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Sleep orchestrates indices of local plasticity and global network stability in the human cortex

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Abstract

Animals and humans spend on average one third of their lives in sleep, but its functions remain to be specified. Distinct lines of research propose that sleep promotes local strengthening of information-bearing synapses (plasticity) and global downscaling of synaptic strength (stability) in neural networks—prerequisites for adaptive behavior in a changing environment. However, the potential orchestration of these processes, particularly in humans, needs to be further characterized. Here, we use electrophysiological, behavioral, and molecular indices to noninvasively study cortical plasticity and network stability in humans. We observe indices of local strengthening of prior induced long-term potentiation-like plasticity (paired associative stimulation induced change in motor-evoked potential) and global network stabilization (homeostatic regulation of wake EEG theta activity) after brief periods of nonrapid eye movement sleep compared with wakefulness. The interplay of local sleep slow oscillations and spindle activity, previously related to synaptic refinements during sleep, is identified as a potential mechanism. Our findings are consistent with the notion that sleep-specific brain activity patterns reduce the plasticity–stability dilemma by orchestrating local plasticity and global stability of neural assemblies in the human cortex. Future studies are needed to further decipher the neural mechanisms underlying our indirect observations.

sleep, transcranial magnetic stimulation, paired associative stimulation, electroencephalography, cortical plasticity, LTP, slow-wave activity, sleep spindles, phase-amplitude coupling

Topic:

electroencephalography

motor evoked potentials

sleep

Issue Section: Basic Science of Sleep and Circadian Rhythms

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