

Tracking the contents of spatial working memory during a bout of aerobic exercise

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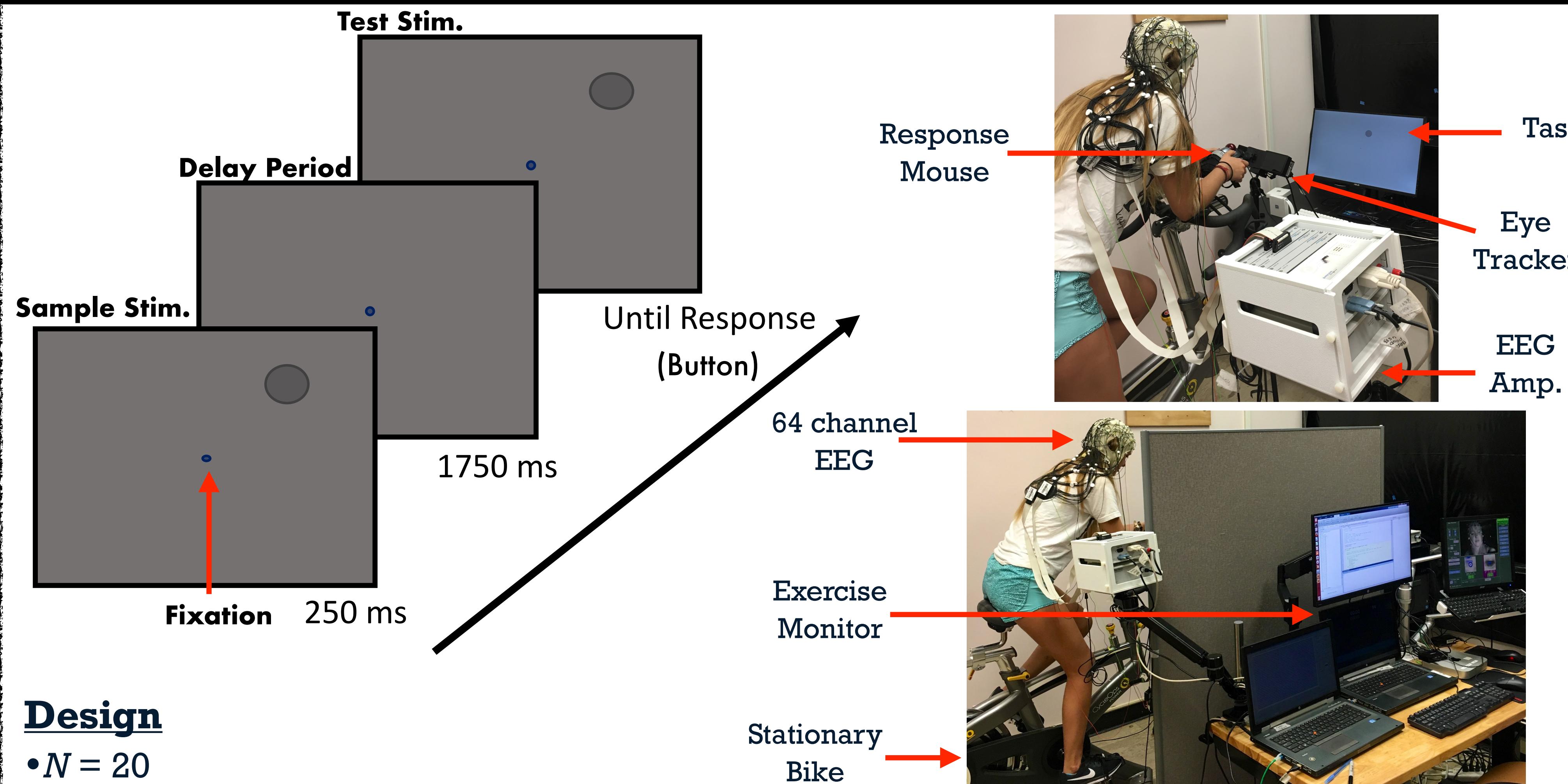
Introduction

- Exercise modulates task performance across a range of cognitive domains.
- Animal studies have shown increases in the visual evoked response during locomotion (Fu et al., 2014, Ayaz et al., 2013). Brief bouts of low-intensity exercise in humans corroborate these findings, supporting the notion that exercise induced arousal results in a gain in sensory processing (Bullock et al., 2015).
- Recent studies using encoding models (EM) have shown that feature-selective responses reconstructed from patterns of neural activity are also altered during bouts of exercise (Bullock et al., 2017).

Aim

Determine whether the selectivity of spatial memories are modulated by a brief bout of aerobic exercise.

Methods



Design

- N = 20
- Spatial change detection task completed during both rest and exercise.
- Low intensity cycling (50 RPM/ 50W)

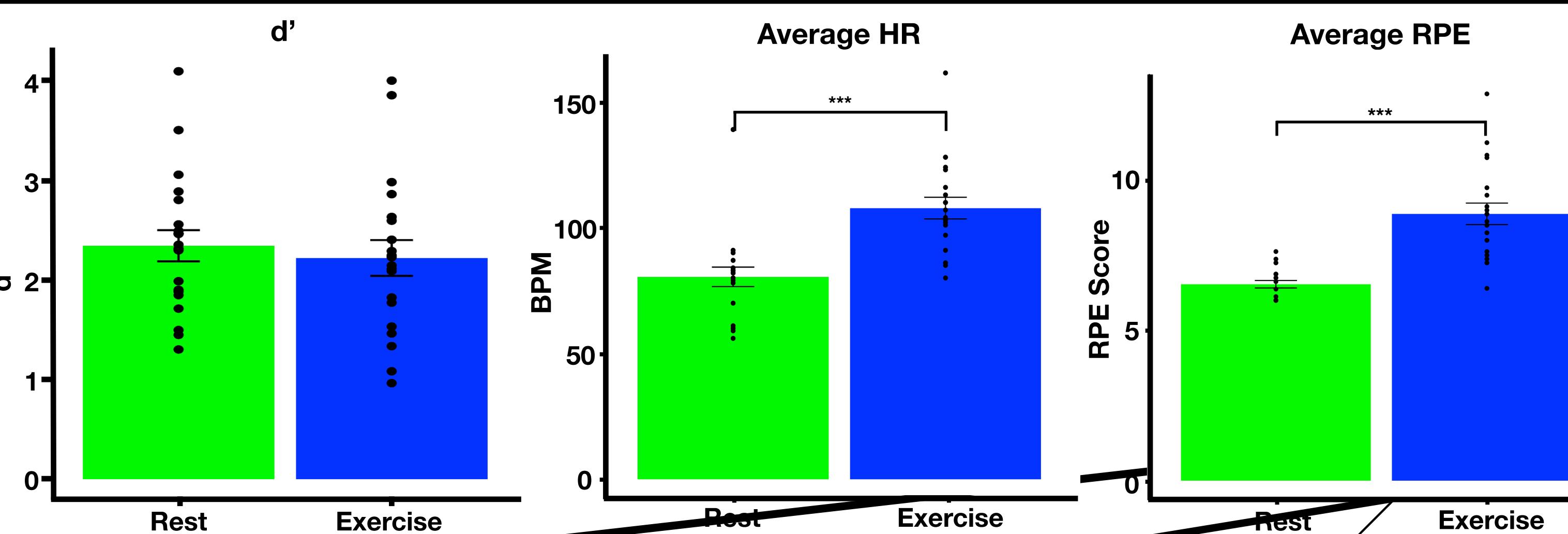
Data Acquisition & Preprocessing

- 64 channel EEG (Brain Products)
- Eye-tracking Eyelink 1000
- High/low pass filter of 4 & 30 μ V
- Epoch from 0 - 2000ms from stimuli onset
- Reject trials greater than +/-150 μ V

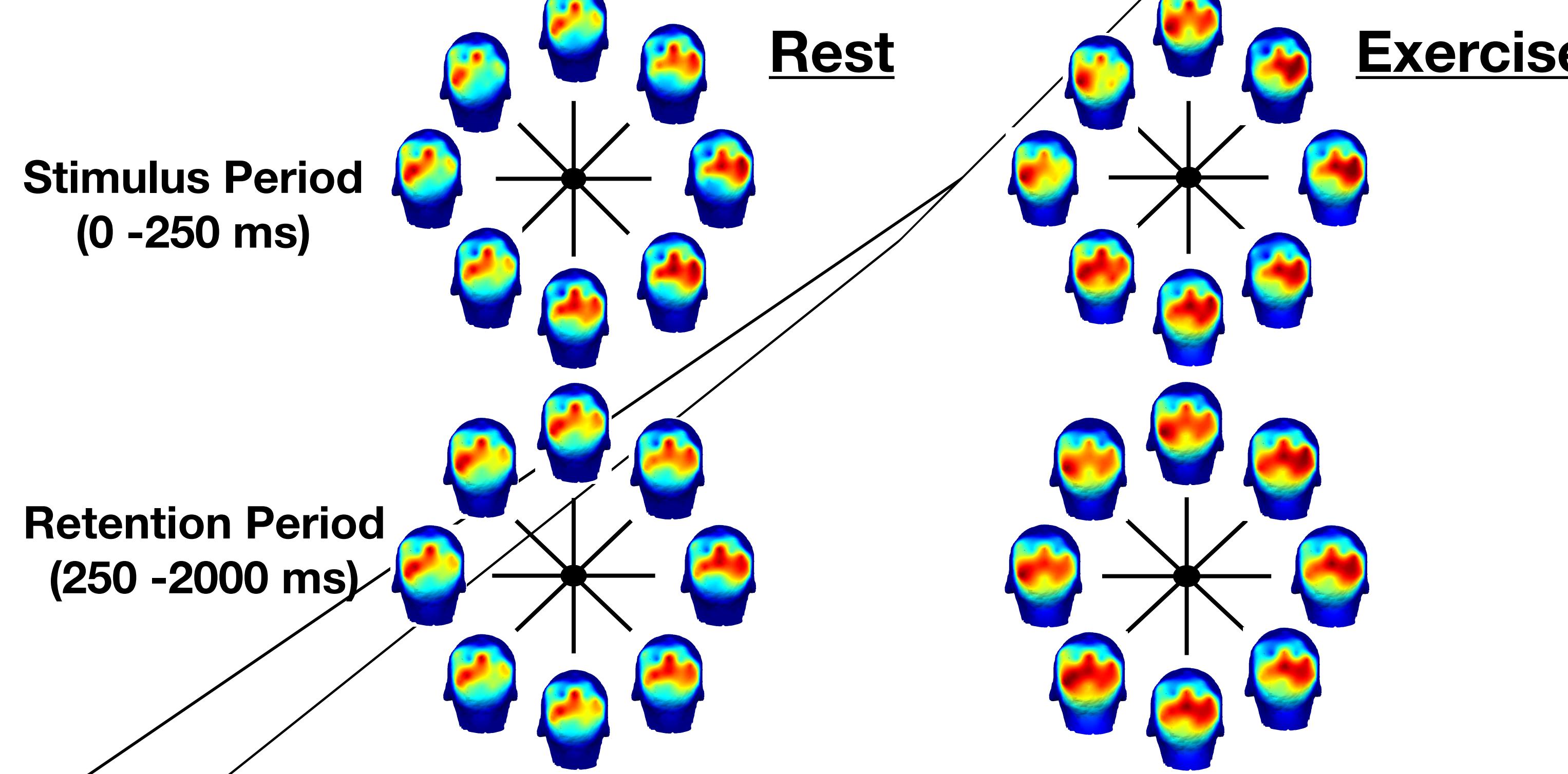
Inverted EM

$$\begin{aligned} B_1 &= WC_1 \\ C &= \text{Hypothesized Channel Response} \\ *Train* &\downarrow \\ \hat{C}_2 &= (\hat{W}^T \hat{W})^{-1} \hat{W}^T B_2 \\ *Test* &\longrightarrow \hat{W} = B_1 C_1^T (C_1 C_1^T)^{-1} \end{aligned}$$

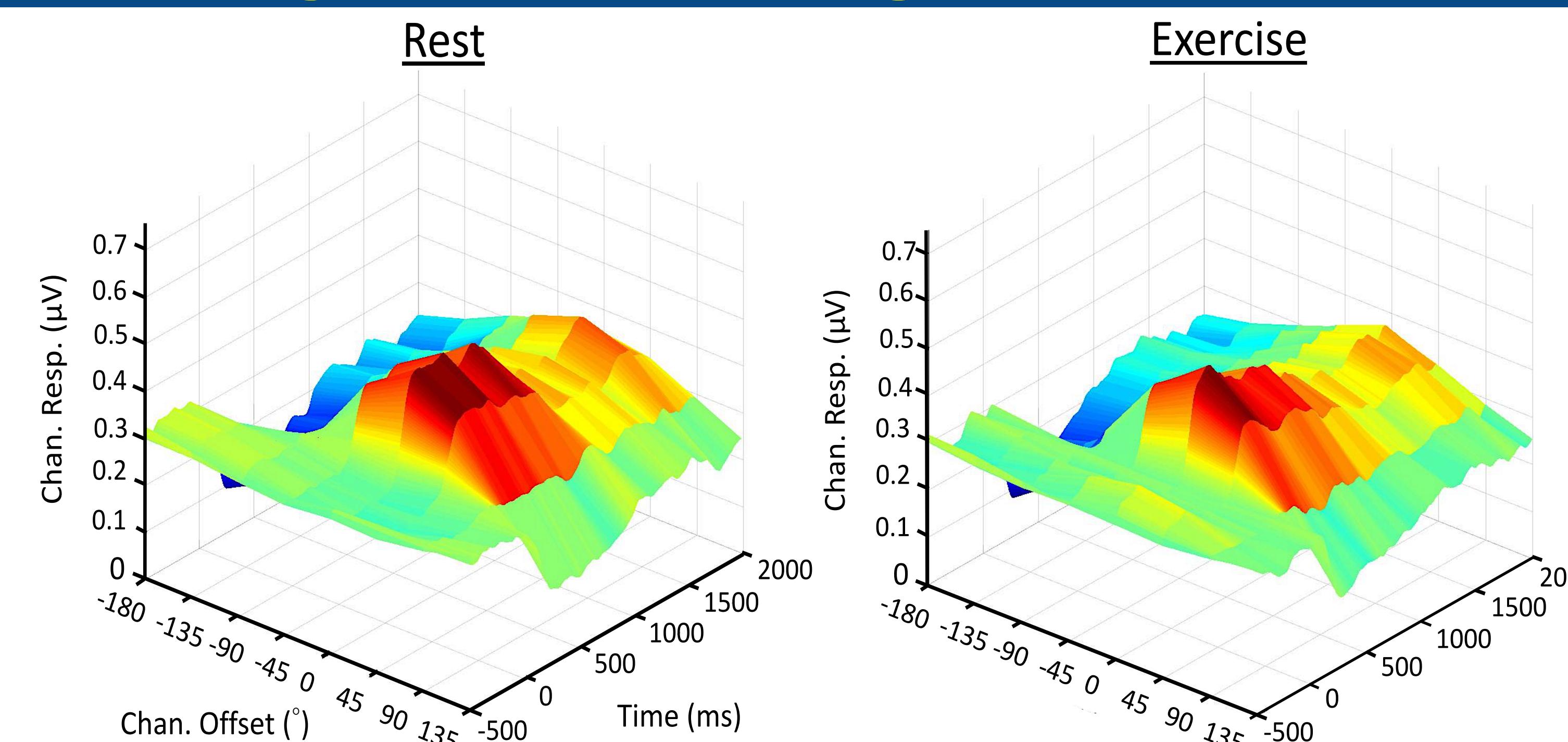
Behavior & Physio



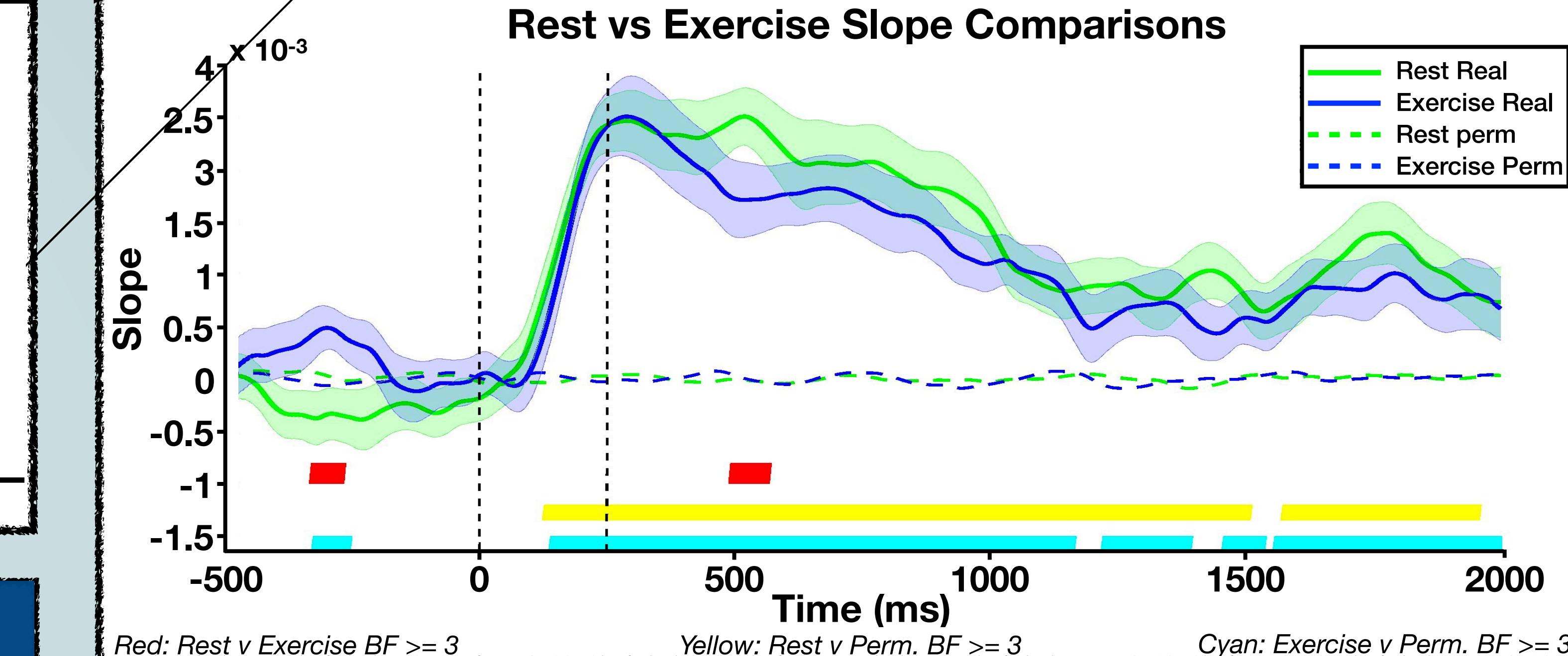
Topographical Alpha-Band Activity



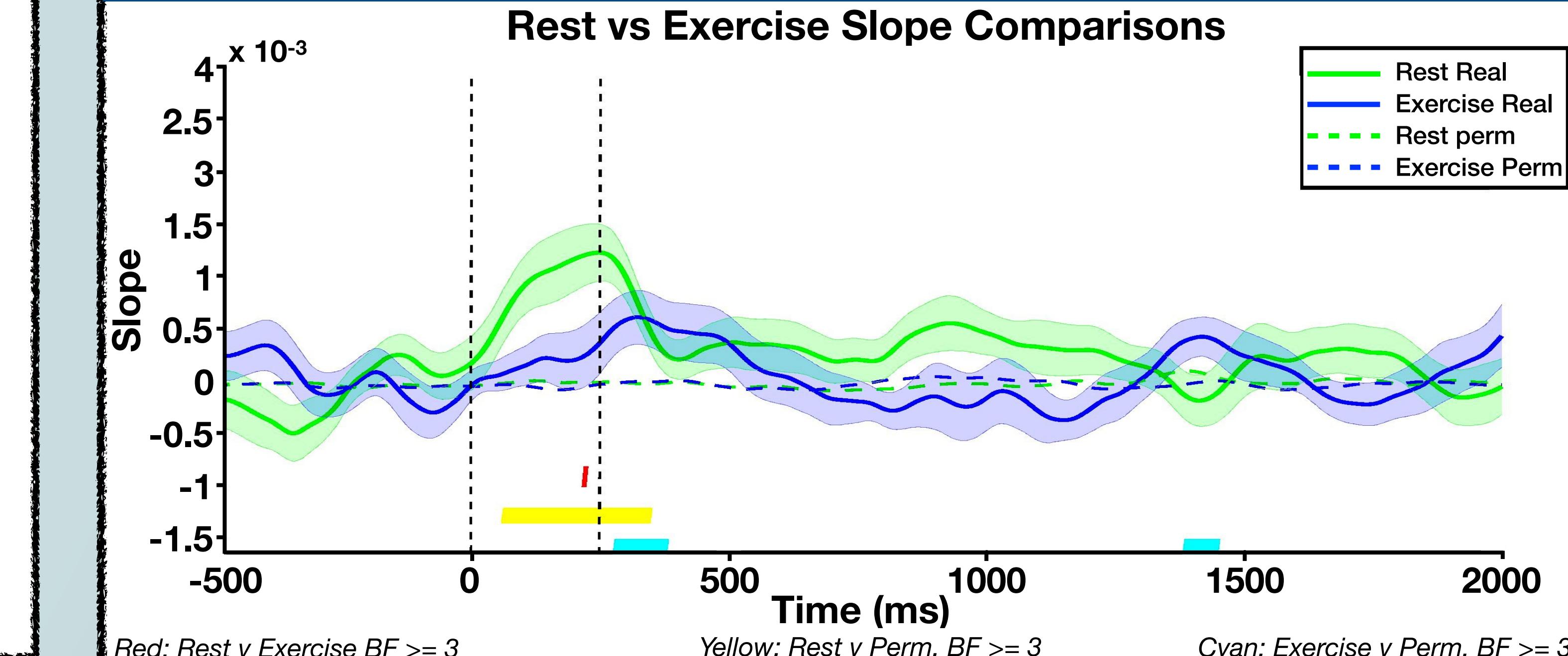
Dynamic Tuning Functions



Alpha Total Power Slopes



Theta Total Power Slopes



Discussion

- We can accurately reconstruct representations of spatial locations during exercise.
- Decrement in maintenance of spatial location from ~450 to 600 ms in alpha band activity.
- Recovery after decrement may be the reason for lack of significant difference in d' between conditions.

References

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- Bullock, T. W., Cecotti, H., & Giesbrecht, B. (2015). Electrophysiological evidence that acute exercise modulates multiple stages of information processing. *Neuroscience*, 307, 138-150.
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