



## PRESS RELEASE

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### Splitting sleep to create enduring long-term memories

**Singapore, 17 March 2021** — Researchers at the National University of Singapore reported in the journal ‘Scientific Reports’ that napping as part of a daily schedule significantly improves learning and memory both when the total sleep duration over 24h is sufficient and when it is insufficient. Splitting sleep between a shorter nocturnal bout and an afternoon nap over two weeks led to significant gains in afternoon memory performance. Critically, the reduced nocturnal sleep associated with this ‘split sleep schedule’ did not impair learning in the morning. Analysis of EEG recordings of brain activity during sleep suggested that the additional opportunity to engage in slow wave sleep during the nap could have contributed to this benefit.

“Demonstrating the benefit of a multi-night split sleep schedule on memory in two different tasks in the same students is a unique finding and should persuade educators to make provisions for napping,” said the study’s principal investigator Professor Michael Chee, Director of the Centre for Sleep and Cognition at the Yong Loo Lin School of Medicine.

This study is the fifth in the series of ‘Need for Sleep’ studies that investigated the effects of sleep restriction on adolescent cognition under realistic settings but with good experimental rigour. The memory benefits of daytime naps are well known, but typically, naps have been studied as a one-off supplement to nocturnal sleep, rather than as part of a regular sleep schedule. As many high-school students already do not

sleep enough, the researchers wanted to investigate how different ways of apportioning sleep across 24 hours could affect learning.

They addressed this in two 15-day studies conducted in a boarding school. The 112 adolescent participants aged 15 to 19 were divided into four groups. The first factor examined was whether students had the minimum adequate sleep opportunity (8h for each 24h) or had their sleep restricted to a level common in the local adolescent population (6.5h for each 24h). The second factor examined was whether sleep occurred in one continuous bout nocturnally or was split between nocturnal sleep and a 1.5h afternoon nap. This created four experimental groups: 8h-continuous, 8h-split, 6.5h-continuous and 6.5h-split. Long-term memory was assessed with a picture encoding task and an educationally realistic factual knowledge task that involved learning facts about several species of amphibians.

Splitting sleep enhanced afternoon performance for both memory tasks, regardless of whether adolescents were sleep restricted or well rested. Sleep monitoring with polysomnography showed a reduced build-up of 'sleep pressure' at night under the split sleep schedule. The researchers propose that slow-wave sleep during the nap may downscale synapses that are crucial for learning, refreshing them to more effectively encode new information afterwards. Alternatively, it could be that memory reactivation during the nap reorganised information learned in the morning, so that there is effectively more room for new information to be learned in the afternoon. Irrespective of the actual mechanism(s), the findings suggest that regular nap opportunities in schools may provide sufficient sleep and improve learning outcomes. Researchers in the Need for Sleep study team, Drs. James Cousins and Ruth Leong, were other major contributors to the work that was funded by the National Medical Research Council, the National Research Foundation and the Far East and Lee Foundations in Singapore.

The Centre for Sleep and Cognition at the Yong Loo Lin School of Medicine studies the scientific underpinnings of human behavior and in improving sleep. Through research and advocacy efforts, the Centre seeks to enhance human cognitive potential as well as to reduce the impact of lifestyle factors and neurodegenerative diseases on cognition and well-being.

Access the full paper here: <https://www.nature.com/articles/s41598-021-84625-8>.

Visit [www.needforsleep.org](http://www.needforsleep.org) for more information on the Need for Sleep project, which explains the history, science and motivation of the teams' work.

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