Physical activity and brain health in children

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What am I worried about?

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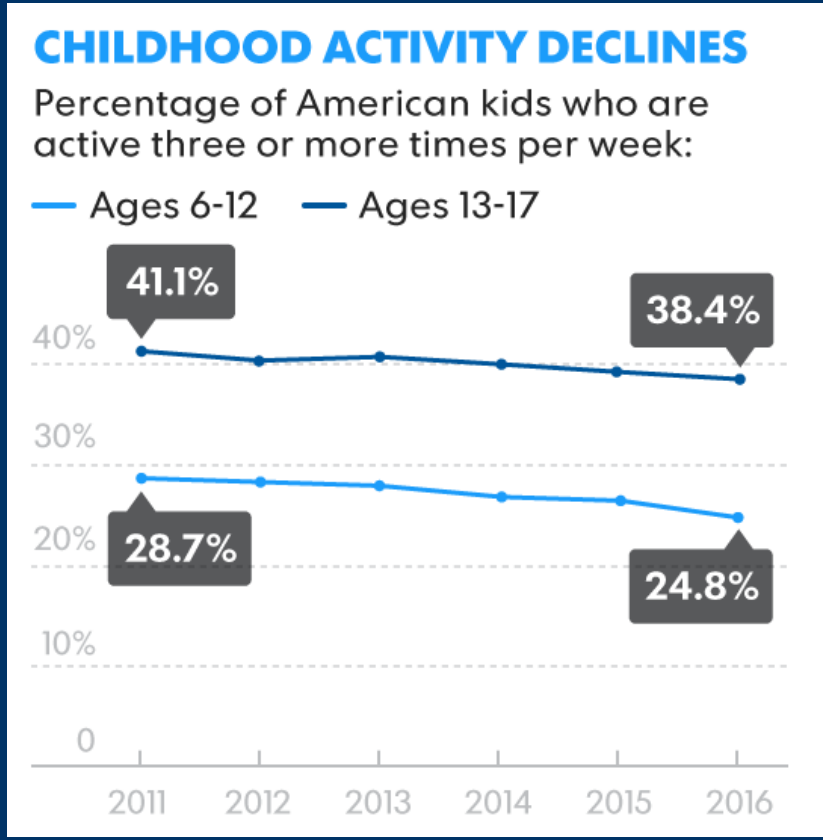
Physical inactivity in youth

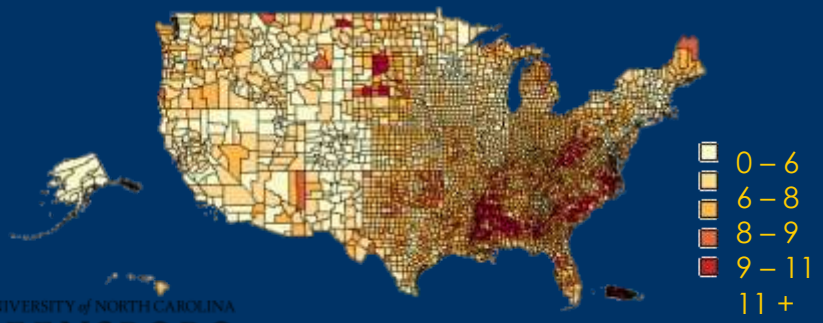
- In 2016 only 21.6% of 6 to 19-year-old children and adolescents in the United States attained 60 or more minutes of moderate-to-vigorous physical activity on at least 5 days per week.



Inactivity health consequences

- Increase the risk of factors that cause:
  - Cardiovascular disease
  - High blood pressure
  - Breast, colon, and lung cancer
  - Low bone density
  - Obesity
  - Type 2 diabetes

Diagnosed Diabetes Percentage from 2004-2010*



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https://www.cdc.gov/healthyschools/physicalactivity/facts.htm

Leading causes of death (non-communicable)

Rank	Cause of Death	Percent of Deaths
1	High Blood Pressure	12.8%
2	Tobacco Use	8.7%
3	High Blood Glucose	5.8%
4	**Physical Inactivity**	**5.5%**
5	Overweight & Obesity	4.8%
6	High Cholesterol	4.5%
7	Unsafe Sex	4.0%
8	Alcohol Use	3.8%
9	Childhood Underweight	3.8%
10	Indoor Smoke Solid Fuels	3.3%
	Source: WHO World Health Organization	

What is changing?

Youth play has shifted.

Academic priority has changed.

Academics

Physical Activity

Kellert et al., 2017

Are we missing something?


Academics
Physical Activity
SCHOOL
Cognitive Health

Cognition

- Set of mental processes that are utilized in a systematic order to accomplish an intended goal or outcome.
  - Memory
  - Perception
  - Attention
  - Knowledge
  - Judgement
  - Problem solving
  - Reasoning
  - Learning
  - Creativity
  - Language

Cognitive Control

Goal-directed mental operations that guide selection, scheduling, maintaining, and coordinating processes that underlie action.

Inhibition

Working Memory

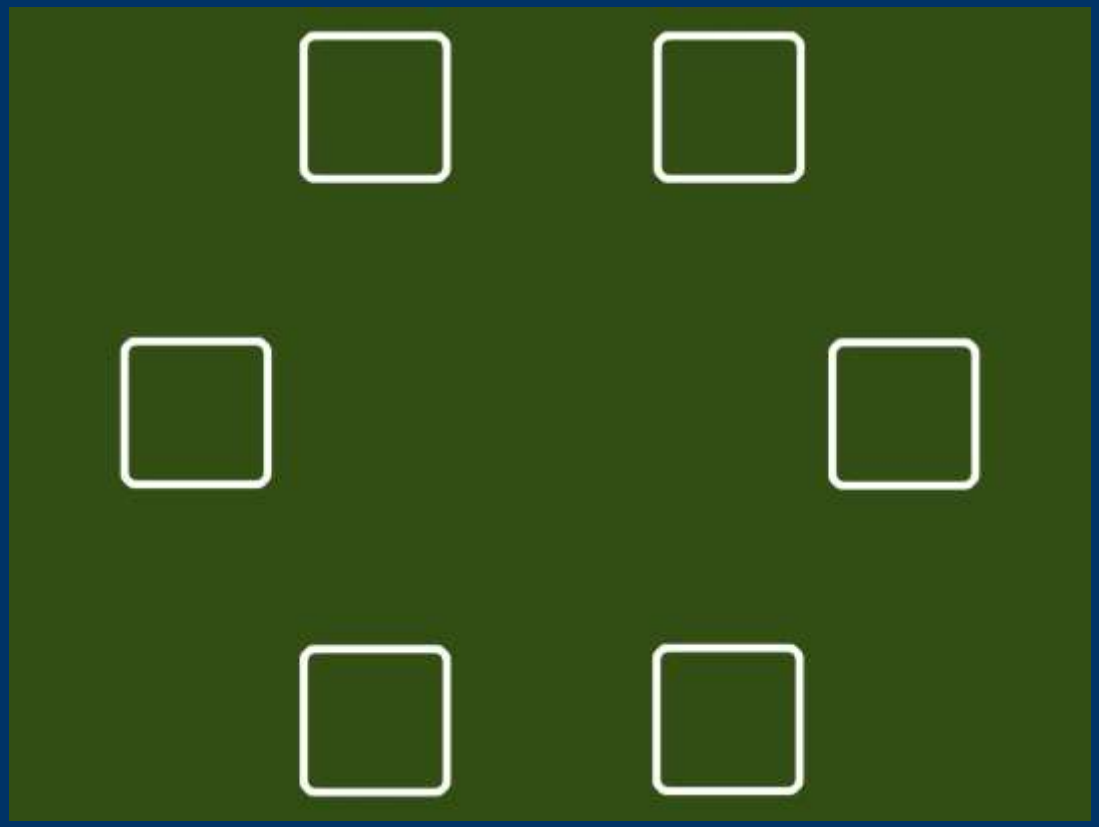
Cognitive Flexibility

Age

Botvinick, Braver, Barch, Carter, & Cohen, 2001, Botvinick, Cohen, & Carter, 2004.

Inhibition

Working Memory



Healthy development of cognitive control

Physical Exercise

Social Engagement

Diet & Nutrition

Cognitively
Engaging Activities

Medical Health

Sleep & Relaxation

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Cleveland Clinic (2019)

Exercise and cognitive control

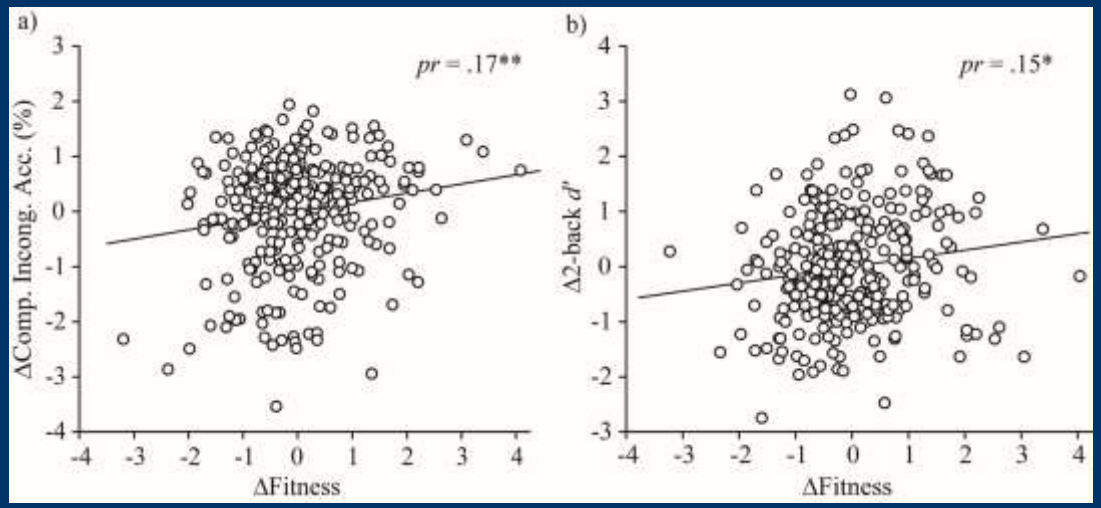
- Investigate change in fitness and change in cognition from 2nd to 4th grade.
- 290 children from six separate elementary schools.
- Tracked PACER (progressive aerobic cardiovascular endurance run) performance across three years.

Scudder, Drollette, et al. (2016). *Health Psychology.*

Exercise and cognitive control

Flanker Accuracy

n-back Accuracy



Scudder, Drollette, et al. (2016). *Health Psychology.*

Exercise and cognitive control

- Increasing fitness over a 3-year period in Elementary age children is associated with improved cognition.

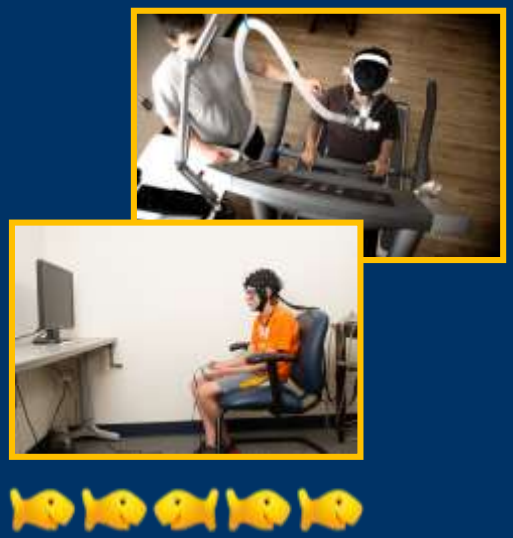
- Significant implications for physical activity as a means to support necessary brain function for academic success.

Scudder, Drollette, et al. (2016). *Health Psychology.*

Is there a connection with healthy brain development?

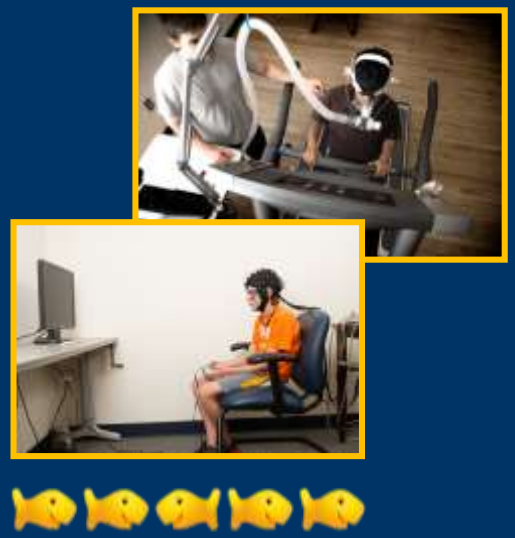
The FITKids Randomized Controlled Trial

308 children 8-9 years old



9-month PA afterschool intervention

Wait-list control



Drollette et al. (2018) *Psychophysiology*.

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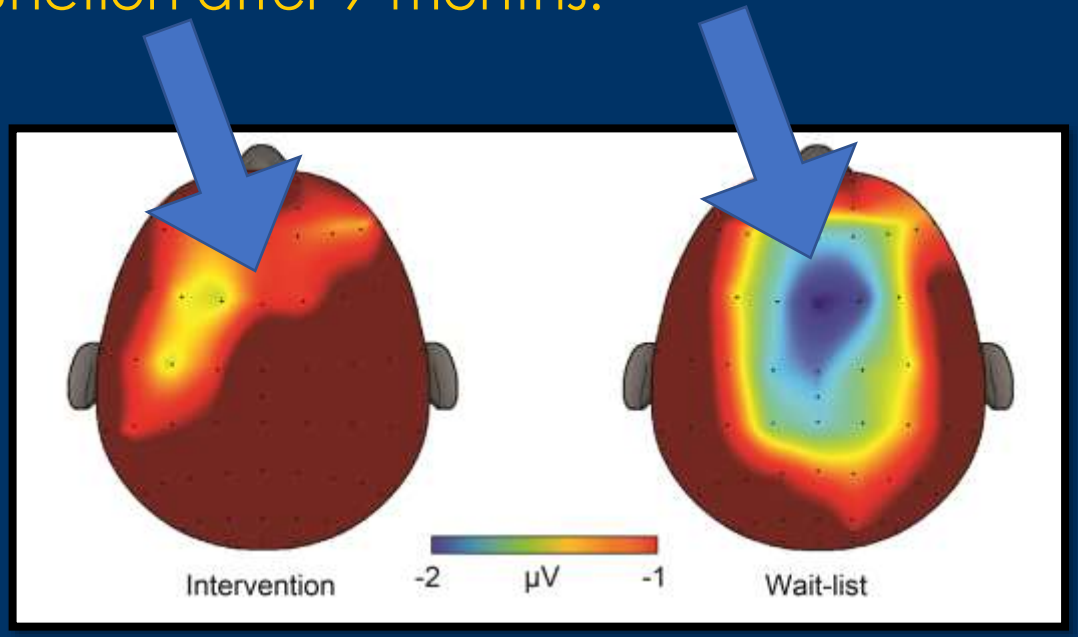
- Error Related Negativity (or ERN) represents brain function associated with making an error.
- Research suggests that normal development should demonstrate no change in ERN brain activity over a 9-month period.
- However, the children who were not in the physical activity intervention demonstrated significant change in brain function after 9-months.



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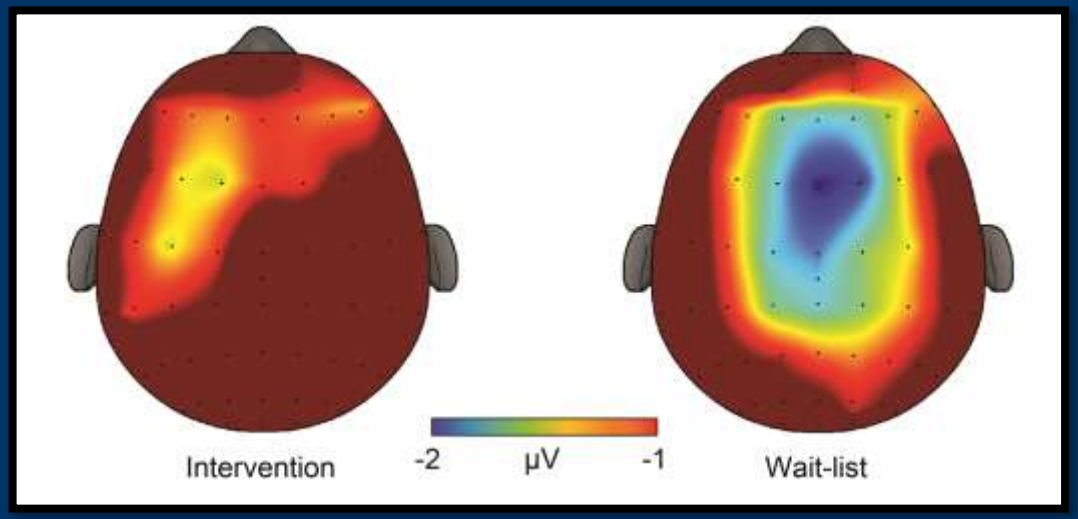
Drollette et al. (2018) *Psychophysiology*.

- Inactivity may be a marker of atypical cognitive development.

- Prior-research demonstrates increased ERN in youth with symptoms of obsessive compulsive disorder, negative affect, and anxiety.



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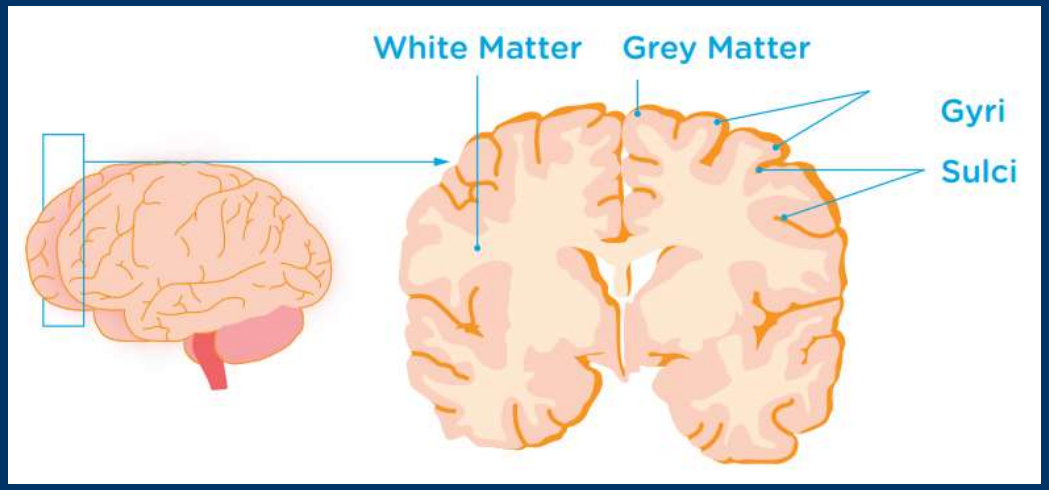
Drollette et al. (2018) *Psychophysiology*.

- Subsample of 143 children from FITKids performed MRI scans at pre- and post-test.
- Evaluated brain microstructure of white matter tracts.
- White matter is important for transmitting information between brain regions. White matter during development increases with cognitive development.



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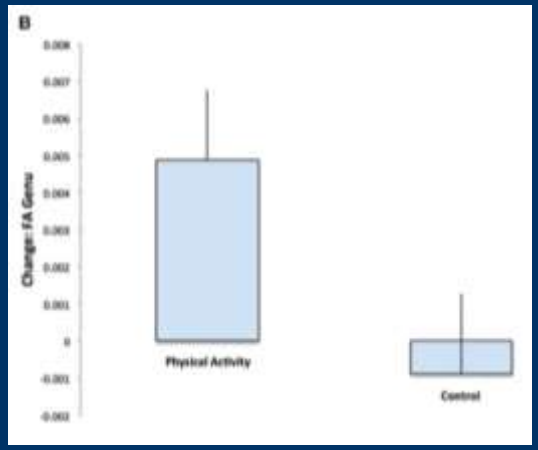
Chaddock et al. (2018) *Frontiers in Neuroscience*.

- Children who participated in the 9-month physical activity intervention revealed increased white matter microstructure in the corpus callosum (typical development).

- However, no change in white matter microstructure was observed in children in the control group (atypical development).



Chaddock et al. (2018) *Frontiers in Neuroscience*.

- Corpus callosum integrates cognitive information between left and right hemispheres.

- Abnormal development of the corpus callosum has been observed in children with attention-deficit hyperactivity disorder, autism, and schizophrenia (Swayze et al., 1990; Barnea-Goraly et al., 2004).

Chaddock et al. (2018) *Frontiers in Neuroscience*.

Where can we start?

(End where I started)

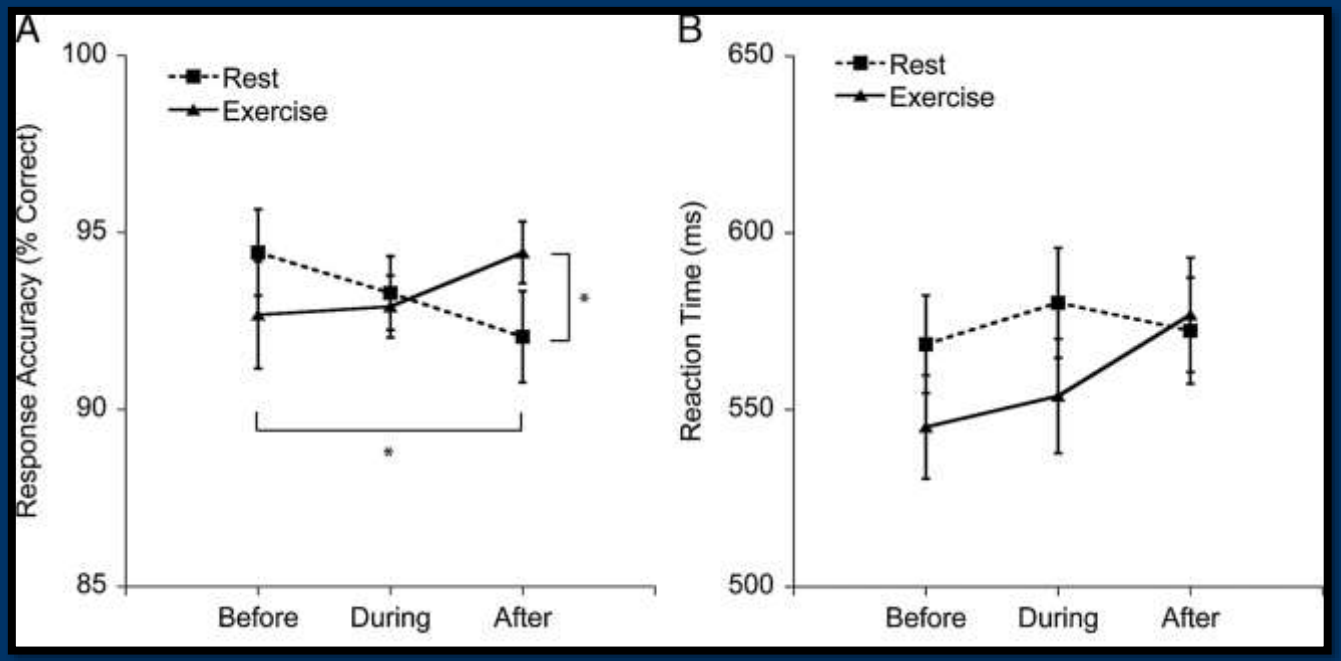
Acute Physical Activity in Children

Drollette et al. (2012) *Medicine & Science in Sports & Exercise, 44*, 2017-2024.

Acute Physical Activity in Children

Flanker Accuracy

Flanker Reaction Time

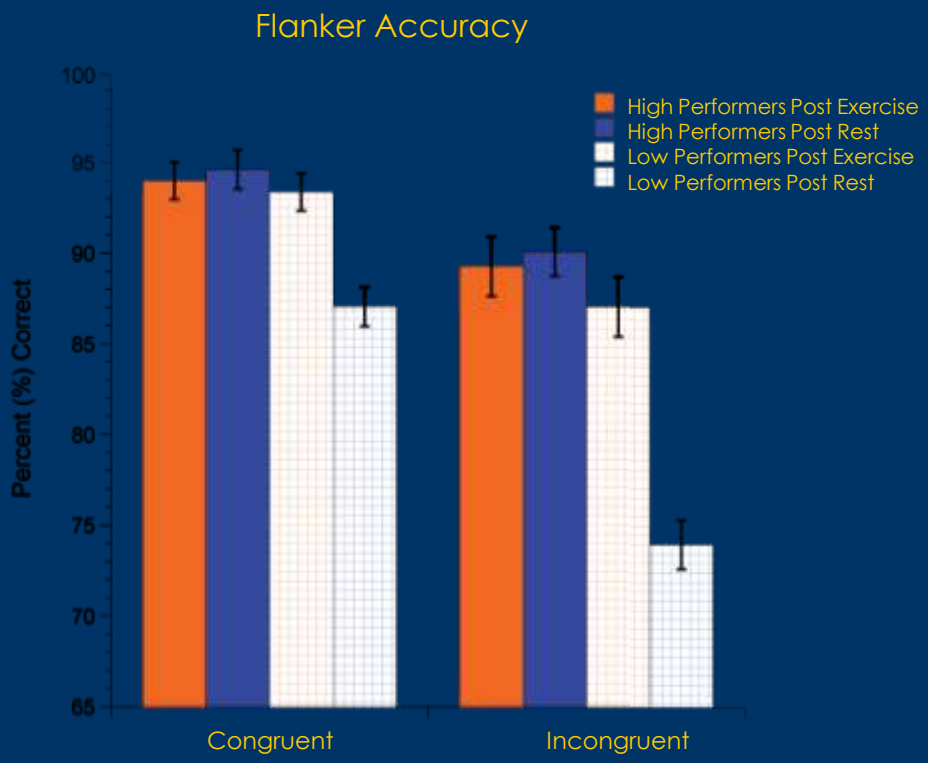


Drollette et al. (2012) *Medicine & Science in Sports & Exercise, 44*, 2017-2024.

Acute Physical Activity in Children

Drollette et al. (2014) *Developmental Cognitive Neuroscience, 7*, 53-64.

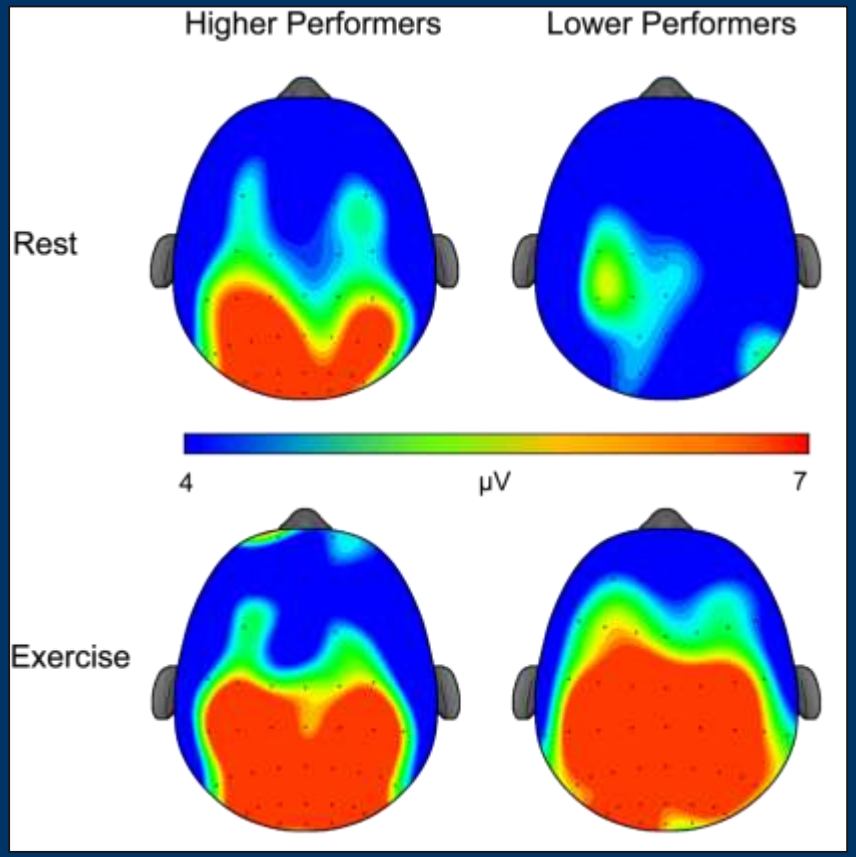
Acute Physical Activity in Children



Drollette et al. (2014) *Developmental Cognitive Neuroscience, 7*, 53-64.

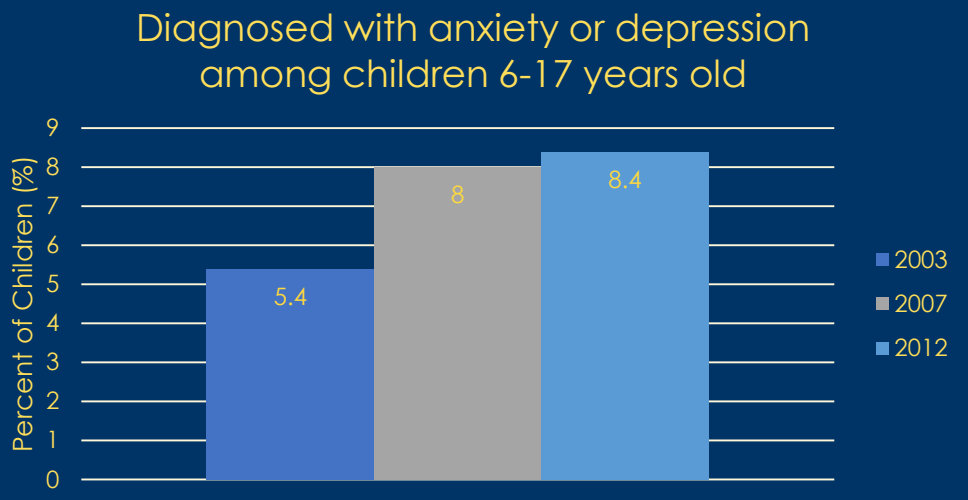
Acute Physical Activity in Children

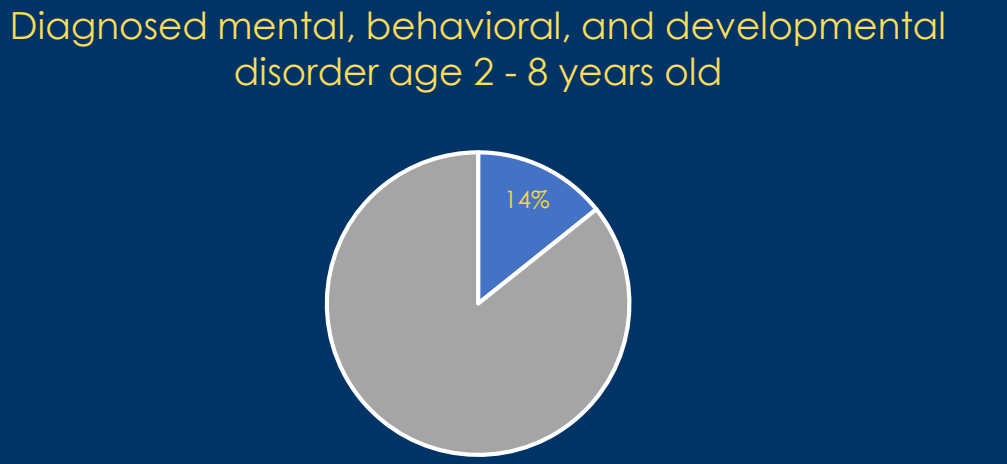
- Brain function associated with attention.
- Increased activation suggests greater allocation of attentional resources.
- Results suggest that a single bout of exercise improves brain and cognitive function in children who need it most.



Drollette et al. (2014) *Developmental Cognitive Neuroscience, 7*, 53-64.

Conclusion





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Conclusion

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Thank you!

Questions?

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