INTRODUCTION
Naps benefit memory in early childhood (3-5 years) even as children transition from biphasic to monophasic sleep. This memory benefit is thought to reflect sleep-dependent memory consolidation orchestrated by three oscillations in the sleep EEG. Recent studies have observed the simultaneous activity of slow oscillations (SOs) and sleep spindles (SPs), referred to as SO-SP coupling, during childhood. This coupling may be strengthened with development as it has been shown to be greater in adolescence relative to childhood. Further, coupling strength has been shown to be positively related to memory consolidation. How SO-SP coupling strength changes during early childhood and how it relates to memory consolidation remains unexamined.

We hypothesize that coupling strength increases with development, thus benefiting memory consolidation. Alternatively, naps may not be sufficient to observe changes in coupling strength.

METHODS

Study Design: This is a preliminary analysis of data from a longitudinal study examining polysomnography (PSG), memory, and brain development. Important to current analyses, there were 2-3 sleep and memory assessments over the course of a year (Wave 1: baseline; Wave 2: 6 months after Wave 1; and Wave 3: 12 months after Wave 1). Analysis involves two groups: children with Wave 1 and Wave 2 data (W1-2 group) and a separate group of children with Wave 2 and Wave 3 data (W2-3 group).

Participants: Participants were 20 preschool-aged children. The W1-2 group included data from 10 preschool-aged children (6 female, M_age = 4.03, SD = 0.60) at Wave 1 and the W2-3 group also included data from 10 preschool-aged children (5 female, M_age = 4.66, SD = 0.41 at Wave 2).

RESULTS

What is slow oscillation-spindle (SO-SP) coupling strength?

The figure on the right illustrates coupling strength for frontal, centrofrontal, and central regions at each wave. There was no systematic change in coupling strength across waves.

DISCUSSION

Our findings indicate that SO-SP coupling strength did not significantly change in the developing brain over the years. However, at Wave 3, we see that coupling strength in frontal regions during nap became positively related to memory consolidation. This supports preliminary suggestions that SO-SP coupling strength in naps in early childhood may contribute to the strength of memory consolidation to some extent.

Further, our results indicate that males had greater frontal strength than females. This finding is in line with work highlighting that between the ages of 12-14 years, there is a longitudinal increase in SP density in males. 33% greater compared to females. This suggests that there may be sex differences in the functional trajectories of SPs that may affect coupling strength of SO-SP events in early childhood.

Overall, these results suggest that physiological markers of brain and memory development may undergo changes during the biphasic to monophasic sleep transition. Specifically, these changes may reflect a molding of a more efficient frontal neural network that benefits memory consolidation. Future research with a greater sample size will allow us to disentangle effects of sex and nap transition status on coupling strength and the relationship between strength and memory consolidation.

REFERENCES

2. Department of Psychology, University of Maryland, College Park.
3. Neuroscience and Behavior Program, University of Massachusetts Amherst.