Nap Time Factors and Memory Retrieval in Young Children

Sarah Badawi*, Kelly Dombek*, Audrey Strachan, Arcadia Ewell, Tracy Riggins
University of Maryland, College Park

Neurocognitive Development Lab

Introduction

- Sleep is important for hippocampal memory function in adulthood, but there is little known about the consequences of sleep in preschool-age children (Kudziel, Duclos & Spencer, 2013).
- Research on sleep-dependent memory consolidation suggests that naps assist in declarative memory formation in young adults, and there is emerging evidence that it functions similarly in young children (Kudziel, Duclos & Spencer, 2013).
- Sleep spindles during naps are associated with sleep-dependent memory consolidation in both adults and children, and may explain the relation between napping and enhanced memory consolidation (Kudziel, Duclos & Spencer, 2013).
- Napping in early childhood may have an important function in consolidating new memories and enhancing delayed memory retrieval after naps.
- **The goal of this study is to investigate whether memory retrieval accuracy in young children is enhanced by napping, compared to being kept awake during normal nap time.**

Methods

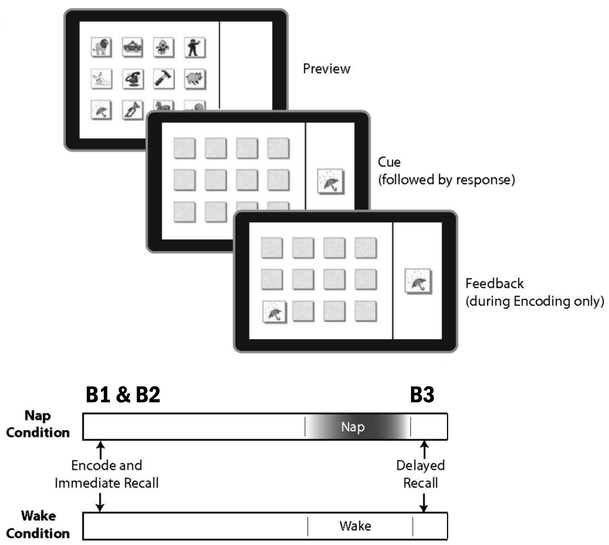
Participants:

- 18 preschool-age children (9 male) were recruited through the University of Maryland Infant and Child Studies database.
- Subject age ranged from 37 months to 57 months (M = 44, SD = 5.28).
- Participants with previous brain injuries, neurological or developmental disorders or non-native English speakers were excluded.
- Participants were "regular nappers" (napping at least five days per week).

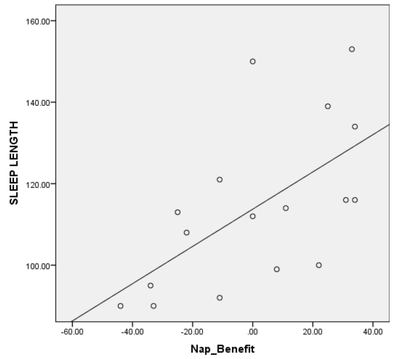
Procedure:

- Two home visits per child were conducted over the course of 2 weeks.
- For one visit the child napped as normal, and for the other the child was kept awake and given non-stimulating toys to play with quietly.
- At each visit, children played a visuospatial memory game.
- The tester administered a Likert scale to record the child's current mood and sleepiness after the final completed task was administered.
- A polysomnography (PSG) cap measured the child's sleep spindles in number and density during the two home visits.
- On the third visit, the child completed a T1-weighted MRI scan to measure hippocampal sub-region volume, which was analyzed using FreeSurfer.

Memory Task:



Results: Memory Task



Sleep Length vs. "Nap Benefit"

r(17) = .606, p = .01

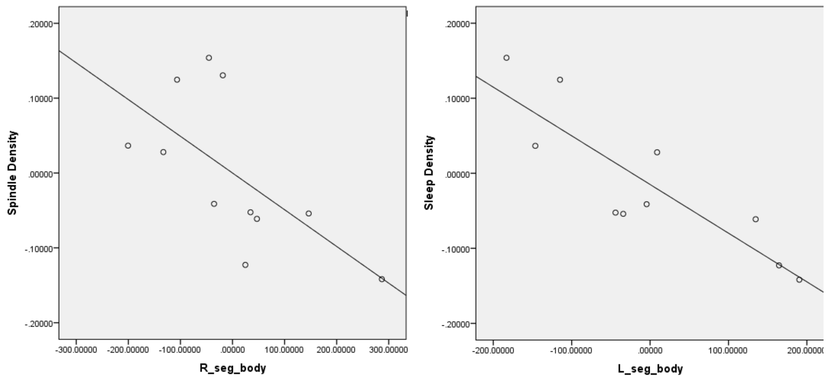
Results: Sleep Spindles and Hippocampal Volume

Right Hippocampal Body

r(10) = -.644, p < .05

Left Hippocampal Body

r(10) = -.869, p < .01



PSG

MRI

Discussion

Memory Task:

- Performance after a nap compared to after awake time (i.e. "nap benefit") was positively and significantly correlated with the length of the child's nap and awake time.
  - Children who napped longer performed better on the task after they napped compared to after they were kept awake.
  - Children who napped for shorter lengths of time performed better on the task after they were kept awake compared to after they napped.
- There were no significant associations between mood and sleepiness after the final task and performance.

Sleep Spindles & Hippocampal Volume:

- Right and left body hippocampal volumes were negatively and significantly correlated with sleep spindle density when controlling for intracranial volume.
- There were no significant associations between the neurophysiological data and memory task performance.

Conclusion

Conclusion:

- Longer naps could be linked to greater memory benefits after a nap compared to after being kept awake.
- Longer periods of being kept awake could be associated with greater memory benefits of napping.
- Our results suggest that the hippocampal body may be related to quality of sleep during naps, measured by sleep spindle density, and therefore potentially relate to memory consolidation during naps.

Future Directions:

- We would like to analyze mood and sleepiness prior to the nap and awake time.
- We would like to further investigate the role of hippocampal volumes and sleep spindle densities in memory consolidation using a larger sample size.

References

- Kurdziel, L., Duclos, K. and Spencer, R. (2013). Sleep spindles in midday naps enhance learning in preschool children. *Proceedings of the National Academy of Sciences*, [online] *110*(43), pp.17267-17272. Available at: https://www.pnas.org/content/110/43/17267.

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Contact Information for Kelly Dombek: kdombek1@terpmail.umd.edu
Contact Information for Sarah Badawi: sbadawi6@gmail.com
Contact Information for Audrey Strachan: astrachan2@gmail.com