



NEUROSCIENTIFIC EVIDENCE OF LEARNING BENEFITS FROM PHYSICAL ACTIVITY AND OUTDOOR BREAKS

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TRADITIONAL STUDIES OF THE LEARNING AND WORKING BRAIN



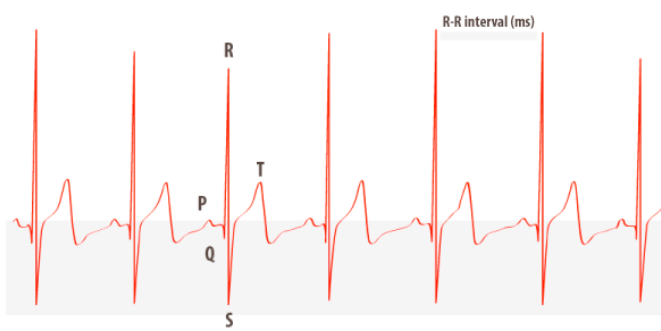
Laboratory-based methods can simulate real learning situations

- MEG (magnetoencephalography)
- fMRI (functional magnetic resonance imaging)

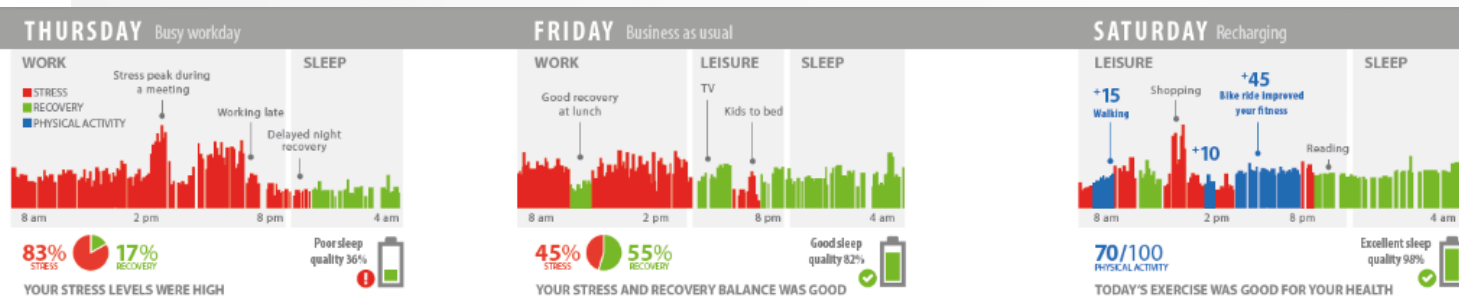




STUDIES OF THE AUTONOMOUS NERVOUS SYSTEM ACTIVITY IN LEARNING SITUATIONS



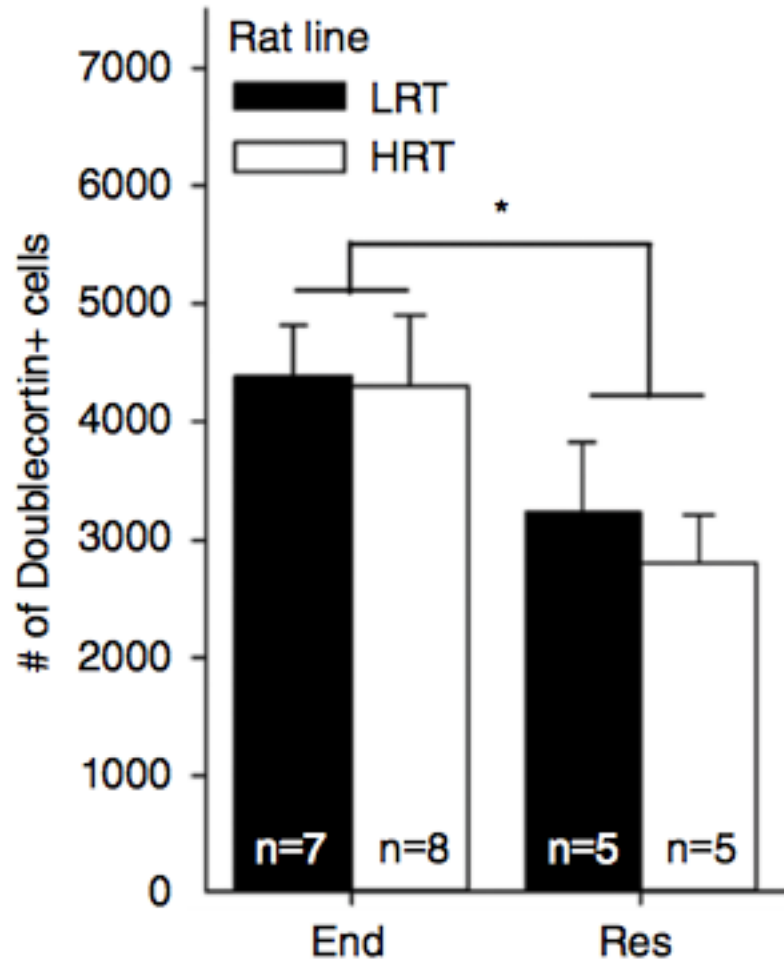
- Measurements of the heart, breathing, movement, skin reactions
- Indirect measures of autonomous nervous system functions



EMBODIED COGNITION



WHY PHYSICAL ACTIVITY IS SO IMPORTANT



New cells are born in the hippocampus especially in endurance training but also on resistance training

Nokia, M. S., Lensu, S., Ahtiainen, J. P., Johansson, P. P., Koch, L. G., Britton, S. L., & Kainulainen, H. (2016). Physical exercise increases adult hippocampal neurogenesis in male rats provided it is aerobic and sustained. *The Journal of physiology*, 594(7), 1855-1873.



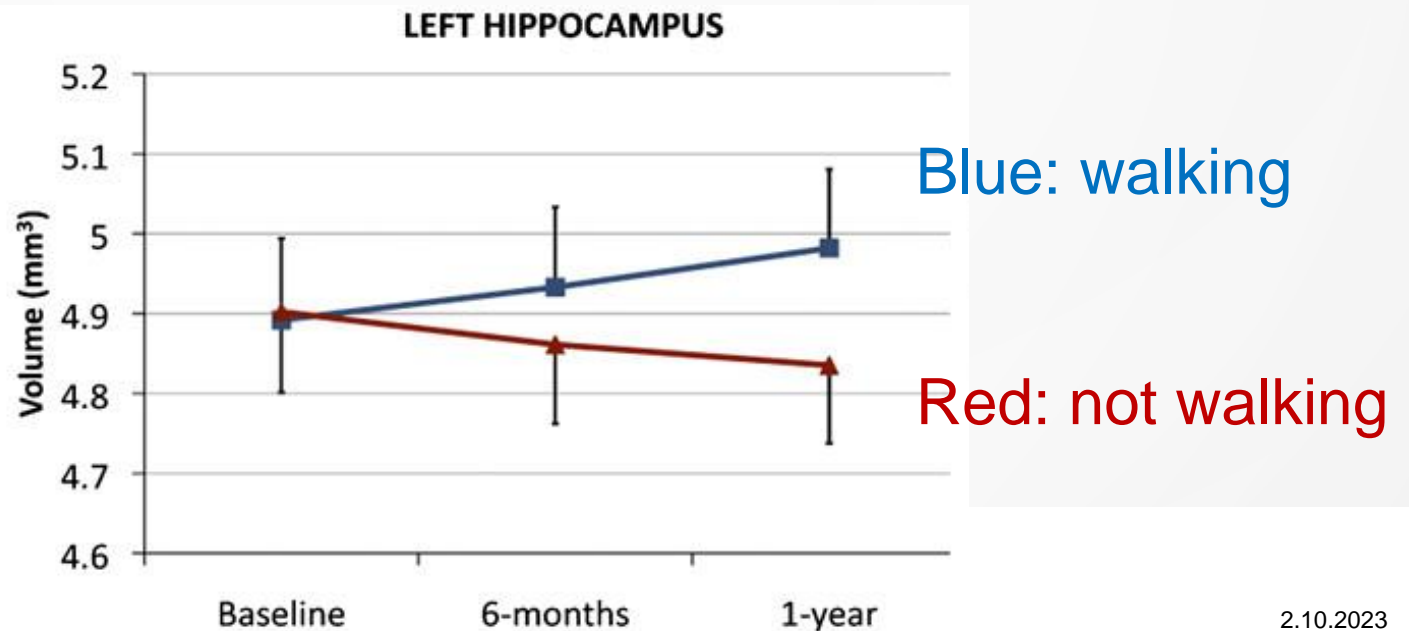
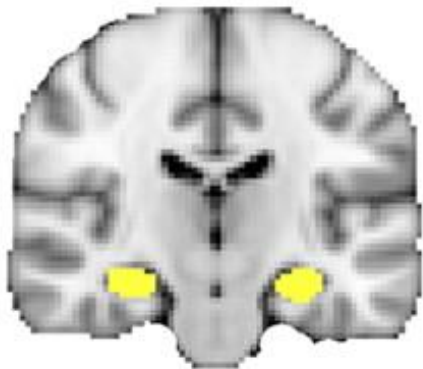
Miriam Nokia
University of
Jyväskylä

Physical activity makes brain memory areas grow and enhances memory functions

Intervention study by
Erickson K I et al. PNAS 2011;108:3017-3022

- 120 sedentary adults
- Blue team: walking 3 x per week 1 year with 60-75% max pulse 40 min
- Red team: continuing sedentary lifestyle: brain ageing with shrinking hippocampus
- growth of hippocampus and also better memory functions in blue group

A Hippocampus

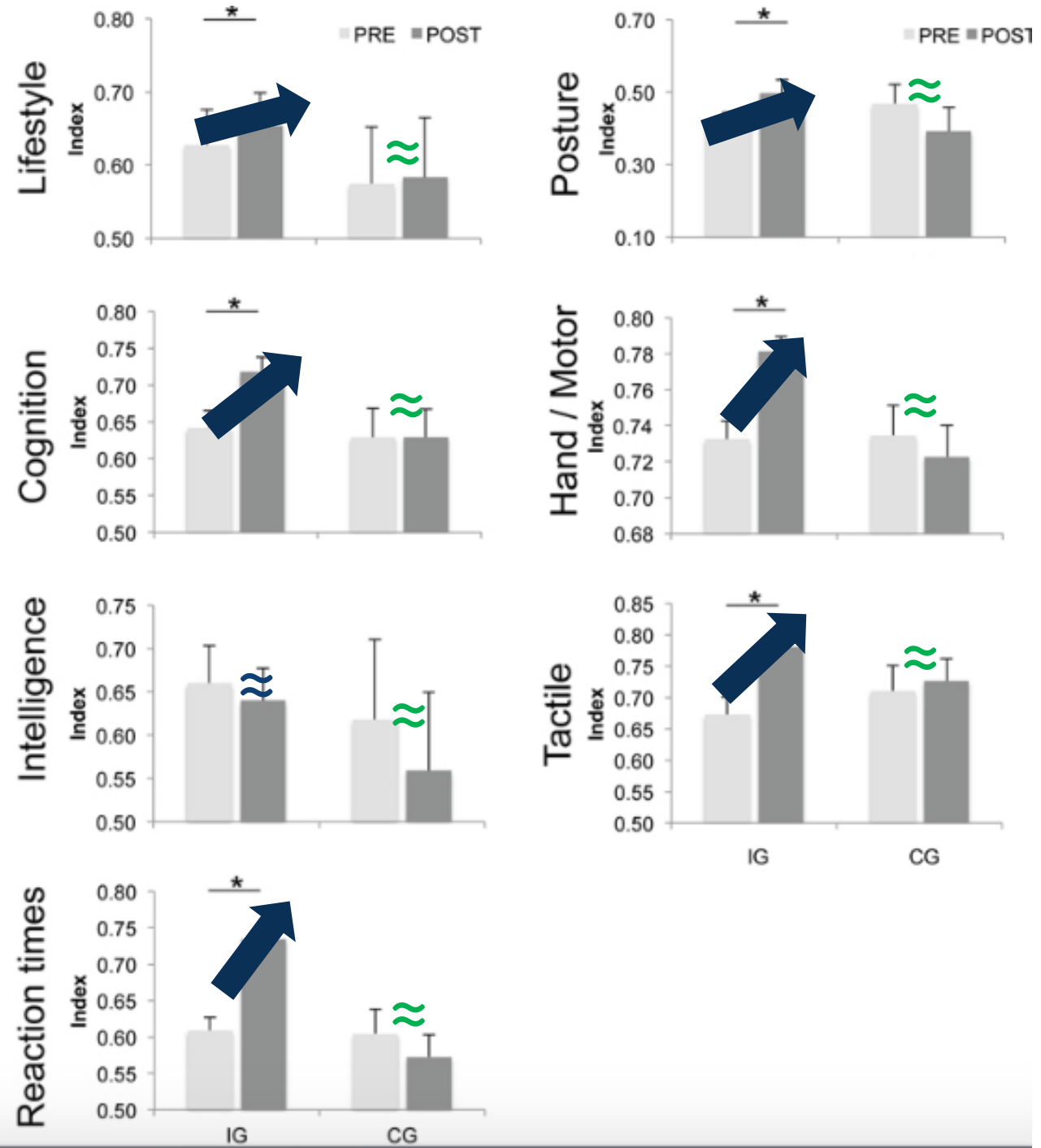


DANCING ENHANCES PHYSICAL AND MENTAL FUNCTIONS



Cognitive tests: memory test
 Physical tests: Posture, Hand motor skills, Hand motor speed, Hand motor accuracy, Hand reaction time
 Questionnaire: lifestyle

Kattenstroht et al., 2013, Aging Neuroscience



STUDIES OF PHYSICAL ACTIVITY INTERVENTIONS IN SCHOOLS

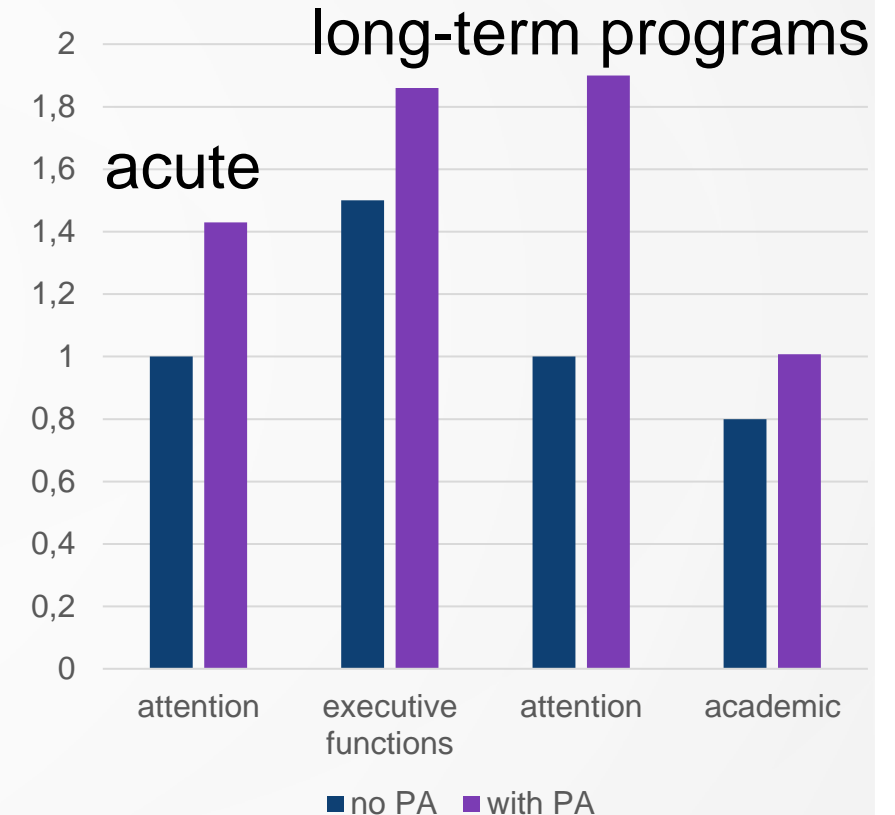
Author	Sample	Milieu	Intervention	Outcome measure	Response	
Fourestier [7]	Children in final year of primary school 13 years	Vanves (Paris)	Various sports and other activities, 13 h/wk increase for one year	Overall academic performance	Enhanced in experimental group	+
Shephard et al. [8]	546 children in grades 1 through 6	Trois Rivières, Québec	5 h of specialist physical education per week for 6 years	Teacher ratings, Standard Provincial examination, WISC tests	Enhanced teacher ratings, Maths but not English improved in Provincial exams, 3–4% gain on WISC	+
Sallis et al. [9]	655 children grades 5 and 6	California	27–42 min additional physical education per week for two years	Metropolitan achievement tests	Non-significant trend to gains in English, arithmetic and behaviour	(+)
Dwyer et al. [11]	500 10-year-old students	South Australia	75 min/day of endurance training	Scores for reading and arithmetic	Non-significant trend to gains in English and arithmetic at 2-year follow up	(+)
Ahamed et al. [13]	287 9–11 year old primary students	British Columbia	Added 47 min/wk of varied activities for 16 months	Canadian Achievement Test (CAT-3)	Slight trend to improved scores	(+)
Coe et al. [14]	214 grade 6 students	Western Michigan, U.S.A.	Nominal 55 min/day (actual 19 min/day) physical education for one semester	Classroom assessments and nationally standardized achievement scores	No change in academic performance except in sub-group who exercised vigorously	+
Raviv et al. [15]	358 kindergarten and grade 1 students	Israel	One-year movement education program	Reading skills and arithmetic skills	Both improved relative to controls	+

Trudeau & Shephard 2008 review



PHYSICAL ACTIVITY PROGRAMS AND COGNITION IN CHILDREN – META-ANALYSIS

- Acute physical activity has a positive effect on
 - attention
 - $g = 0.43$; 95% CI = 0.09, 0.77; 6 studies
- Longitudinal physical activity has a positive effect on
 - executive functions
 - $g = 0.24$; 95% CI = 0.09, 0.39; 12 studies
 - attention
 - $g = 0.90$; 95% CI = 0.56, 1.24; 1 study
 - academic performance
 - $g = 0.26$; 95% CI = 0.02, 0.49; 3 studies



De Greeff, J. W., Bosker, R. J., Oosterlaan, J., Visscher, C., & Hartman, E. 2018. Effects of physical activity on executive functions, attention and academic performance in preadolescent children: a meta-analysis. *Journal of science and medicine in sport*
Kasvatustieteellinen tiedekunta



WHY SLEEP IS SO IMPORTANT

The brain does not “rest” during the night but works heavily

Memory consolidation: move learnt information to long term memory

Processing emotional information

Sleep is a key factor in learning and in neural resilience



EFFECTS OF E-LEARNING TO BEHAVIOUR



Photo: PennDutch



Photo: Guardian



CHANGING ENVIRONMENTS OF LEARNING

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SUMMARY

- Our cognitive capacity is situational and highly dependent on the environment
 - To be mentally active is easier with physical activity
- Teachers are responsible for creating healthy, physically active ways of teaching and learning for children and adolescents