

Investigating Differences in Brain Activity Preceding Loss of Balance Related to mTBI and Emotion

Background: Current diagnostic criteria for concussions do not consider the impact of concussions on emotional regulation. Since concussions are related to balance deficits and balance deficits are related to anxiety, measuring neural activity when balance is compromised can improve diagnostic criteria to include anxiety-balance links.

Methods: A pilot participant performed 20 trials where they leaned forward with an experimenter supporting them. On a computer, a blue square indicated continuous support, and when a red square appeared, the experimenter released support at a random interval. We measured brain activity when they were “safe” (blue square) and when they were at “risk” of falling (red square) (Fig. 1). Electroencephalography (EEG) was measured during all experiment conditions.

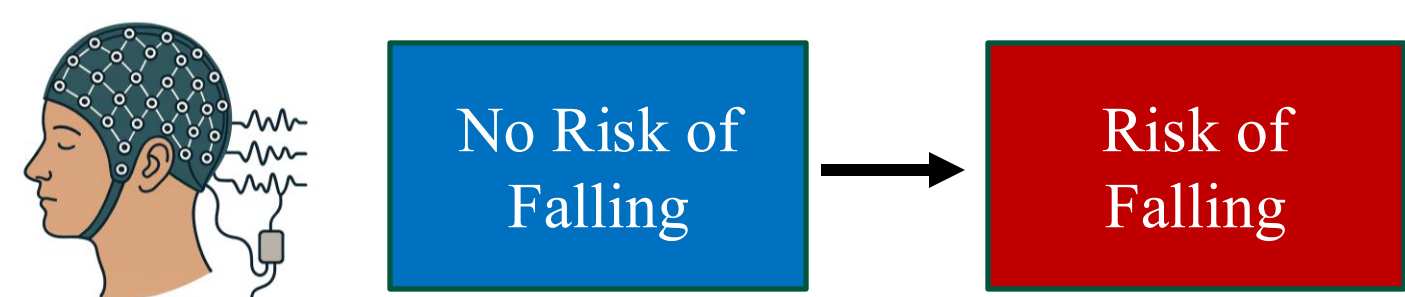


Fig 1: The participant was assured they would not fall when the blue square was on the screen. The appearance of the red square meant their balance support could be removed at any time.

Pilot results: EEG data showed increased communication between left temporal and central frontal brain regions when there was risk of falling, a neural activity pattern related to conscious motor processing that often occurs under anxiety (Fig. 2).

Additional Progress: During the project period, we installed and tested a novel lean-and-release system that supports participants leaning forward from a harness and releases them while measuring and standardizing forces (Fig. 3). This system will improve quality of future experiments. We also developed an adaptable experiment program and neural data processing pipeline for future iterations of this study.

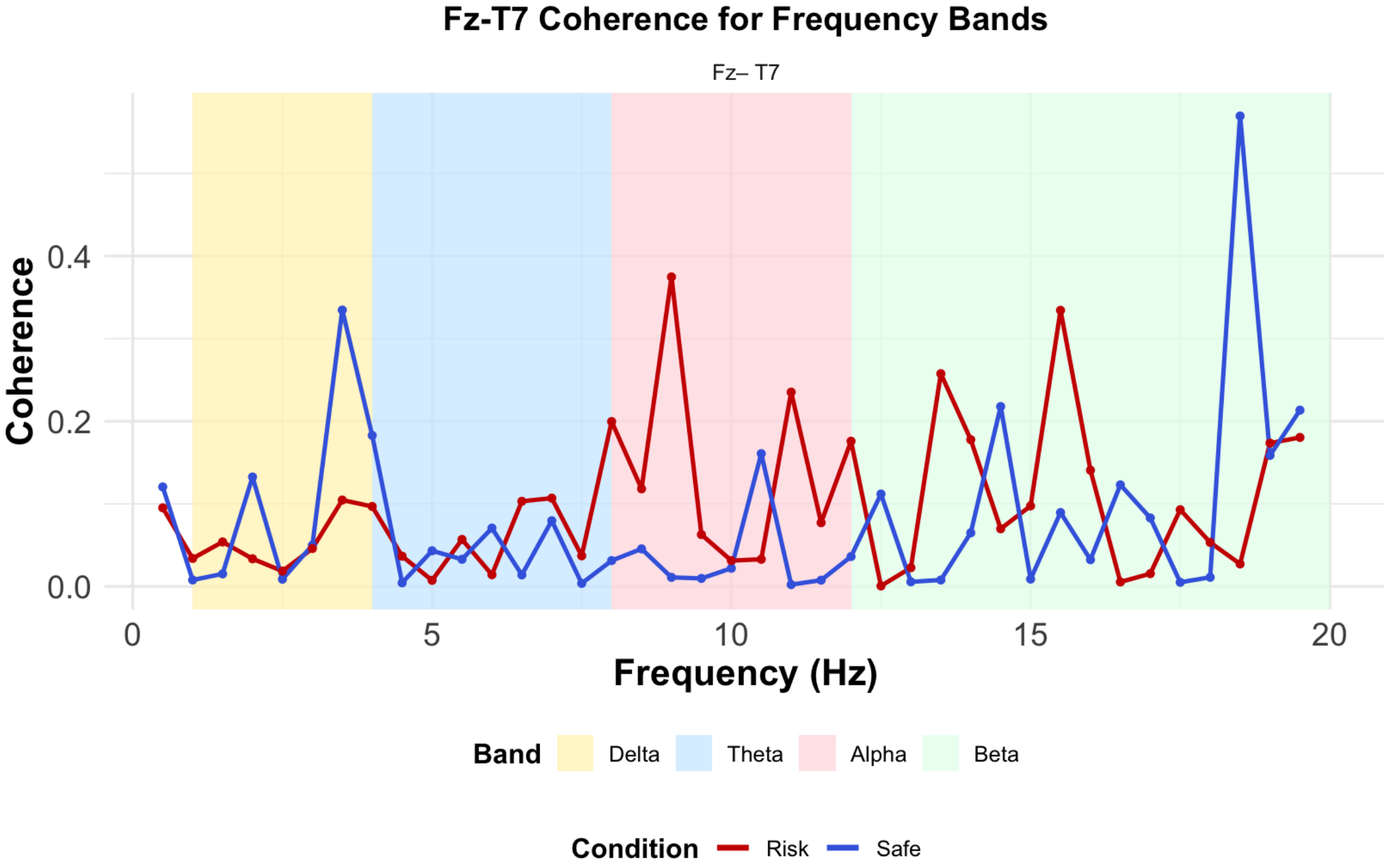


Fig 2: Coherence between left temporal (T7) and Frontal (Fz) EEG electrodes. The risk condition showed greater communication between the two brain regions at the frequency band indicative of conscious movement planning (alpha – red).

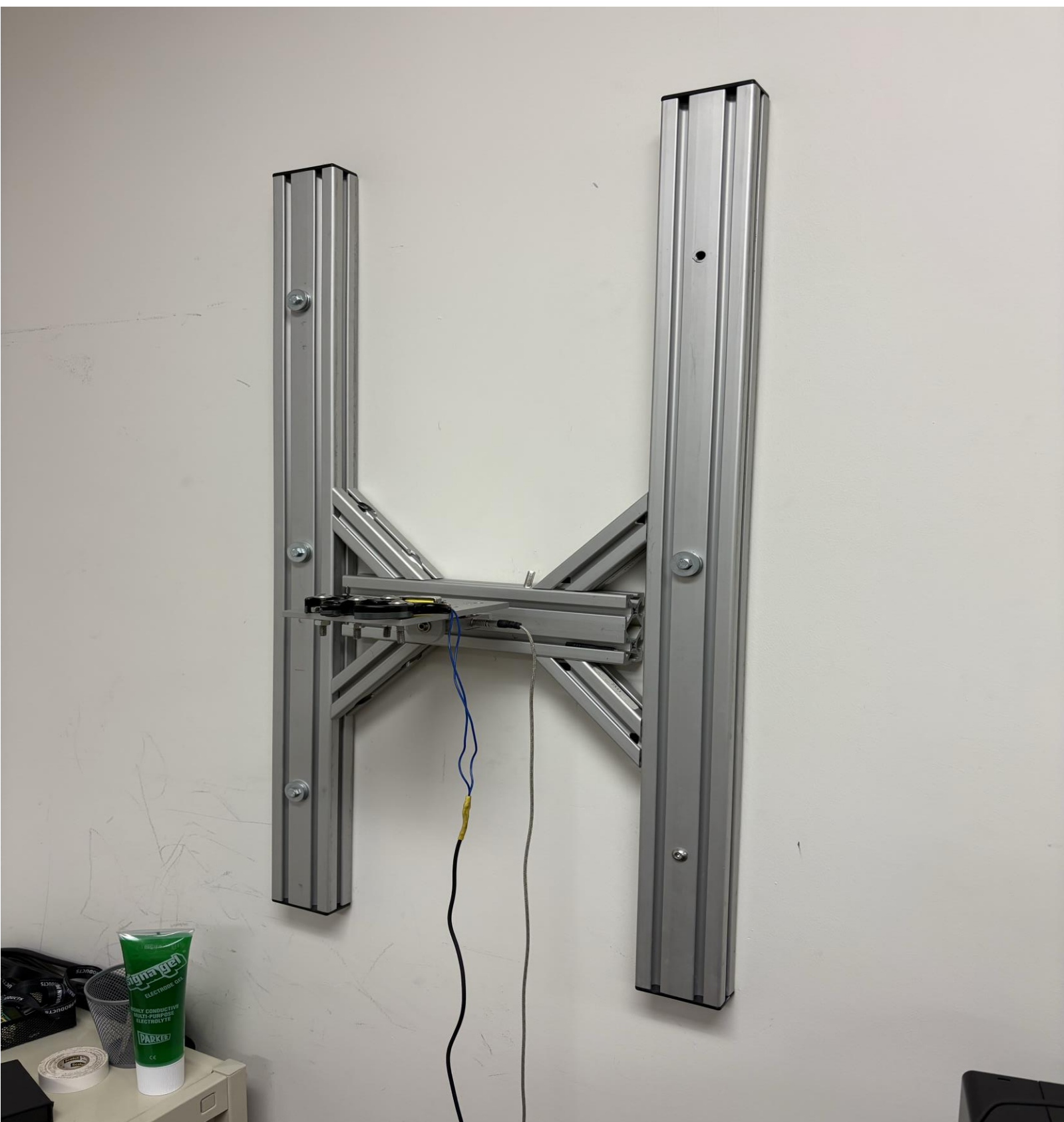


Fig 3: The novel lean-and-release system that was installed and experimented on during the project period. This system measures forces while supporting participants leaning away from it via a harness and hook, and releases support via a button press

Future Directions: Building upon this pilot work, we can delve into experiments identifying neural markers related to anxiety and movement planning in this unique apparatus that places participants in a balance-compromised position. This work will set the groundwork for the development of diagnostic neuroimaging tools to detect neurological disorders related to balance (e.g., concussion) and anxiety.