EEG in the Wild:

Field-side assessment of Rugby players' brain activity

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Introduction

In high-velocity contact sports like Rugby Union and Rugby League, **concussion** is a common injury at all levels of the sport (e.g., professional, amateur, women's divisions).
Concussion often results from the brain striking against the skull due to some impact to the player's head (e.g., receiving a knock to the head, hitting the ground head-first).

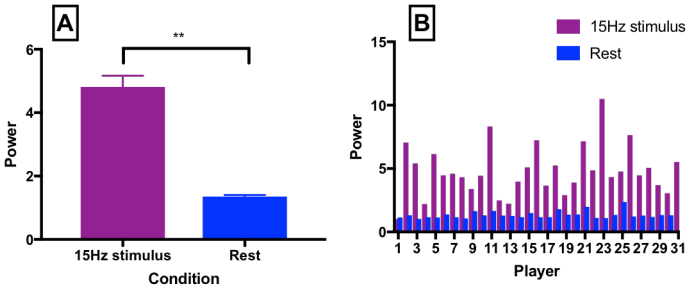
Rapid and accurate **assessment** of concussion, ideally **field-side**, is crucial for the player's health and safety. However, assessment is often complicated by:

- Non-specificity of symptoms (e.g., dizziness, tiredness)
- General absence of a visible wound or immediate pain
- Subjectivity in reporting of symptoms (e.g., self-report)

Idea: Could **portable** electroencephalography (EEG) be used for a more **objective field-side** assessment of concussion?

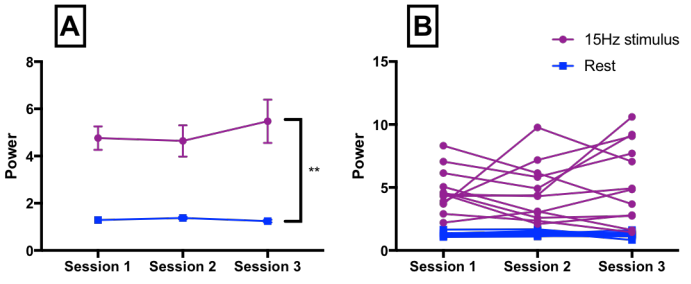
Results

Research Question 1: Can we record SSVEP field-side?



Note: Oz data from Session 1 (N = 31). A= Group data. B= Individual data
** t(30) = 9.72, p < .001

Research Question 2: How reliable is the SSVEP over time?



Note: Oz data (N=12). A= Group data. B= Individual data

** Condition: F(1,11) = 47.51, p< .001
Session: F(2,22) = 0.45, p > .05
Condition*Session: F(2.22) = 0.84, p > .05

Our study

The challenge in using EEG for the assessment of concussion is our **limited knowledge** of how the concussed brain differs from the 'normal' sporting brain. The **first step** in this endeavour is to understand the **non-concussed sporting brain in action**.

Concussion might temporarily disturb the **visual system**, with vision-related issues (e.g., photosensitivity, blurred vision) amongst the more commonly reported symptoms. Our study set out to **leverage these symptoms** and "test" the visual system by evoking a steady-state visual-evoked potential (**SSVEP**).

Method

Who?
31 MQ Rugby Union & Rugby League players (23 🚹, 8 🚺, M_{age}: 22)

Where?
MQ sports fields

What?

- Mobile phone for stimulus presentation
  - 2 conditions:
    - 15 Hz stimulus: Alternating black & white screen (2min)
    - Rest with eyes open (2min)
- VR goggles to control luminance of stimulus
- Emotiv EPOC+ to record EEG data

Conclusions

Key findings:

1. We can **successfully** measure SSVEP **field-side**, using a mobile phone, VR goggles, and the Emotiv headset
2. The recorded SSVEP in fairly **consistent** across sessions

Why is this good news?

Using our paradigm for the field-side assessment of concussion, ultimately requires us to use the test to make a call on whether the player should "**play-on or sit-out**". However, how might we decide that the outcome requires the player to "sit-out"?

Baseline: Although the SSVEP appears consistent across sessions, our graphs clearly illustrate the **individual variability**. Using the group's average would therefore be misleading, and result in lots of false positives or negatives. We propose to calculate a player's **own individual baseline** to which we can compare the outcome of the concussion test.

Next step(s)?

- Increase participants and recording sessions by inviting Australian Football (AFL) players to our study.
- Investigate factors that may influence SSVEP in players, such as exertion.
- Explore the effect of concussion on the SSVEP.

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