

Examining the Effects of Intermittent Theta Burst Stimulation on Accuracy and Reaction Time in N Back Tasks

Dipmala Salunke, Yash Bandal, Alexander Zakharov, Natalia Romanchuk, Maria Sergeeva, Yuliya Komarova, Igor Shirolapov, D. Jude Hemanth

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THE INTERVENTION PROTOCOL

Target:
Left DLPFC
(MNI Coordinates)

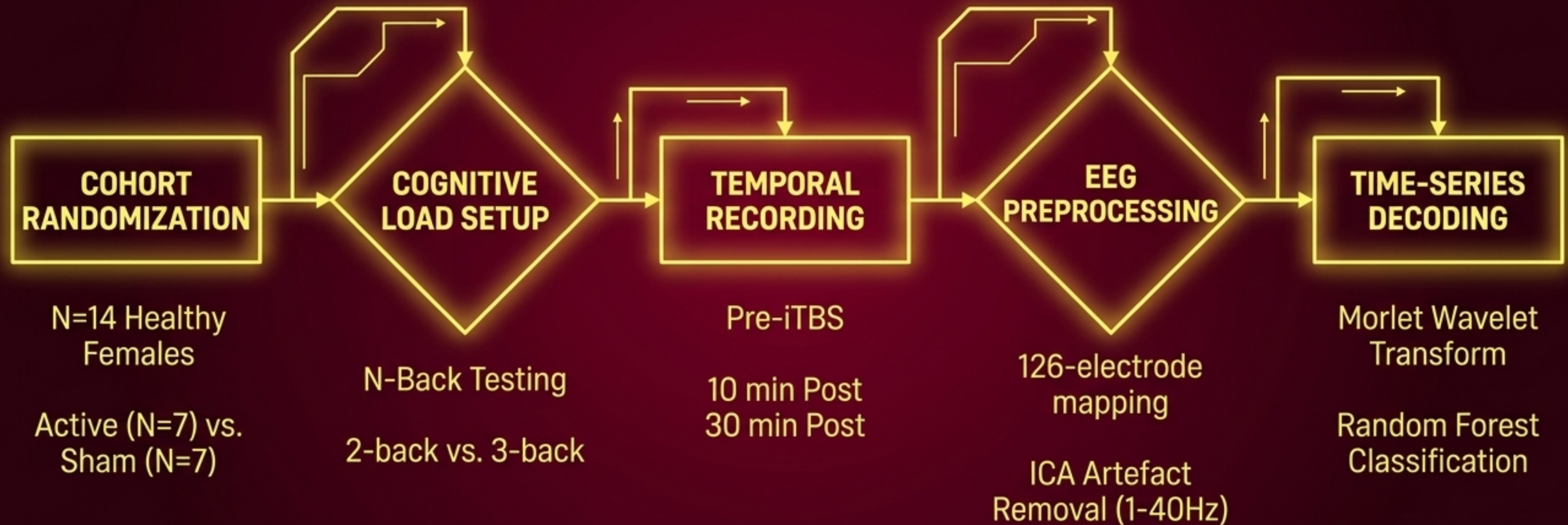
Intensity:
75% resting
motor threshold

Bursts:
3 biphasic pulses at **50** Hz

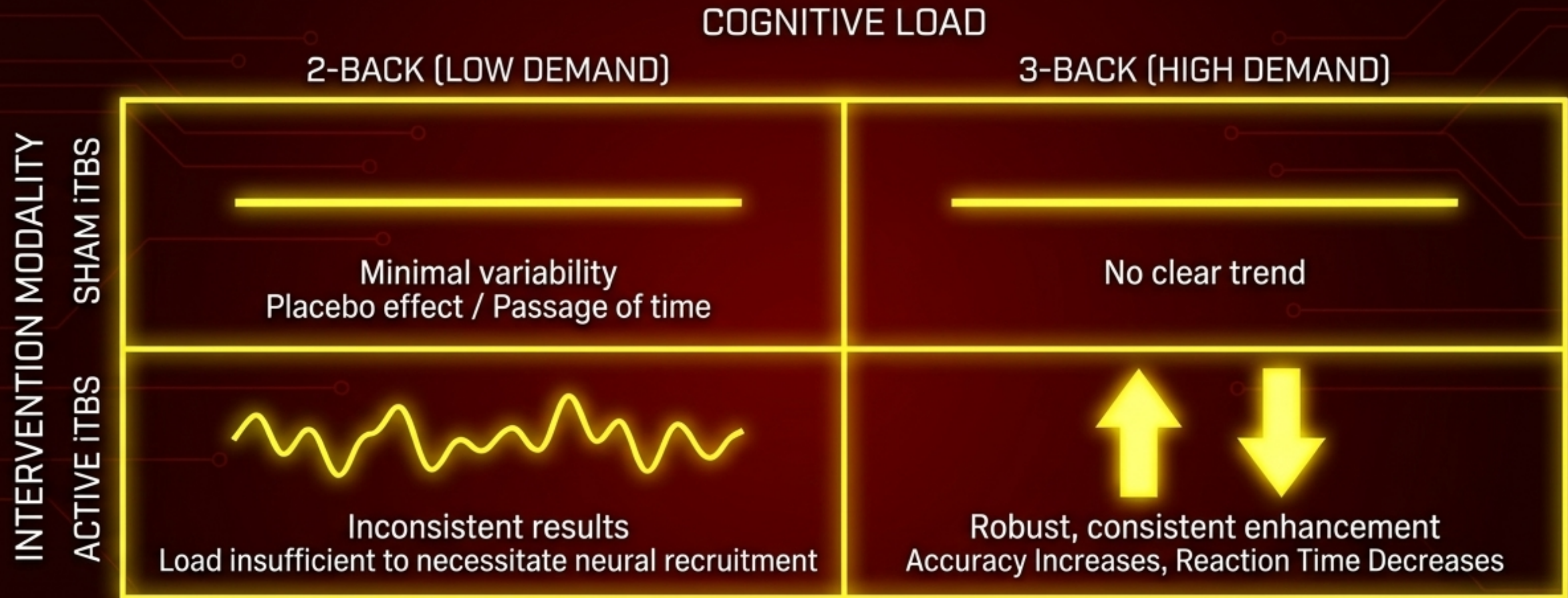
Repetition:
Every **10** seconds at **5** Hz

Total Load:
600 pulses over **180** seconds

EXPERIMENTAL & ANALYTICAL PIPELINE



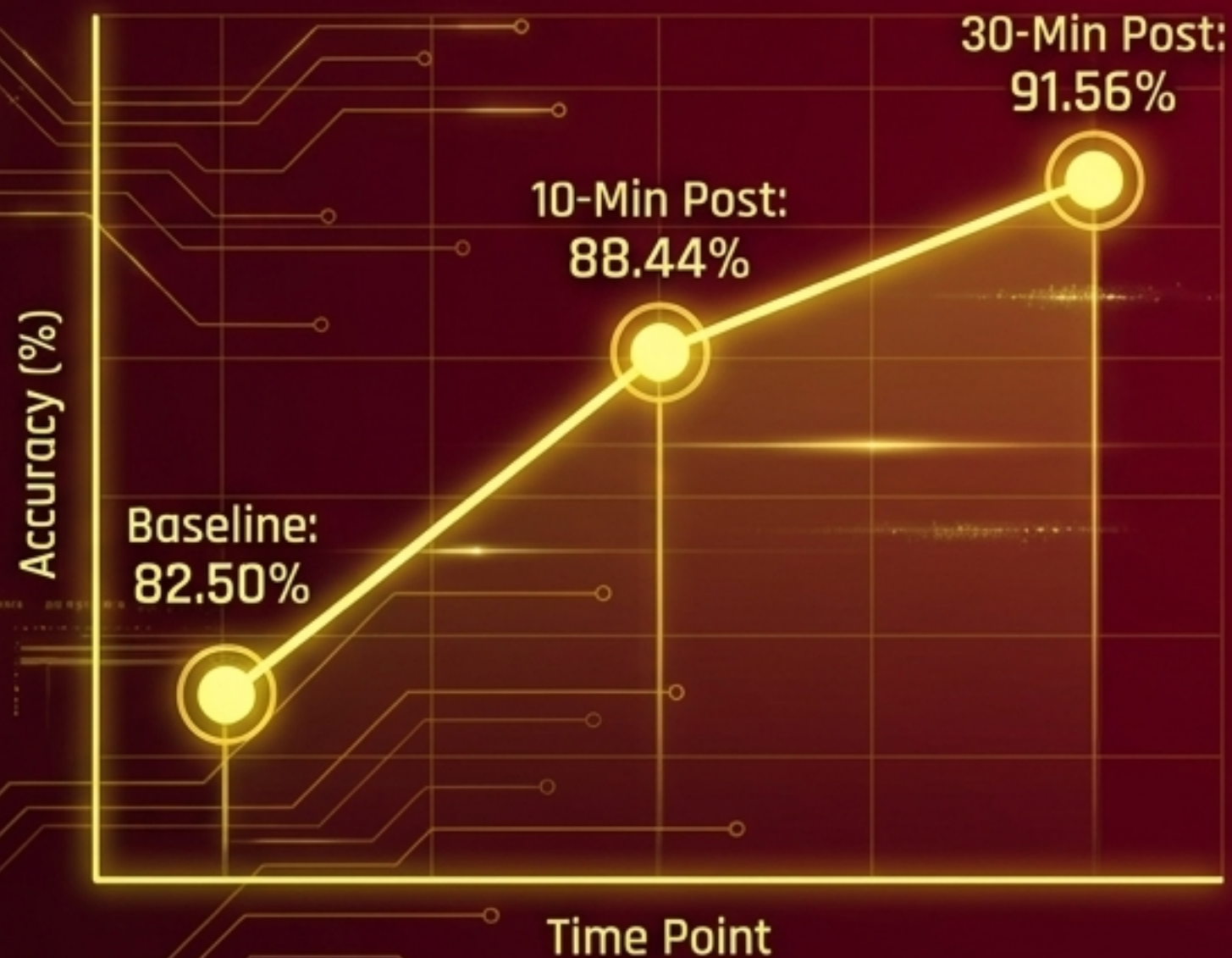
THE LOAD & MODALITY MATRIX: DIAGNOSTIC OUTCOMES



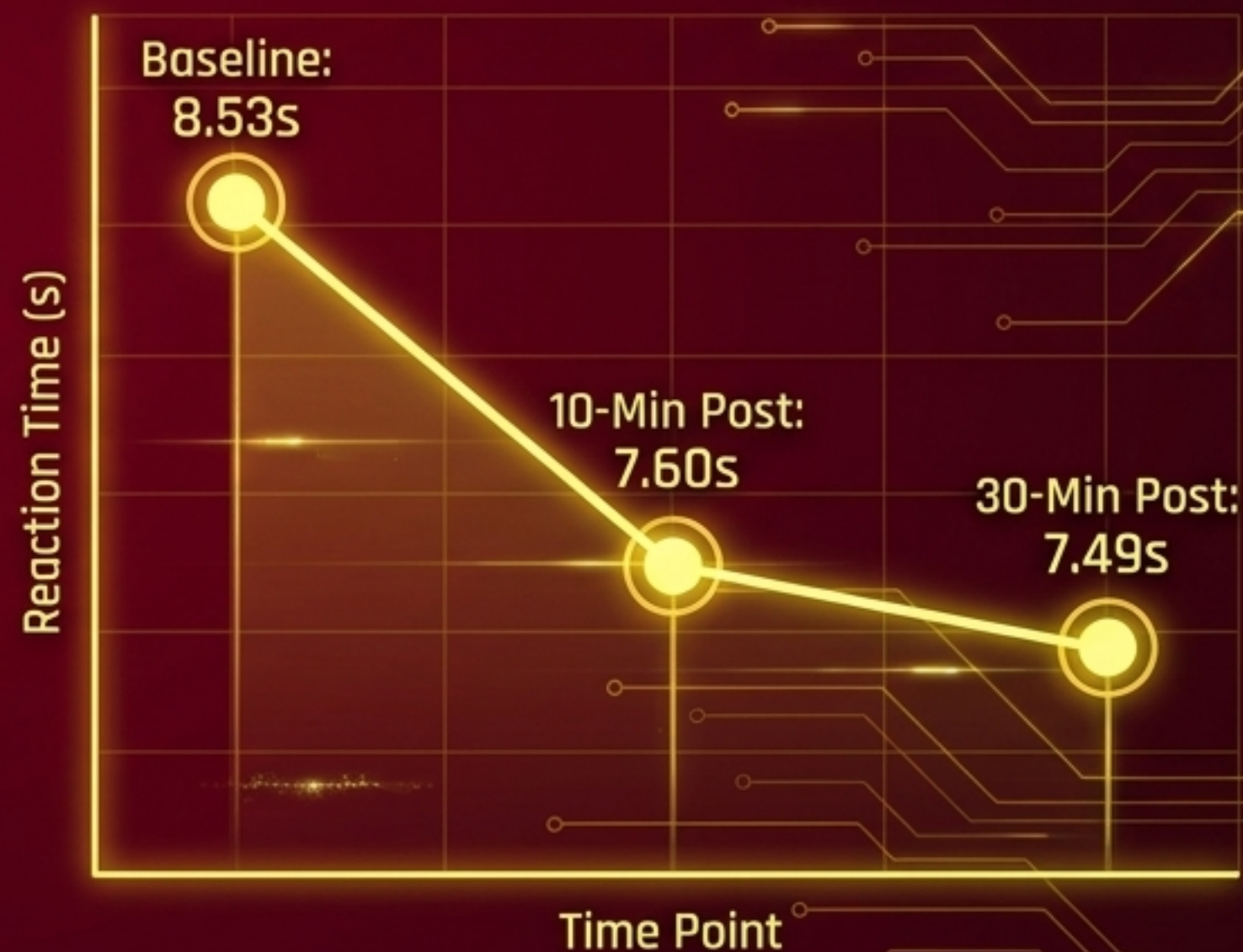
iTBS requires a sufficiently challenged neural state (high cognitive load) to produce consistent empirical behavioral gains.

EMPIRICAL VALIDATION: ACTIVE iTBS + 3-BACK LOAD

ACCURACY TRAJECTORY



REACTION TIME TRAJECTORY



DECODING THE COGNITIVE STATE (RANDOM FOREST CLASSIFIER)

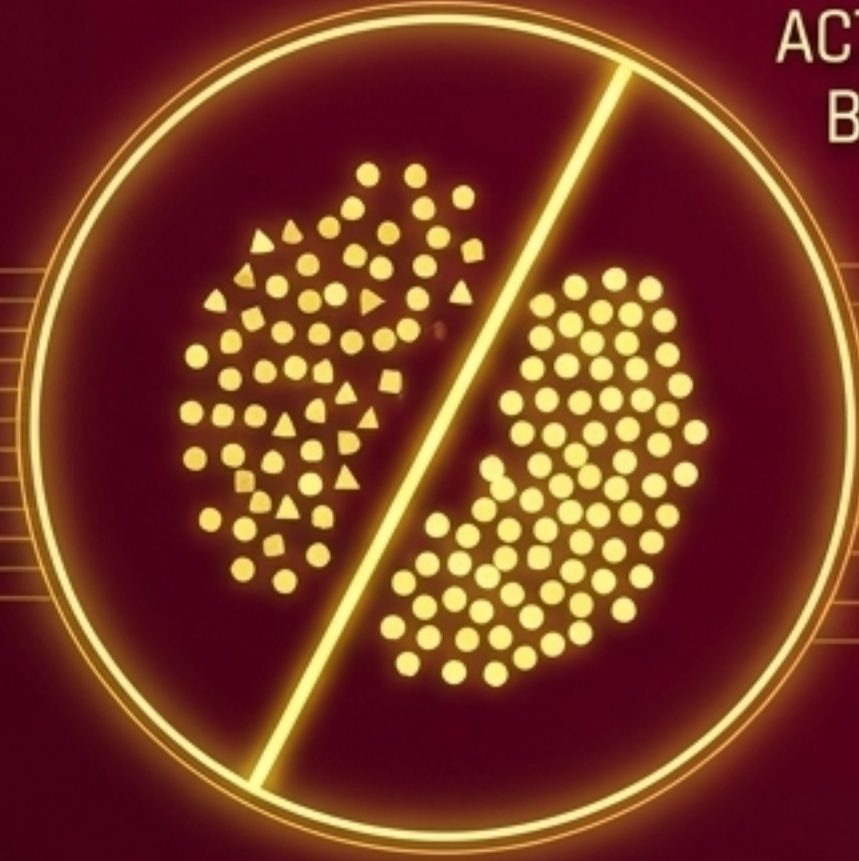
SHAM GROUP
BOUNDARY



81.43% Separability
(2-back vs 3-back)

Separability Radar

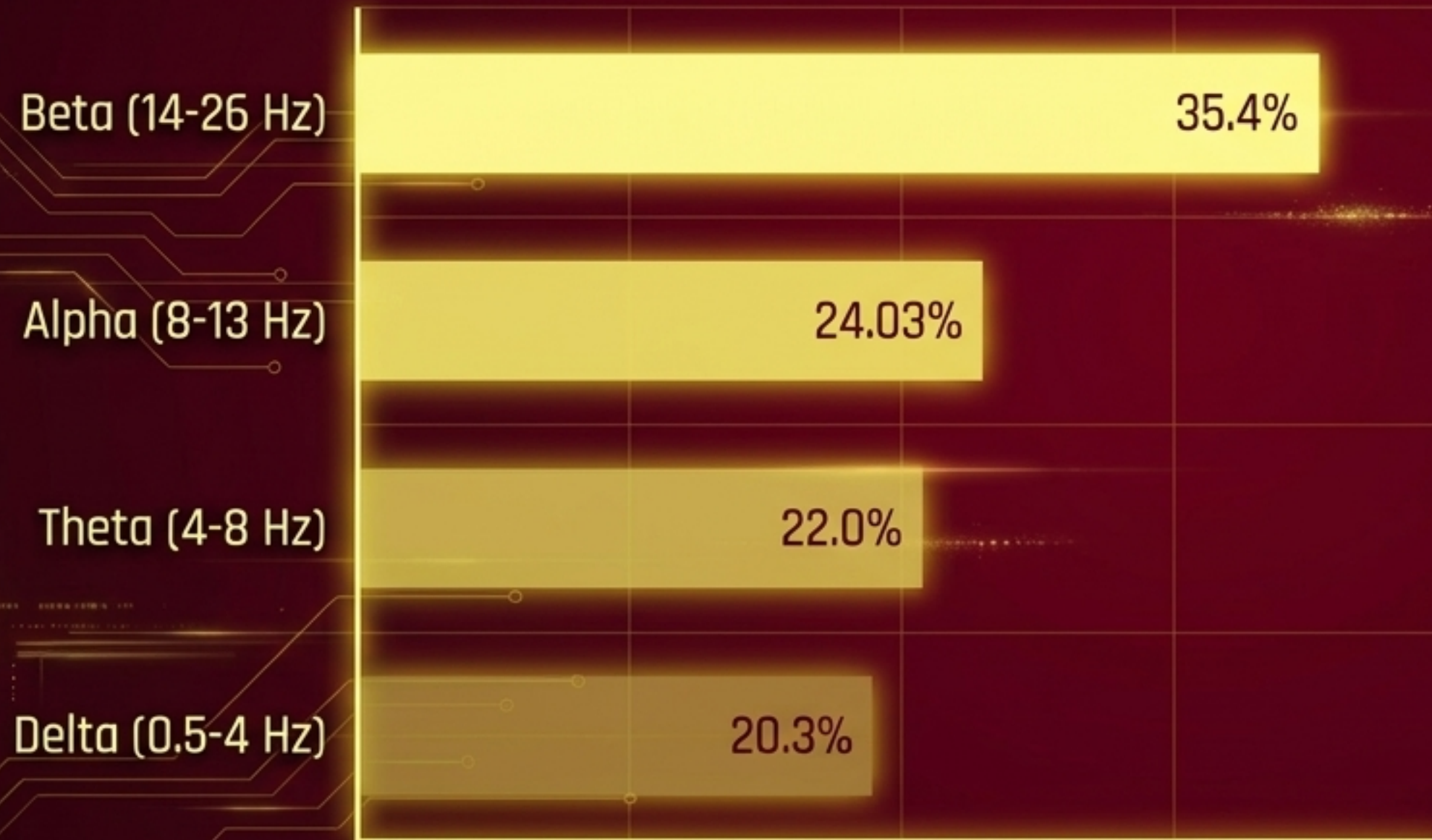
ACTIVE GROUP
BOUNDARY



87.33% Separability
(2-back vs 3-back)

Stratified 5-Fold Cross-Validation of Morlet wavelet transformed EEG features reveals that active iTBS fundamentally alters the distinctiveness of neural signals under varying memory loads. The brain's electrical activity becomes significantly more organized and readable under stress.

THE ARCHITECTURE OF ENHANCEMENT: FEATURE IMPORTANCE



BETA BAND DOMINANCE

While Theta is typically associated with working memory load, Beta features drove the classification. iTBS specifically heightens frontal executive top-down control and active cognitive processing, enabling the behavioral gains observed in the 3-back task.

SYNTHESIZING THE INTERVENTION MECHANICS



Non-invasive stimulation does not indiscriminately enhance cognition. iTBS provides the neural infrastructure (heightened Beta activity) that only manifests as behavioral improvement when the brain is subjected to sufficient cognitive friction (3-back load). Without the load, the stimulated capacity goes unutilized.

A single session of iTBS applied to the left DLPFC reorganizes neural efficiency under high cognitive loads, proving that neurological enhancement requires both the stimulation to unlock capacity, and the cognitive stress to harness it.

- Demonstrated via Random Forest EEG separability (87.33%).
- Driven by Beta-band top-down control.
- Evident exclusively in high-demand (3-back) working memory tasks.