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A home-based paradigm of phase-targeted auditory stimulation during human sleep.

Friday, September 12, 2025 6:10 PM (10 minutes)

Slow-wave oscillations (SOs) orchestrate memory-relevant communication between neocortex and hippocampus, yet field-ready tools for their manipulation remain scarce. We present a fully home-based protocol that couples a customised ZMax EEG headband with the real-time EventIDE algorithm to deliver phase-targeted auditory stimulation (PTAS). The system delivers 50-ms, 45-dB bursts of pink noise precisely at the 90° up-phase of the SO.

Two distinct data collections were performed.First, six healthy adults recorded 26 nights (184 h) of simultaneous ZMax EEG headband (Fpz-M1, AF8-M1) and polysomnography (PSG). Automatic staging with YASA on ZMax data matched manual PSG scoring with 84.3% accuracy (Cohen's Kappa=0.77), validating our custom montage.

A second investigation enrolled 26 participants, each completing one home night with PTAS and the same headband setup. EEG signals were processed in real-time by the EventIDE sine-fitting algorithm to detect the targeting phase. Auditory stimuli were delivered via loudspeakers specifically timed to coincide with this targeted SO phase throughout the night. Grand average ERPs revealed a sharp negative deflection ~500 ms after stimulation, and subsequent positive peaks after ~1000ms, indicating robust cortical activation. Time frequency analysis showed increases ($p < 0.01$) in delta (0.5-4Hz) and theta (4-8Hz) power 250-550ms post stimulus, alongside enhanced spindle activity (11-16Hz) between 700 and 1500ms, relative to sham.

Our results demonstrate the capacity of the modified-home-based ZMax and EventIDE system to accurately detect and modulate SO dynamics using precisely timed auditory stimuli. Collectively our results validate a fully home-deployable platform for modulating human sleep dynamics, paving the way for large-scale real-world applications.

If you're submitting a symposium talk, what's the symposium title?

If you're submitting a symposium, or a talk that is part of a symposium, is this a junior symposium?

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