

Christine W. St. Laurent¹ and Rebecca M. C. Spencer^{1,2}

¹Department of Psychological and Brain Sciences, University of Massachusetts, Amherst; ²Institute of Applied Life Sciences, University of Massachusetts, Amherst

ABSTRACT

Acute bouts of physical activity (PA) appear to benefit declarative memory in older adults. Although studies are limited, findings have been favorable in older children as well. However, effects of acute PA on declarative memory have not been explored in children under 6 years and early childhood generally includes a sensitive period for memory development.

PURPOSE: To determine if acute bouts of structured PA can impact declarative memory performance in preschool children. **METHODS:** Two cross-over studies in preschool children explored effects of 15-min bouts of structured PA with memory assessed immediately following the conditions and again after an approximately 5-hour delay. The first study ($n = 15$; age = 52.3 ± 10.5 months) had two conditions delivered via a recorded video (active or quiet play) and memory was measured with an episodic memory task. Between immediate and delayed recall, 44% of the children napped. The second study ($n = 23$; age = 52.9 ± 10.4 months) compared a PA story session (physically acting out the story) to a traditional, seated session ($n = 8$ remotely and $n = 15$ in a classroom) and used a visuospatial task to probe memory. Mixed models adjusting for age explored effects of the conditions on immediate and change (delayed-immediate) in memory accuracy. Models also explored the interaction of condition and napping for the first study, and the interaction of condition and setting for the second study. **RESULTS:** Acute PA did not affect immediate episodic memory ($p = 0.385$). There was a main effect of napping ($B = 45.5$, $p = 0.001$), but no main effect of condition or interactive effect. Although there was no effect of PA on immediate visuospatial memory, children had more favorable changes in recall following PA ($B = 21.5$, $p = 0.009$). Additionally, there was an interaction of condition and setting ($B = -19.6$, $p = 0.004$), indicating that the PA benefit was observed in the remote setting. **CONCLUSION:** A single bout of PA does not appear to benefit episodic memory, but may be beneficial for visuospatial memory. Our findings suggest that integrating movement into story time in young children may assist in one domain of their learning. Additional analyses of the present data should explore how fidelity of the conditions influenced the findings. Future work may consider larger sample sizes and varying doses or modalities of PA.

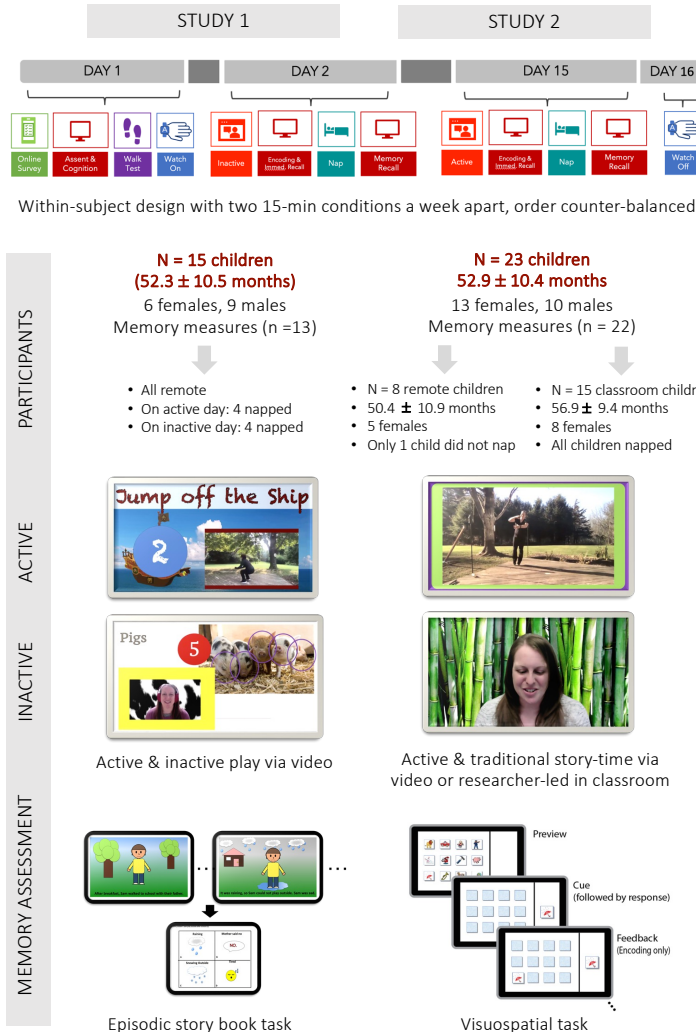
INTRODUCTION

- Declarative memory is a type of explicit long-term memory that involves recollection of daily experiences, particular facts, and events. This extrinsic memory system works to encode, maintain, and retrieve information into and out of longer-term storage (1).
- Rapid brain and cognitive development occurs during early childhood, a significant period for memory improvement (1,2).
- Declarative memory performance and development in preschoolers (~3-5 years) can be influenced by many biological and environmental factors (2,3).
- Physical activity (PA) appears to benefit memory in older adults, but few studies have explored memory (aside from working memory) in children (4,5).
- Acute PA may improve encoding strength, as well as retrieval, but this design has not been explored in preschool children for memory (5,6).

Purpose: To determine if acute bouts of structured physical activity can impact memory performance in preschool children.

Hypotheses: Episodic and visuospatial memory performance would be greater following an acute bout of structure PA compared to an inactive bout.

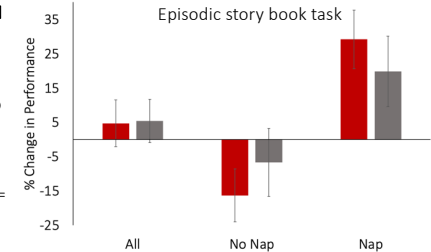
METHODS



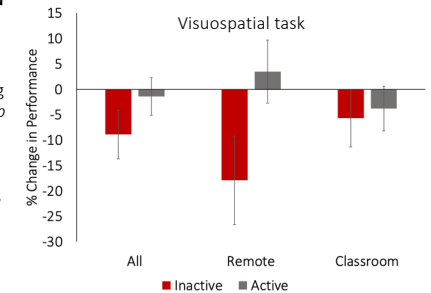
RESULTS

Immediate Recall: There were no differences in memory accuracy immediately following inactive vs. active sessions in either study.

Study 1 Delayed Recall: There was a main effect of nap ($p = 0.001$), but no interaction between condition and taking a nap ($p = 0.227$).



Study 2 Delayed Recall: There was an interaction between setting and condition ($p = 0.044$). Children performed better remotely after the active condition ($p = 0.009$).



CONCLUSIONS

- Acute PA in preschool children may benefit visuospatial memory, but not episodic memory as measured by the story book task.
- Integration of movement into reading time in young children may assist in one domain of learning.
- Future work may consider larger sample sizes, varied doses or modalities of PA, and the synergistic influences of acute PA and sleep.

REFERENCES

- Riggins, T., & Bauer, P. J. (2022). A Developmental Neuroscience Approach to the Study of Memory. In M. L. Courage & N. Cowan (Eds.), *The Development of Memory in Infancy and Childhood*. Psychology Press.
- Ghetti, S., & Bunge, S. A. (2012). Neural changes underlying the development of episodic memory during middle childhood. In *Developmental Cognitive Neuroscience* (Vol. 2, Issue 4, pp. 381-395).
- Spaniol, J., Davidson, P. S. R., Kim, A. S. N., Han, H., Moscovitch, M., & Grady, C. L. (2009). Event-related fMRI studies of episodic encoding and retrieval: Meta-analyses using activation likelihood estimation. In *Neuropsychologia* (Vol. 47, Issues 8-9, pp. 1765-1779).
- Erickson, K. L., Hillman, C., Stulman, C. M., Ballard, R. M., Bloodgood, B., Conroy, D. E., Macko, R., Marquez, D. X., Petruzzello, S. J., & Powell, K. E. (2019). Physical Activity, Cognition, and Brain Outcomes: A Review of the 2018 Physical Activity Guidelines. *Medicine and Science in Sports and Exercise*, 51(6), 1242-1251.
- Gunnell, K. E., Poitras, V. J., LeBlanc, A., Schibli, K., Barbeau, K., Hedayati, N., Ponitex, M. B., Goldfield, G. S., Dunlap, C., Lehan, E., & Tremblay, M. S. (2019). Physical activity and brain structure, brain function, and cognition in children and youth: A systematic review of randomized controlled trials. *Mental Health and Physical Activity*, 16(November 2018), 105-127.
- St. Laurent, C. W., Burkart, S., Andre, C., & Spencer, R. M. C. (2021). Physical Activity, Fitness, School Readiness, and Cognition in Early Childhood: A Systematic Review. *Journal of Physical Activity and Health*, 18(8), 1004-1013.