

Journal Scan

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Sleep accelerates the improvement in working memory performance

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Working memory (WM) performance, which is an important factor for determining problem-solving and reasoning ability, has been firmly believed to be constant. However, recent findings have demonstrated that WM performance has the potential to be improved by repetitive training. Although various skills are reported to be improved by sleep, the beneficial effect of sleep on WM performance has not been clarified. Here, we show that improvement in WM performance is facilitated by posttraining naturalistic sleep. A spatial variant of the *n*-back WM task was performed by 29 healthy young adults who were assigned randomly to three different experimental groups that had different time schedules of repetitive *n*-back WM task sessions, with or without intervening sleep. Intergroup and intersession comparisons of WM performance (accuracy and response time) profiles showed that *n*-back accuracy after posttraining sleep was significantly improved compared with that after the same period of wakefulness, independent of sleep timing, subject's vigilance level, or circadian influences. On the other hand, response time

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was not influenced by sleep or repetitive training schedules. The present study indicates that improvement in *n*-back accuracy, which could reflect WM capacity, essentially benefits from posttraining sleep.

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Executive dysfunction and memory impairment in idiopathic REM sleep behavior disorder

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Background: Idiopathic REM sleep behavior disorder (iRBD) might be a stage in the development of neurodegenerative disorders, especially Parkinson disease and dementia with Lewy bodies. Recent studies showing a slowing of waking EEG in iRBD suggest that iRBD is associated with cognitive impairment.

Objective: To compare patients with iRBD on measures of cognitive function and quantitative waking EEG.

Methods: Fourteen patients with iRBD and 14 healthy control subjects matched for age and educational level were studied. Subjects underwent an extensive neuropsychological evaluation and waking EEG recordings.

Results: Compared to controls, patients with iRBD showed a lower performance on neuropsychological tests measuring attention, executive functions, and verbal memory. Moreover, patients with iRBD showed EEG

slowing (higher delta and theta power) during wakefulness in all brain areas compared to controls. However, no correlation was found between performance on cognitive tests and quantitative waking EEG in patients with iRBD.

Conclusion: This study shows a co-occurrence of impaired cognitive profile and waking EEG slowing in patients with idiopathic REM sleep behavior disorder similar to that observed in early stages of some synucleinopathies.

Abbreviations: ANOVAs = analyses of variance; BDI-II = Beck-II Depression Inventory; DLB = dementia with Lewy bodies; DRS = Dementia Rating Scale; EOG = electro-oculograms; FCRTT = four choice reaction time test; iRBD = idiopathic REM sleep behavior disorder; MA = microarousals; MMSE = Mini-Mental State Examination; MSA = multiple system atrophy; NA = not applicable; NS = not significant; PD = Parkinson disease; PLMS = periodic leg movements during sleep; PLMW = periodic leg movements during wakefulness; PSG = polysomnography; qEEG = quantitative EEG; SWS = slow wave sleep; UPDRS = Unified Parkinson's Disease Rating Scale; WAIS = Wechsler Adult Intelligence Scale.

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Sleep hygiene for children with neurodevelopmental disabilities

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Sleep disturbances in children with neurodevelopmental disabilities are common and have a profound effect on the quality of life of the child, as well as the entire family. Although interventions for sleep problems in these children often involve a combination of behavioral and pharmacologic strategies, the first line of treatment is the promotion of improved sleep habits or "hygiene." Despite the importance of sleep-hygiene principles, defined as basic optimal environmental, scheduling, sleep-practice, and physiologic sleep-promoting factors, clinicians often lack appropriate knowledge and skills to implement them. In addition, sleep-hygiene practices may need to be modified and adapted for this population of children and are often more challenging to implement compared with their healthy counterparts. This first comprehensive, multidisciplinary review of sleep hygiene for children with disabilities presents the rationale for incorporating these measures in their treatment, outlines both general and specific sleep-promotion practices, and discusses problem-solving strategies for implementing them in a variety of clinical practice settings.

Keywords: children • sleep hygiene • sleep disorders • disabilities • burden of care

Abbreviations: NDD—neurodevelopmental disability

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Lapsing during sleep deprivation is associated with distributed changes in brain activation

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Lapses of attention manifest as delayed behavioral responses to salient stimuli. Although they can occur even after a normal night's sleep, they are longer in duration and more frequent after sleep deprivation (SD). To identify changes in task-associated brain activation associated with lapses during SD, we performed functional magnetic resonance imaging during a visual, selective attention task and analyzed the correct responses in a trial-by-trial manner modeling the effects of response time. Separately, we compared the fastest 10% and slowest 10% of correct responses in each state. Both analyses concurred in finding that SD-related lapses differ from lapses of equivalent duration after a normal night's sleep by (1) reduced ability of frontal and parietal control regions to raise activation in response to lapses, (2) dramatically reduced visual sensory cortex activation, and (3) reduced thalamic activation during lapses that contrasted with elevated thalamic activation during nonlapse periods. Despite these differences, the fastest responses after normal sleep and after SD elicited comparable frontoparietal activation, suggesting that performing a task while sleep deprived involves periods of apparently normal neural activation interleaved with periods of depressed cognitive control, visual perceptual functions, and arousal. These findings reveal for the first time some of the neural consequences of the interaction between efforts to maintain wakefulness and processes that initiate involuntary sleep in sleep-deprived persons.

Keywords: lapses • visual cortex • functional neuroimaging • cognitive control • attention • sleep deprivation

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Remediation of sleep-deprivation-induced working memory impairment with fMRI-guided transcranial magnetic stimulation

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Repetitive transcranial magnetic stimulation (rTMS) was applied to test the role of selected cortical regions in remediating sleep-deprivation-induced deficits in visual working memory (WM) performance. Three rTMS targets were chosen using a functional magnetic resonance imaging (fMRI)-identified network associated with sleep-deprivation-induced WM performance impairment: 2 regions from the network (upper left middle occipital gyrus and midline parietal cortex) and 1 nonnetwork region (lower left middle occipital gyrus). Fifteen participants underwent total sleep deprivation for 48 h. rTMS was applied at 5 Hz during a WM task in a within-subject sham-controlled design. The rTMS to the upper-middle occipital site resulted in a reduction of the sleep-induced reaction time deficit without a corresponding decrease in accuracy, whereas stimulation at the other sites did not. Each subject had undergone fMRI scanning while performing the task both pre- and postsleep deprivation, and the degree to which each individual activated the fMRI network was measured. The degree of performance enhancement with upper-middle occipital rTMS correlated with the degree to which each individual failed to sustain network activation. No effects were found in a subset of participants who performed the same rTMS procedure after recovering from sleep deprivation, suggesting that the performance enhancements seen following sleep deprivation were state dependent.

Key Words: facilitation • fMRI • sleep deprivation • TMS • working memory

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Cholinergic augmentation modulates visual task performance in sleep-deprived young adults

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Using 24 h of total sleep deprivation to perturb normal cognitive function, we conducted a double-blind, placebo-controlled crossover study to evaluate the effect of the acetylcholinesterase inhibitor, donepezil, on behavioral performance and task-related brain activation in 28 healthy, young, adult volunteers. The behavioral tasks involved the parametric manipulation of visual short-term memory load and perceptual load in separate experiments indirectly evaluating attention. Sleep deprivation significantly reduced posterior cortical activation (intraparietal sulcus and extrastriate cortex) at all levels of visual memory as well as perceptual load. Donepezil modulated an individual's performance in both tasks in accordance to whether accuracy declined after sleep deprivation without treatment. Critically, there were significant correlations between donepezil-induced increases in neural activation in the posterior cortical areas and improvement in accuracy. Reduced visual short-term memory after sleep deprivation may thus originate from a decline in visual attention and/or visual processing. Cholinergic augmentation can alleviate these deficits in individuals vulnerable to the effects of sleep deprivation, but it may have neutral or negative effects on those resistant to sleep deprivation.

Keywords: visual cortex • parietal cortex, fMRI • visual short-term memory • attention • sleep deprivation • cholinergic system

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The relationship between reported problems falling asleep and cognition among african American elderly

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This study examined the relationship between elders' cognitive performance and self-reported trouble falling asleep. Analyses were conducted on 174 older independently living, community dwelling African Americans (*M* age = 72.74; range = 65 to 90). Cognitive performance was measured using the Mini-Mental State Examination, Forward Digit Span task, Backward Digit Span task, Alpha Span task, and California Verbal Learning Test. Results suggested that individuals who reported trouble falling asleep tended to perform significantly worse than individuals who did not report trouble falling asleep on measures tapping short-term memory and working memory after controlling for age, education, gender, depression, and current health. These results demonstrate that a self-report of sleep difficulty may be a unique predictor of cognitive performance.

Keywords: African Americans • cognition • falling asleep • sleep

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Chaotic living conditions and sleep problems associated with children's responses to academic challenge.

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The ecology of economic disadvantage includes chaotic living conditions that may disrupt children's regulatory functioning and undermine mastery oriented responses to challenge. The present study examined chaotic living conditions, sleep problems, and responses to academic challenge for 96 economically disadvantaged children enrolled in a Head Start preschool. Caregiver interviews provided information regarding chaotic living conditions of residential crowding, noise, and family instability, as well as child sleep problems. Tasks individually administered to children provided measures of responses to academic challenge. Chaotic living conditions statistically predicted helpless/hopeless responses to academic challenge, and sleep problems partially mediated this relationship. Implications concern pathways of ecological risk and diversity in the school functioning of economically disadvantaged children.