

Exploring Sleep-Dependent Memory Consolidation in Preschoolers

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Introduction

- Sleep is important for memory consolidation in early childhood.
- Previous research shows that depriving children of their habitual nap can adversely affect their learning and memory capabilities¹.
- The specific mechanisms by which sleep, including napping, influence young children's memory remains unclear.
- **Objective:** Our study aims to investigate the impact of sleep conditions on memory performance in early childhood by using a child-appropriate memory paradigm called the Mnemonic Similarity Task (MST).

Methods

Participants

- N = 12 children between 3-5 years old who are habitual nappers (nap more than 5 days a week).

Procedure

- The study consisted of two visits spaced 1 week apart.
- At each visit, participants completed the MST task twice - once in the afternoon before and after the awake or nap period and again before and after the overnight sleep period (see Figure 1).

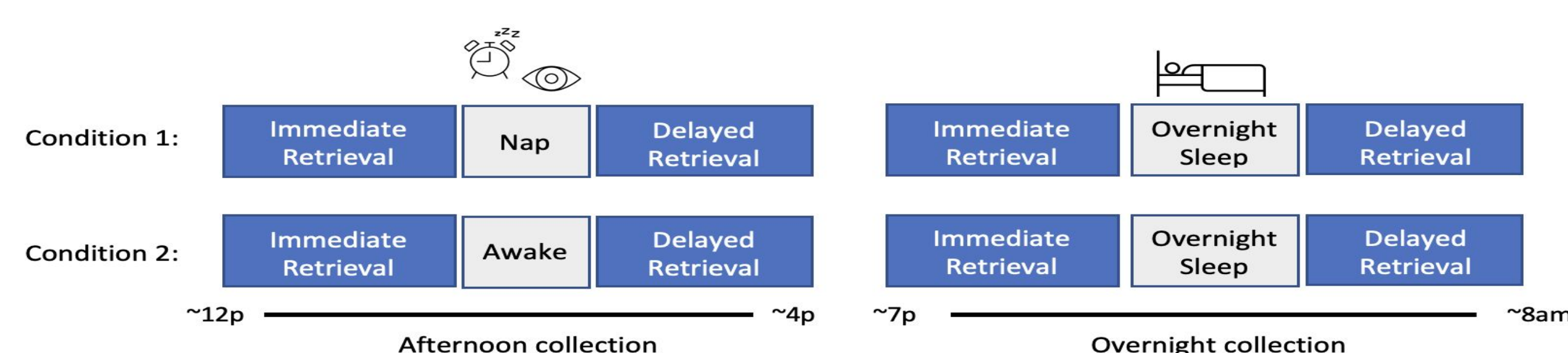
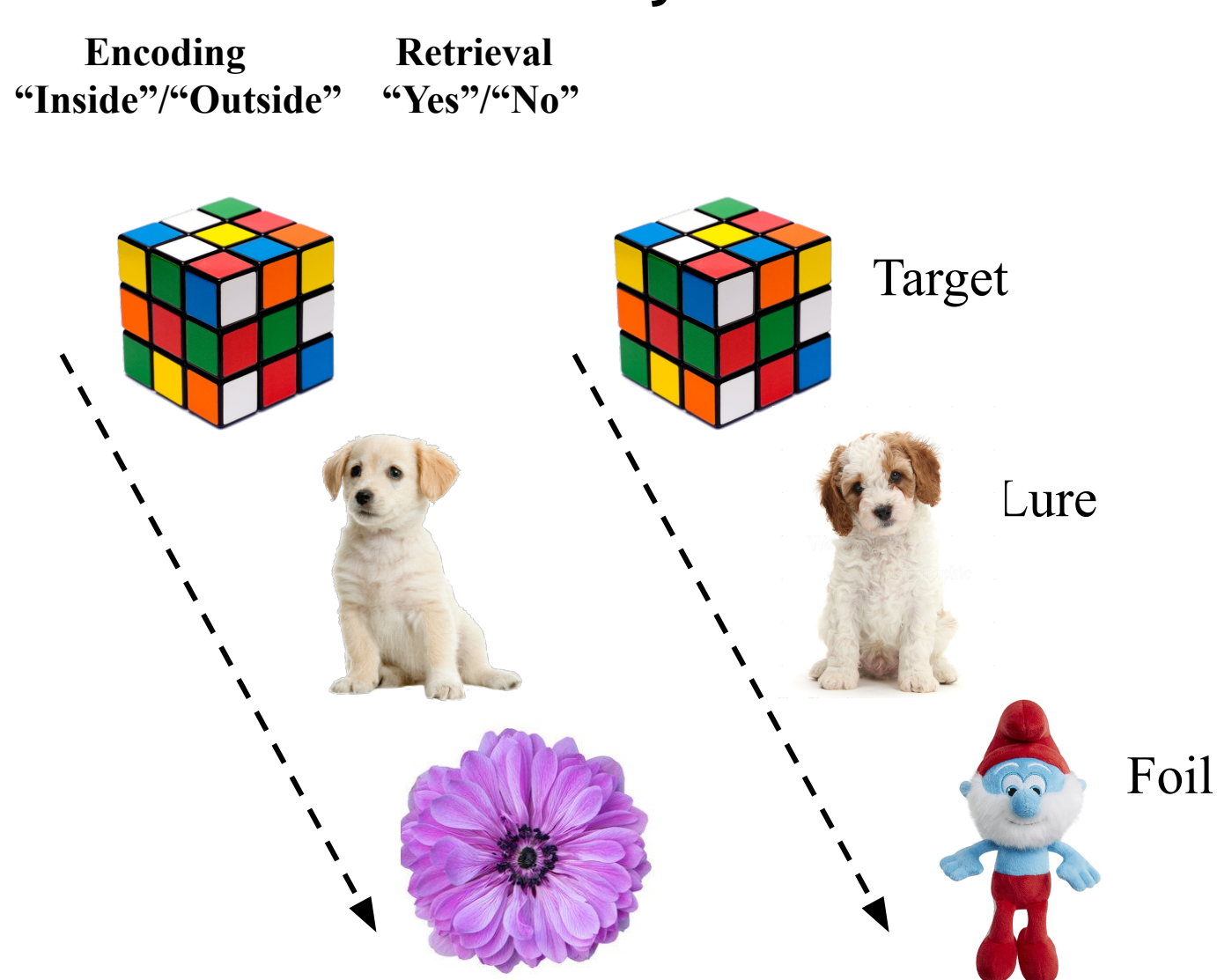


Figure 1. Study Design. Nap and awake conditions were counterbalanced.

Mnemonic Similarity (MST) Task Design



Target: Exact picture seen at encoding
Lure: Picture similar to Target, but not exact picture seen at encoding
Foil: Brand new picture not seen at encoding

Figure 2. Mnemonic Similarity Task Design. During encoding, participants were shown 60 pictures. During immediate and delayed retrieval, participants were shown a subset of these pictures (targets), as well as lures and foils, and asked to determine whether they saw the picture during encoding.

Results

Figure 3. Boxplot of Results

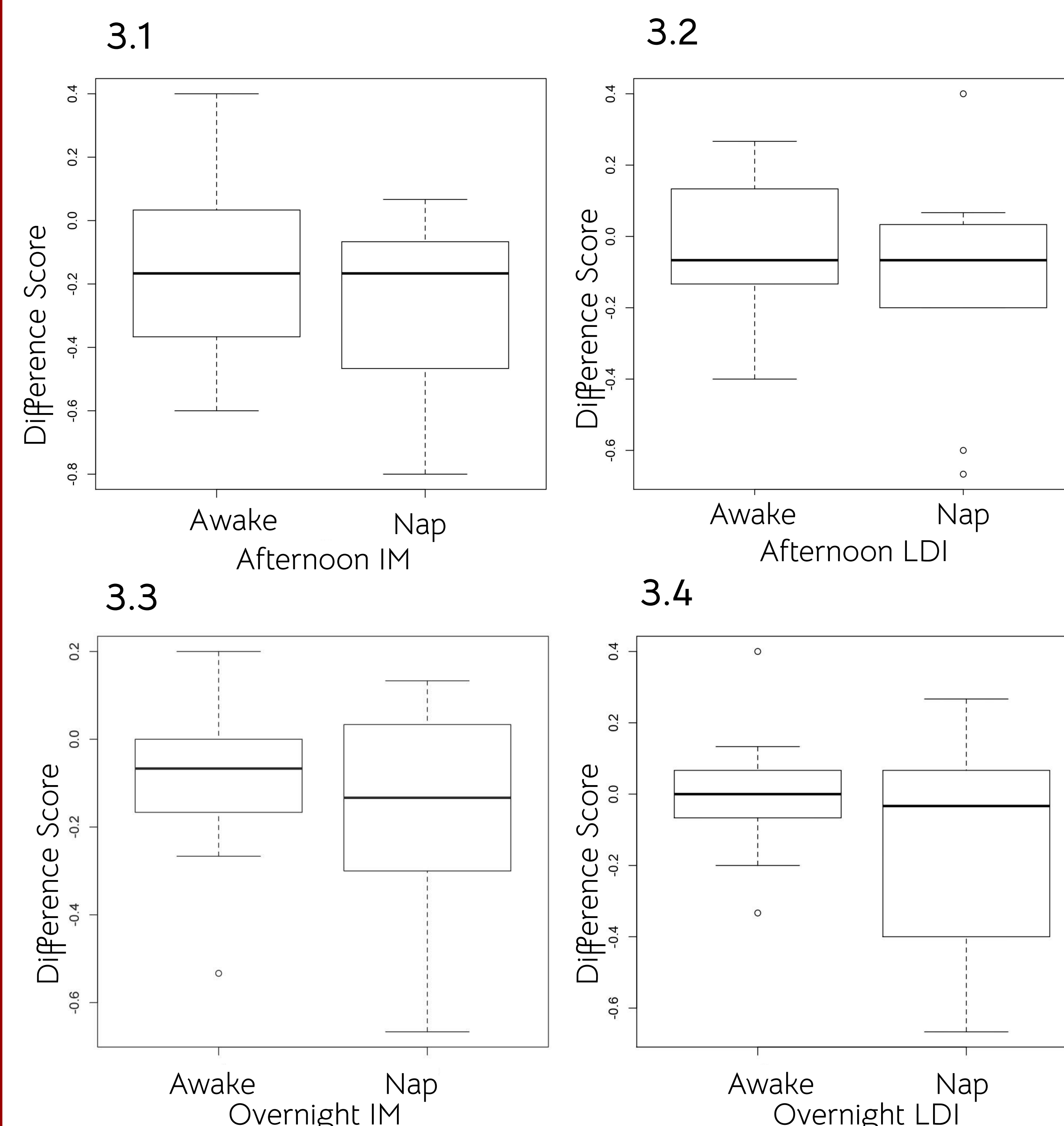


Figure 3.1. Boxplot showing results of t-test comparing IM performance for afternoon awake vs afternoon nap condition. **Non-significant** results were found.

Figure 3.2. Boxplot showing results of t-test comparing LDI performance for afternoon awake vs afternoon nap condition. **Non-significant** results were found.

Figure 3.3. Boxplot showing results of t-test comparing IM performance for overnight awake vs overnight nap condition. **Non-significant** results were found with slightly more variations in medians.

Figure 3.4. Boxplot showing results of t-test comparing LDI performance for overnight awake vs overnight nap condition. **Non-significant** results were found.

- No significant difference in LDI was found between the awake condition and nap condition ($t(11) = 0.82, p = 0.43$) at the afternoon collection or LDI for the awake and nap condition ($t(11) = 1.34, p = 0.21$) at the overnight collection.
- No significant difference in IM was found between the awake condition and nap condition ($t(11) = 0.73, p = 0.48$) at the afternoon collection or IM for awake and nap condition ($t(11) = 0.72, p = 0.49$) at the overnight collection.

Statistical Analysis

- The following memory performance metrics were derived from the MST for each immediate and delayed retrieval run:
 - Item memory (IM): **Target Hits - Foil Misses (false alarms)**
 - Proportion of target hits to foil misses ("yes" to target, "yes" to foil)
 - Lure Discrimination Index (LDI): **Target Hits - Lure Misses (false alarms)**
 - Proportion of target hits to lure misses ("yes" to target, "yes" to lure)
- Difference scores for LDI were calculated by subtracting immediate retrieval LDI from delayed retrieval LDI for each collection period for each condition.
- Difference scores for IM were calculated by subtracting immediate retrieval IM from delayed retrieval IM for each collection for each condition.
- Four paired samples t-tests were completed in R⁵ to compare these memory performance metrics for the afternoon and overnight collections for both conditions (nap and awake).

Discussion

- The study explores the relation between sleep conditions on memory performance in pre-school aged children using a widely known and effective memory paradigm.
- Our findings reveal memory performance did not differ by sleep conditions (i.e. nap or awake) in preschoolers.
- These results were unexpected given previous literature showing associations between memory performance and sleep conditions² in adults. For example, sleep deprivation diminished adult's mnemonic discrimination abilities².
- Notably, the vast majority of these studies were conducted with adult samples, thus additional research with younger populations is needed to understand these findings.
- Our small sample size is likely contributing to our lack of findings. A larger sample size is needed to further test these relationships.
- Possible incorrect sleep reports and tester bias are major limitations.
 - Parents might have reported incorrect sleep/nap times.
 - Testers might have accentuated certain items and given clues on the MST administration.
- Study can be repeated longitudinally with different sleep conditions (e.g., quantity of sleep assigned) and larger sample sizes.

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References

