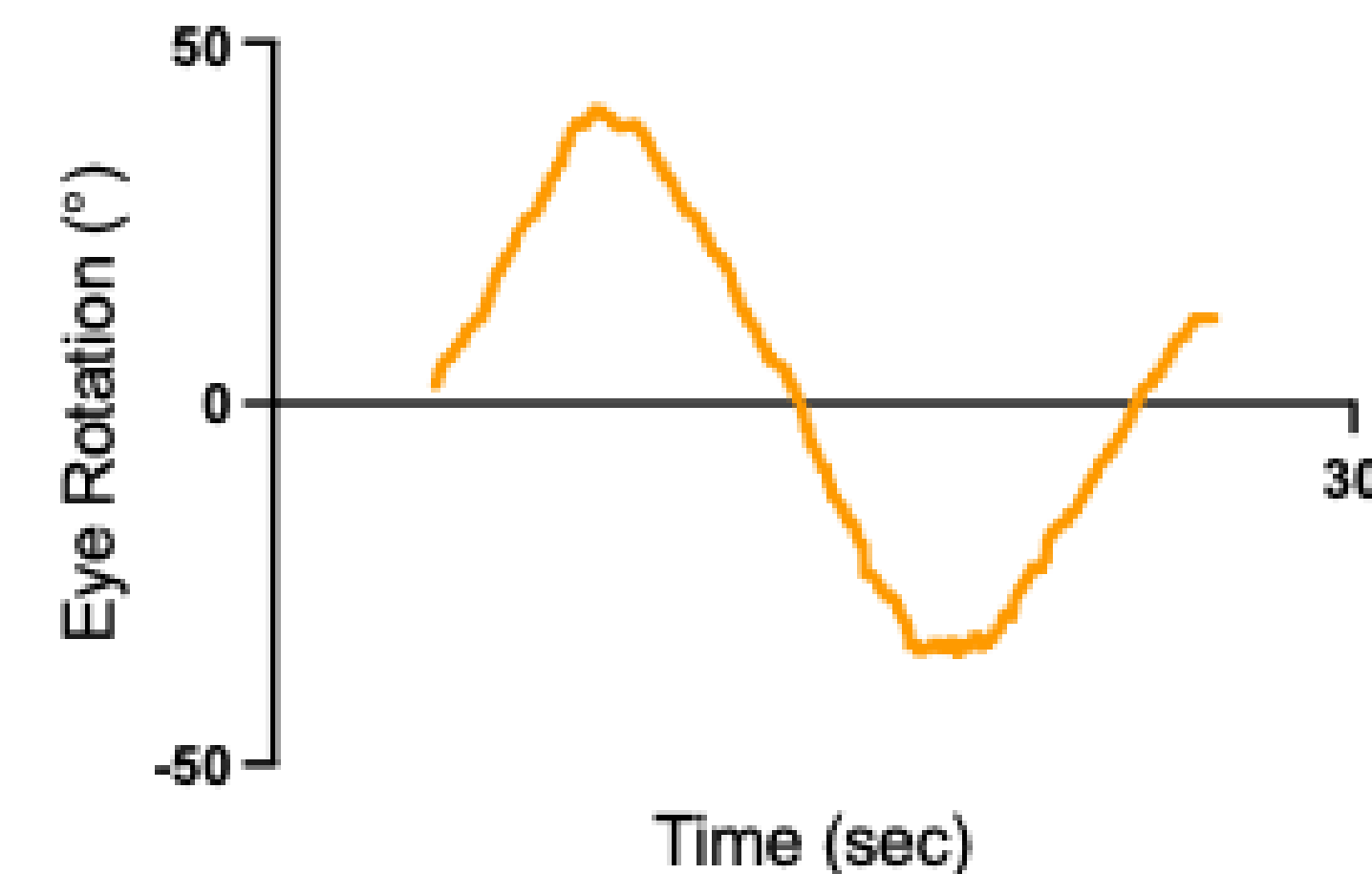
- Convergence:** VR tracks alignment to detect vergence abilities as object approaches user
- Vestibulo-Ocular Reflex (VOR):** Users move their heads while fixating to test gaze stability
- VOR Suppression:** Users perform VOR while suppressing the reflex to stabilize gaze

## RESULTS

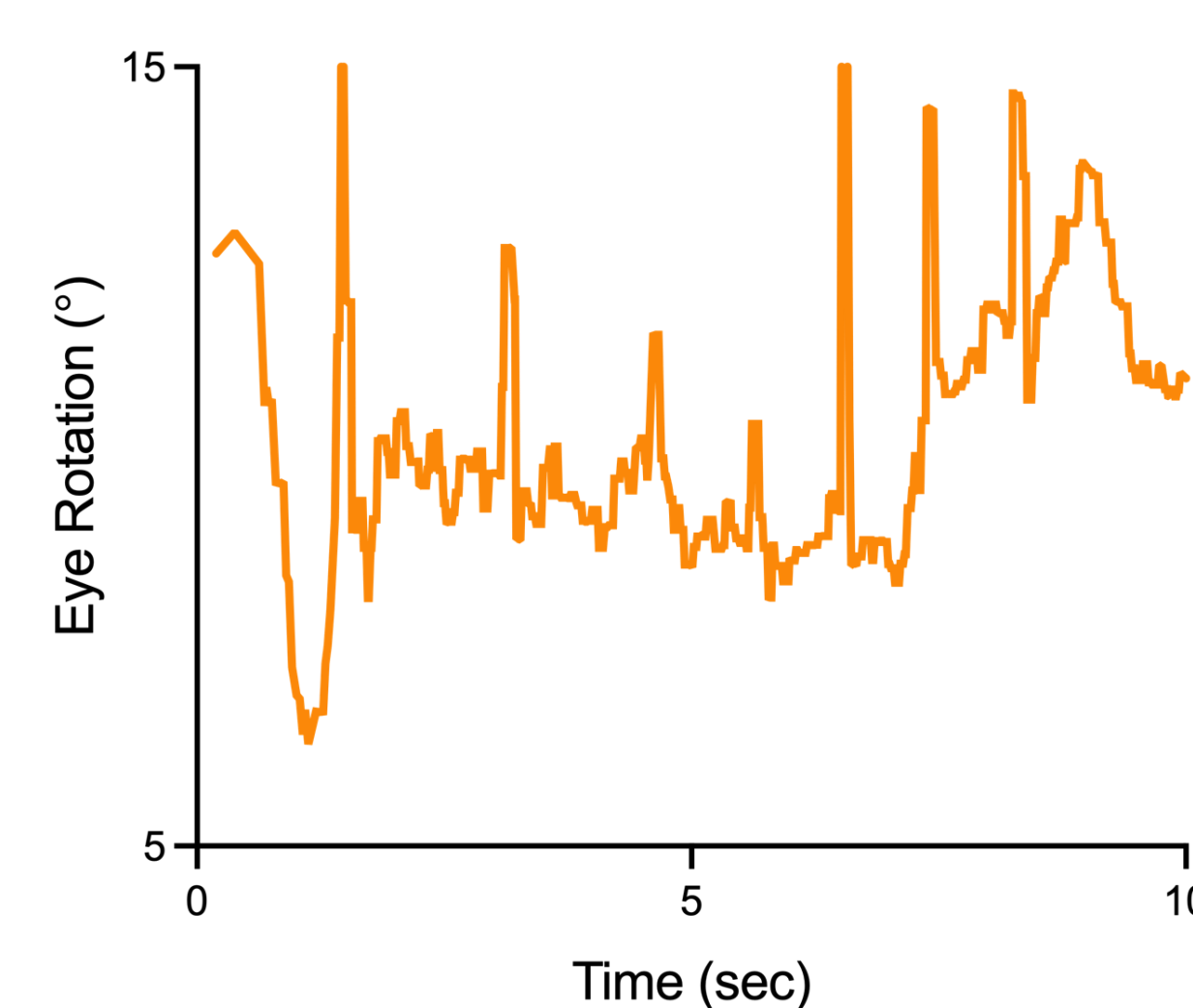
### Smooth Pursuit



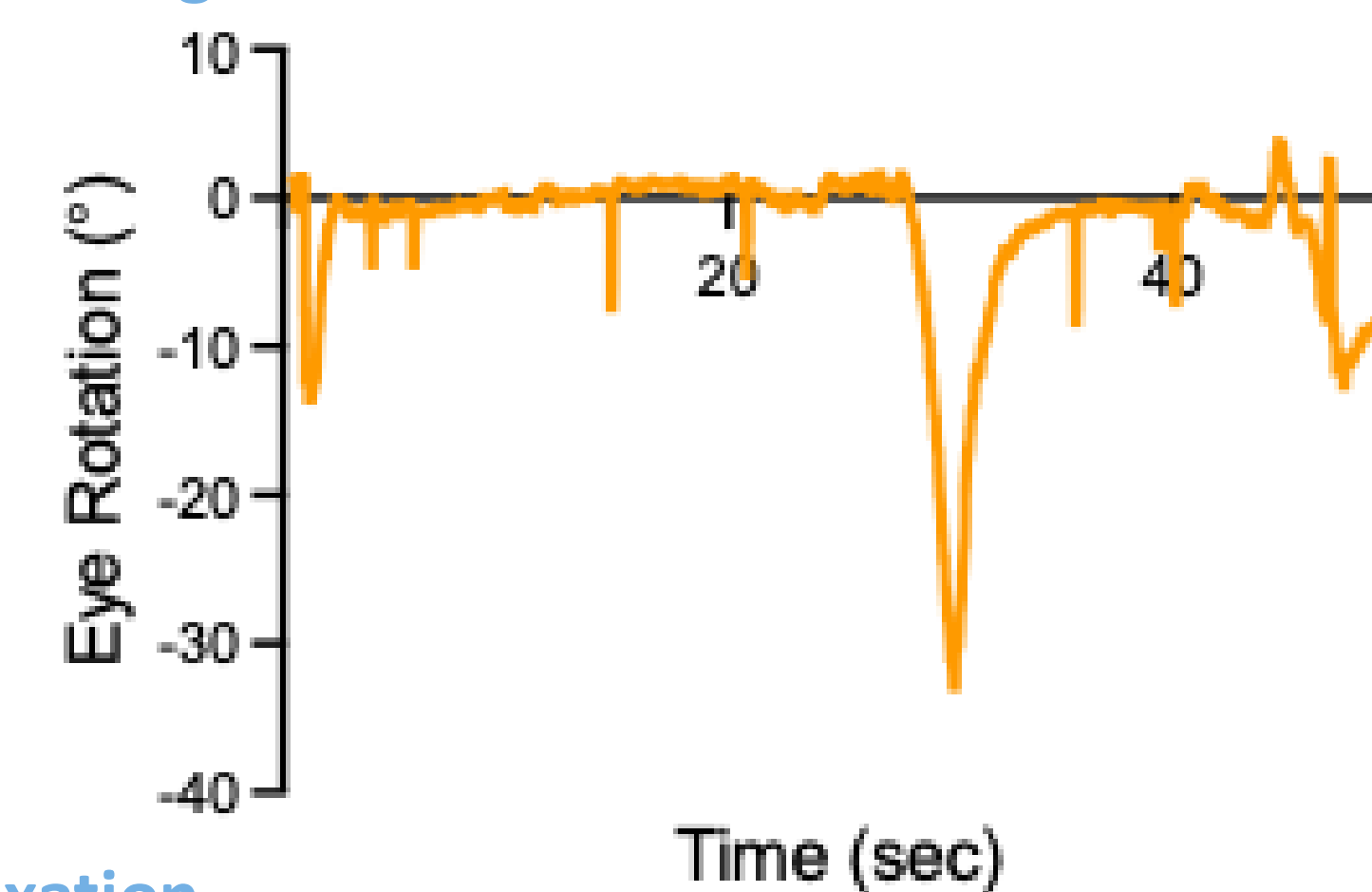
### VOR



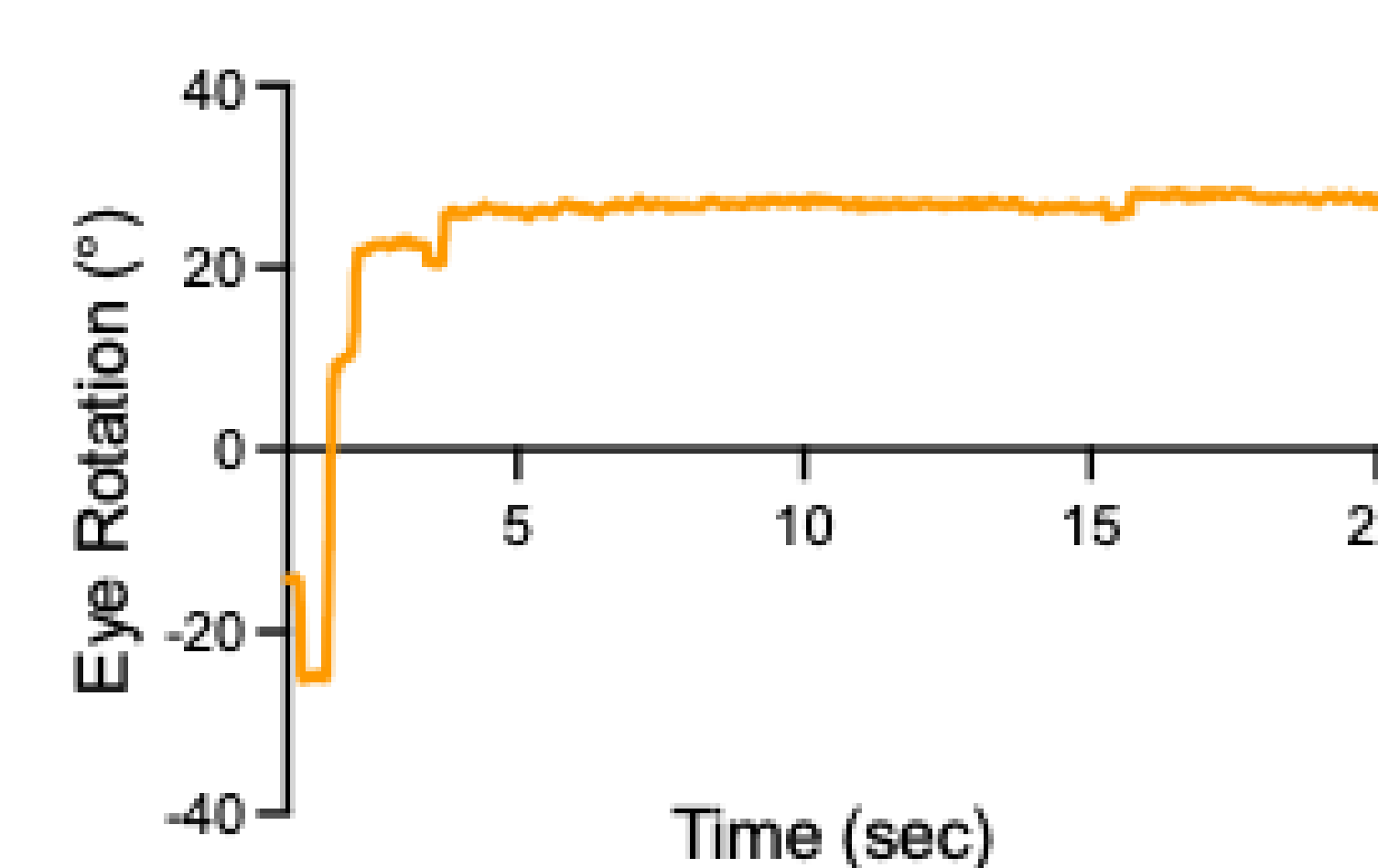
### VOR Suppression



### Convergence



### Fixation



## IMPACT

**214,000**

Athletic TBI injuries occur annually

**15%**

Increased risk of re-injury

**\$87,634**

Average in-patient cost per patient

**5.3 Million**

Americans live with a long-term disability from TBI

## FUTURE DIRECTIONS

- An AR/VR-based neuromonitoring platform has promise as an emerging mTBI **digital neurotherapy**
- Incorporating multi-sensory **neurophysiologic measurement** will enable **objective** monitoring of recovery.
- The future tool will leverage emerging AI technology for **autonomous** therapeutic **personalization**

## ACKNOWLEDGEMENTS

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