

Prefrontal dynamics of sustained attention in high-load tasks

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Abstract. We investigate the temporal dynamics of dorsolateral prefrontal cortex activity during sustained attention under variable cognitive load. Using high-density EEG and pupillometry in 84 adults, we identify frontal theta bursts that predict lapse recovery within 300 ms and dissociate load-driven from time-on-task fatigue effects. Findings inform cognitive training protocols and clinical assessment of attentional dysregulation.

1. Introduction

Sustained attention underlies learning, driving, and clinical function. Prior work has emphasized either tonic arousal or phasic control, but rarely their joint dynamics under realistic load.

2. Methods

Eighty-four adults (18–42y) completed a 40-minute adaptive continuous performance task. We recorded 128-channel EEG at 1 kHz alongside binocular pupillometry.

3. Results

Frontal theta (4–7 Hz) bursts preceded response-time recoveries by 280 ± 40 ms. Load and time-on-task showed independent contributions to lapse frequency.

4. Discussion

Rapid frontal theta appears to gate re-engagement after attentional lapses, independent of tonic arousal indexed by pupil size. Implications for closed-loop neurofeedback are discussed.

References

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