Impact of varying sleep pressure levels on sleep propensity in healthy young and older adults

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Introduction

Fixed sleep schedules with 8-hour time in bed are used before laboratory studies to ensure participants are well rested. However, such schedules may lead to cumulative excess wake in young individuals. We combine modelling and experimental data to **quantify the effects of sleep debt on sleep propensity profiles** in healthy young and older adults.

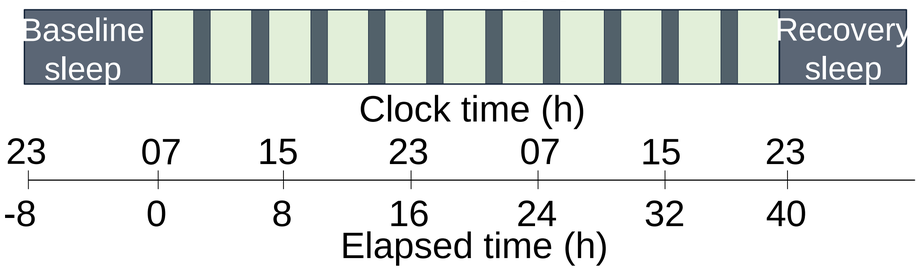
Methods

We combined **experimental data** and **biophysical modelling**.

Participants: 22 young (20-31 years; 11 male) and 26 older adults (61-82 years; 15 male)

Protocol: >1 week of fixed 8-hour time in bed sleep schedules, followed by a 40h multiple nap protocol with polysomnography:

40h multiple nap protocol:



Model: A model of arousal dynamics[1] was fitted to sleep data. The **homeostatic sleep drive** at study start was varied to identify best fits, for individual and group average sleep profiles.

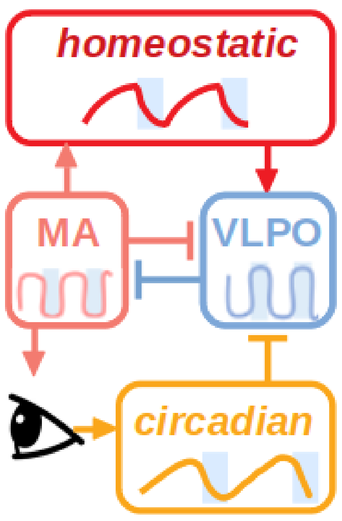


Figure 1. Model of arousal dynamics

Results

- No difference in daytime sleep duration between protocol days (young: 3.14 ± 0.98 h vs 3.06 ± 0.75 h, older: 2.60 ± 0.98 h vs 2.37 ± 0.64 h), despite higher prior 24h TST on day 1 compared to day 2.
- Model predicted an increased initial homeostatic drive **above well-rested**:

H0'/H0	Young	Older
Group fit	112.3%	108.2%
Averaged individual fits	111.2 ± 3.5%	110.1 ± 3.5%

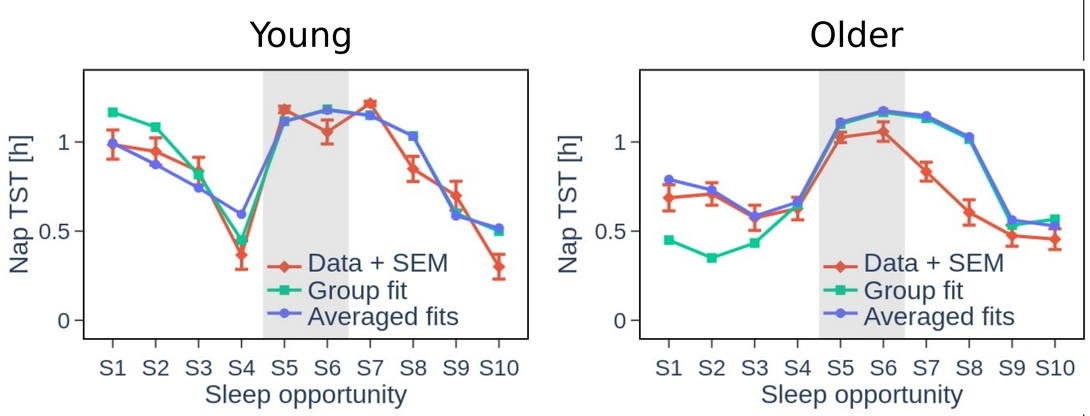


Figure 2. Nap total sleep times and model fits for group average data

- Initial homeostatic drive explains individual variability in sleep patterns for the first but not the second day:

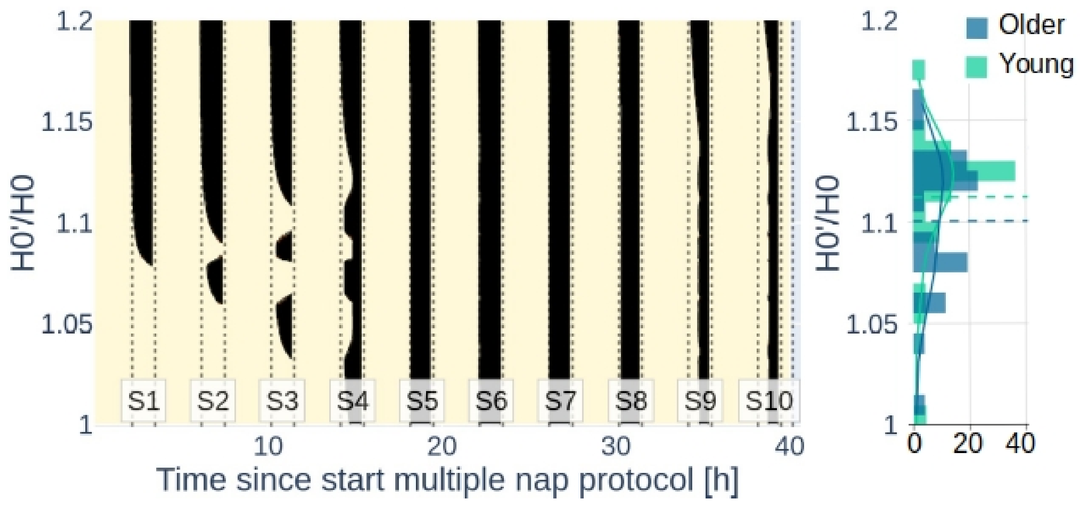


Figure 3. Effect of the initial homeostatic drive on sleep patterns on the multiple nap protocol (left) with individual best fit values (right)

Discussion

- Fixed sleep schedules with 8-hour time in bed increase sleep debt in young and, unexpectedly, in older adults despite decreased sleep capacity.
- Sleep propensity appears to be driven by different mechanisms over protocol days.
- These results contribute to the understanding of the mechanisms underlying sleep propensity.

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fnrs FREEDOM TO RESEARCH

References

1. Postnova, S., et al., Prediction of Cognitive Performance and Subjective Sleepiness Using a Model of Arousal Dynamics. J Biol Rhythms, 2018. 33(2): p. 203-218.