Association between Hippocampal Functional Connectivity, Sleep, and Memory during Early Childhood.

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Introduction

- The hippocampus belongs to a network of regions that show increases in intrinsic connectivity across childhood. Further, individual differences in instinct connectivity are related to memory performance (Geng et al., 2019; Riggins et al., 2016).
- During early childhood, children also show a memory-related nap benefit. However, the magnitude of nap benefit is not equal across children (Kurdiziel et al., 2013).
- Individual differences in nap benefit magnitude may be related to maturation of the hippocampal memory network.
  - Specifically, children with a more mature memory network may show less memory decay when kept awake during a nap interval (Lokhandwala et al., 2022).
- **Purpose:** To investigate relations between hippocampal connectivity and a memory-related nap benefit.

Methods

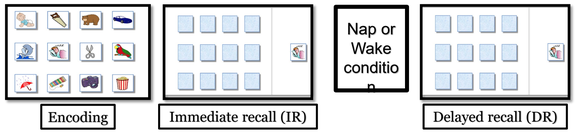
Participants

- Participants are a cross-sectional sample of 56 3-to-5-year-old participants (M_{age}=4.06, 9 F).

Experimental Design

- The 3 visits were one week apart

Behavioral Memory Task

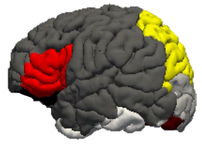


- **Nap/Wake Difference Score** = (DR –IR)/IR
- **Nap Benefit Score** = Nap Diff. Score – Wake Diff. Score

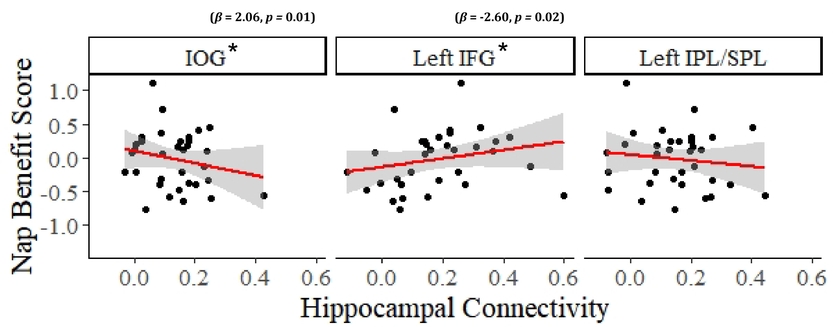
MRI Data

- A T1-weighted structural MRI scan (.9 mm^3) and a 7-minute rsfMRI scan was obtained using a Siemens 3T scanner with a 32-channel coil.
- Hippocampal seed regions (anterior and posterior) were extracted using Freesurfer v6.0 (Fischl, 2012) and adjusted using ASAT (Wang et al., 2011).
- To address motion, volumes with a framewise displacement > 0.05 were scrubbed.
- Time-series correlations of hippocampal seeds and ROIs drawn from Geng et al., 2019 were calculated.

Fusiform
IOG
Left IFG
Left IPL/SPL
Left ITG
OFG

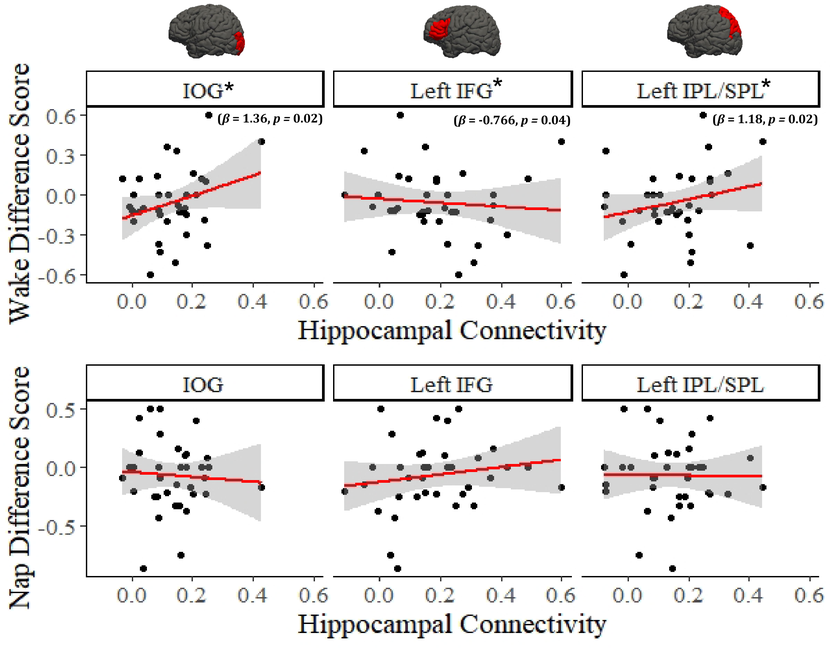


Hippocampal Connectivity and Nap Benefit



- We assessed associations between nap benefit score and anterior hippocampal connectivity controlling for age and time between IR and DR.
- Findings demonstrate a greater nap benefit was associated with greater connectivity to left IFG and less connectivity with IOG (R^2=.35, F(8,23)=3.13, p<.02).

Hippocampal Connectivity and Nap/Wake Difference Scores



- We assessed associations between condition difference scores and anterior hippocampal connectivity controlling for age and time between IR and DR.
- Findings demonstrate that better performance across the wake session was associated with greater connectivity to IOG and Left IPL/SPL, and less connectivity to left IFG (R^2=. 30, F(8,26)=2.84, p<.02). There were no significant associations with nap difference score.

Discussion

- Results demonstrated that a greater nap benefit was associated with greater hippocampal connectivity to Left IFG and less hippocampal connectivity to IOG.
- Additionally, there were associations between hippocampal connectivity and wake difference scores, but not nap difference scores.
  - Specifically, hippocampal connectivity to Left IFG, IOG, and Left IPL/SPL were associated with wake difference score but not nap difference score.
- These findings could suggest that an afternoon nap buffers the effects of memory decay associated with a less mature hippocampal memory network during early childhood.

Take Aways

An afternoon nap may buffer memory deficits caused by immaturity in the hippocampal memory network during early childhood.

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Acknowledgements

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