

The effects of sleep order on procedural learning in preschool-aged children

S. Struzziero², J. F. Holmes¹, R.M.C. Spencer¹

¹Psychological and Brain Sciences, University of Massachusetts Amherst
²Commonwealth Honors College, University of Massachusetts Amherst

INTRO

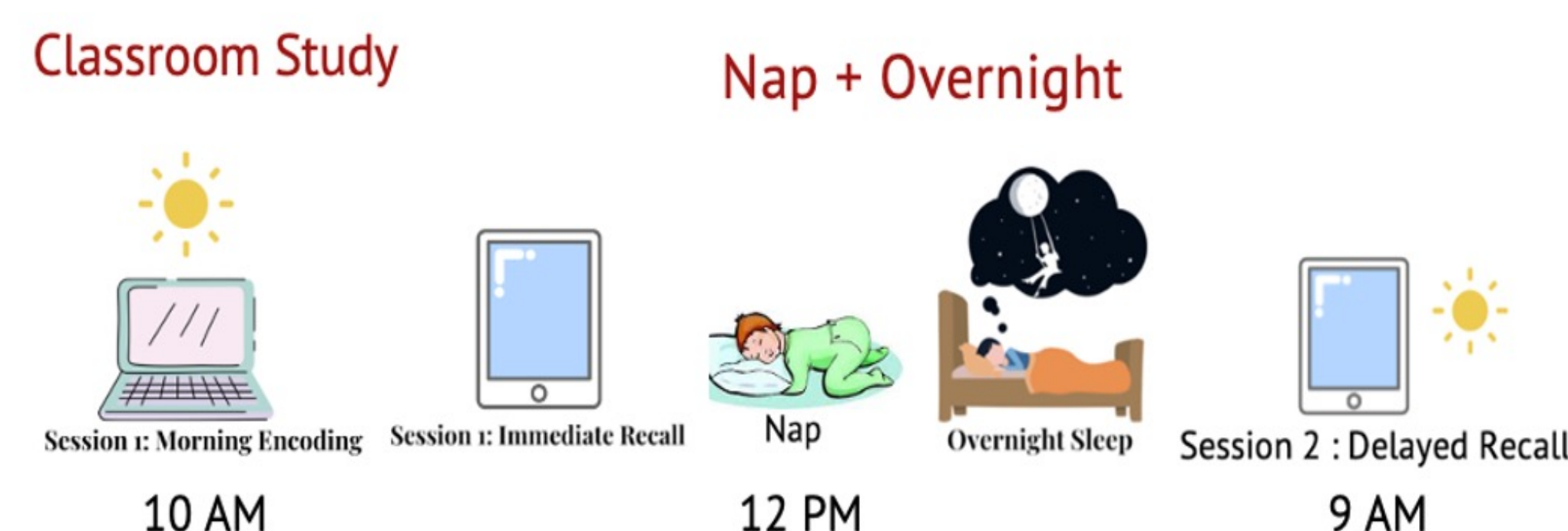
- Naps are known to have either an immediate (post-nap) benefit or delayed (post-nap + post-overnight sleep) benefit on some types of learning in preschoolers :
 - Declarative memory → Immediate Benefit¹
 - Emotional memory → Delayed Benefit²
 - Procedural memory → Delayed Benefit³
- We aimed to explore if the delayed benefit seen in procedural memory is due to the amount of sleep needed or the order of sleep bouts.
- Hypothesis 1: **Overnight Sleep + Nap > Overnight Sleep Only** (Is there a delayed benefit?)
- Hypothesis 2: **Nap + Overnight Sleep > Overnight Sleep + Nap** (Does sleep order matter?)
- Alternatively**, we predicted that the order of sleep may have no effect on procedural learning – and may be more reliant on the *amount* of sleep post-learning.
- Hypothesis 3: **NREM stage 2 sleep will correlate with task improvement**

METHODS

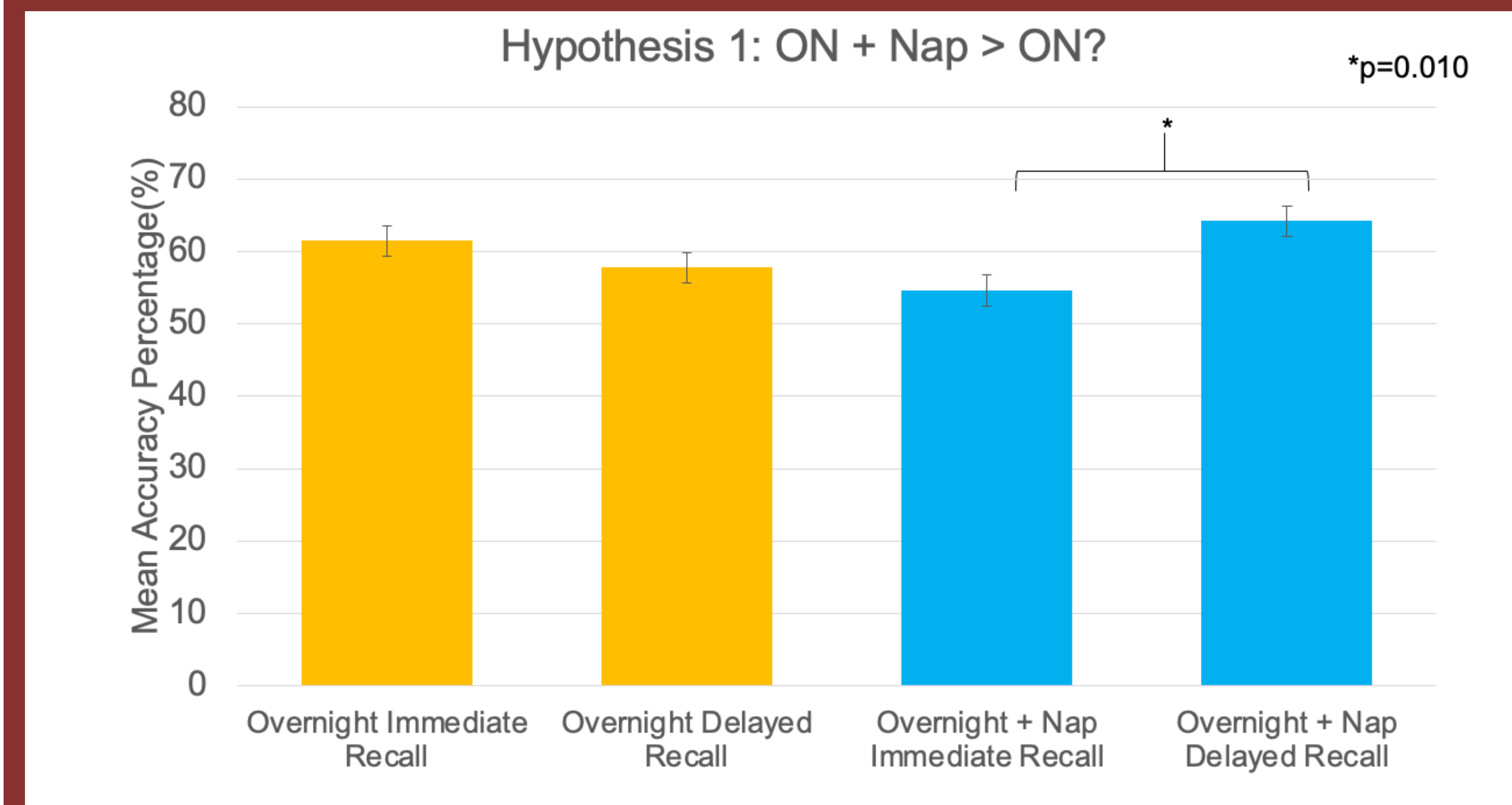
Participants were 16 preschool children (remote: n=8, age = 47.25 months; classroom: n=8, age = 48.13 months)
 Remote children participated in 2 testing sessions, ~1 week apart:



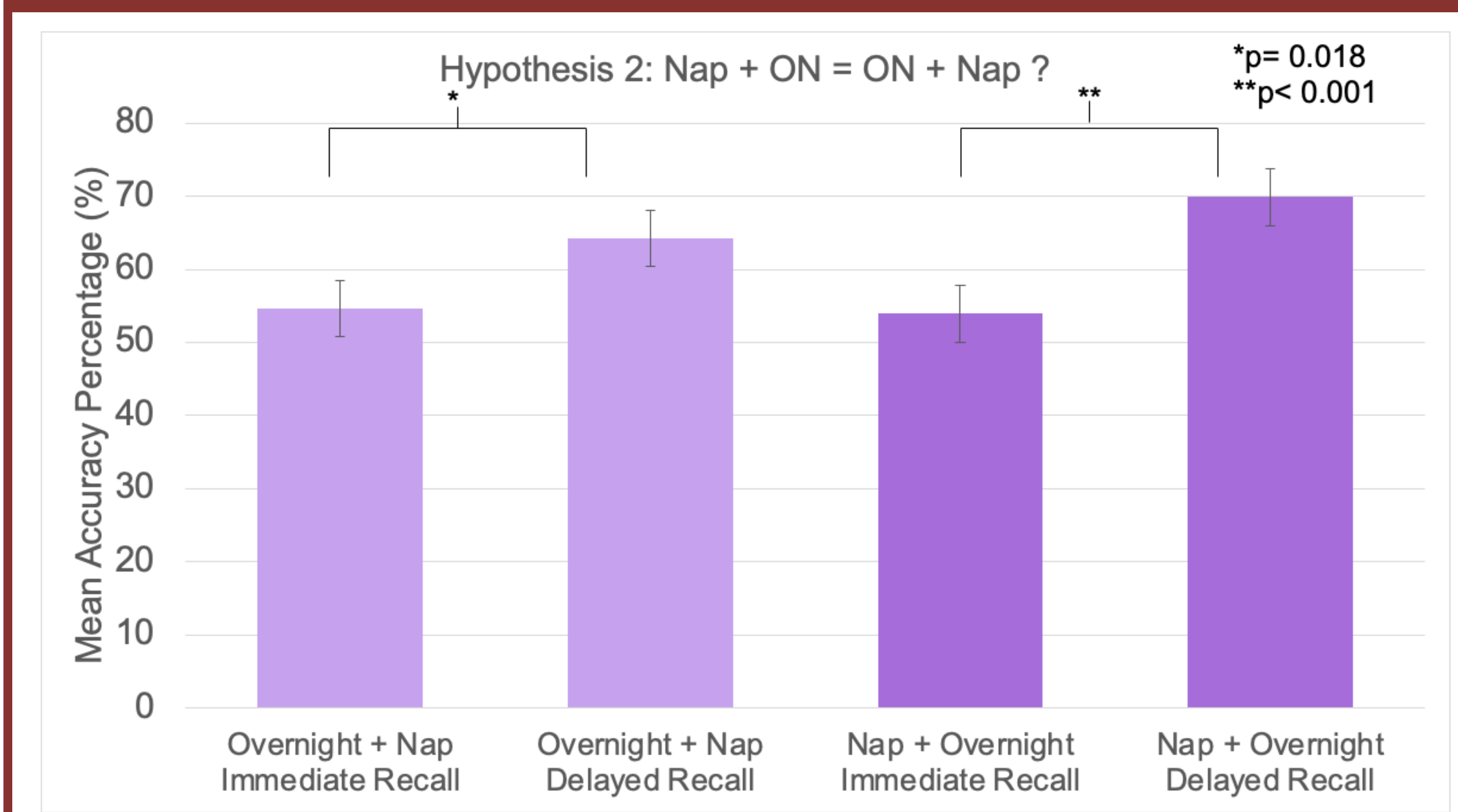
In the Classroom group, children learned prior to a nap:



Overnight sleep followed by a nap confers a greater benefit on procedural learning than overnight sleep alone.



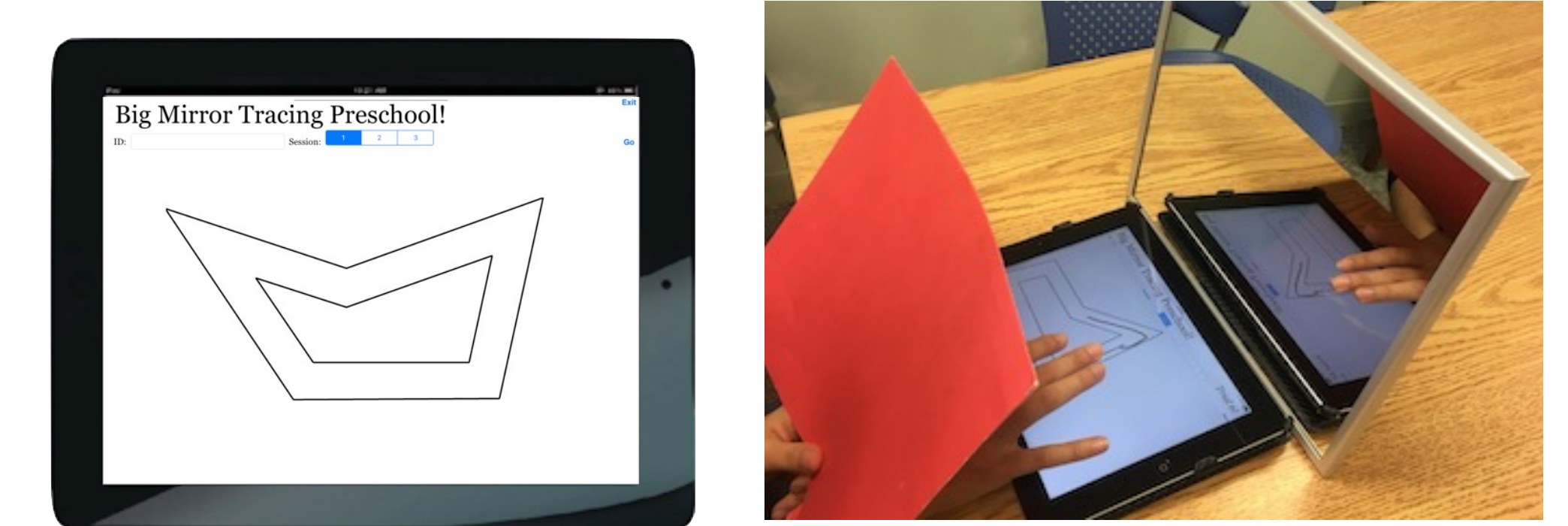
The order of sleep bouts may not affect procedural memory consolidation in preschoolers.



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METHODS (continued)



Children learned a mirror tracing task in the evening and were assessed at two time points:

- Immediate Recall: immediately following initial learning
 - Delayed Recall: the next day either before or after their nap
- Performance was measured by average accuracy percentage (% of time spent drawing inside the shape template).

RESULTS

There were no baseline differences found in these analyses.

Hypothesis 1:

- Overnight Sleep + Nap > Overnight Sleep Only**
 - ON+Nap condition had significant improvement from immediate to delayed recall

Hypothesis 2:

- Nap + Overnight Sleep = Overnight Sleep + Nap**
 - Lack of a group effect and lack of a group X session interaction suggested similar task performance between groups

Hypothesis 3:

- NREM stage 2 sleep is not correlated with task improvement.**

DISCUSSION

- Sleep order might not matter!
- But getting enough sleep might...
- There is a delayed nap benefit on procedural memory.
- Children may just need two sleep bouts to improve on procedural learning task.
- Need to test more participants.

REFERENCES

- Kurdziel, L., Duclos, K., & Spencer, R. M. C. (2013). Sleep spindles in midday naps enhance learning in preschool children. *Proceedings of the National Academy of Sciences of the United States of America*, 110(43), 17267–17272. <https://doi.org/10.1073/pnas.1306418110>
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- Desrochers, P. C., Kurdziel, L. B. F., & Spencer, R. M. C. (2016). Delayed benefit of naps on motor learning in preschool children. *Experimental Brain Research*, 234(3), 763–772. <https://doi.org/10.1007/s00221-015-4506-3>