BRAINFUTURES

Executive Functions:

Supporting the Hidden Skills that Shape Learning and Behavior

Professional Development Workshop for Baltimore County Public Schools
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Professor Wexler is the founder, Chief Scientist and an equity holder in C8Sciences, the Yale Startup created to bring research from his lab, including the ACTIVATE™ program, into the world.

BrainFutures is a nonprofit entity with no equity stake in any of the interventions highlighted in this presentation.

What are Executive Functions?

A Group of Thinking or Cognitive Abilities Essential for Managing Information and Managing Oneself

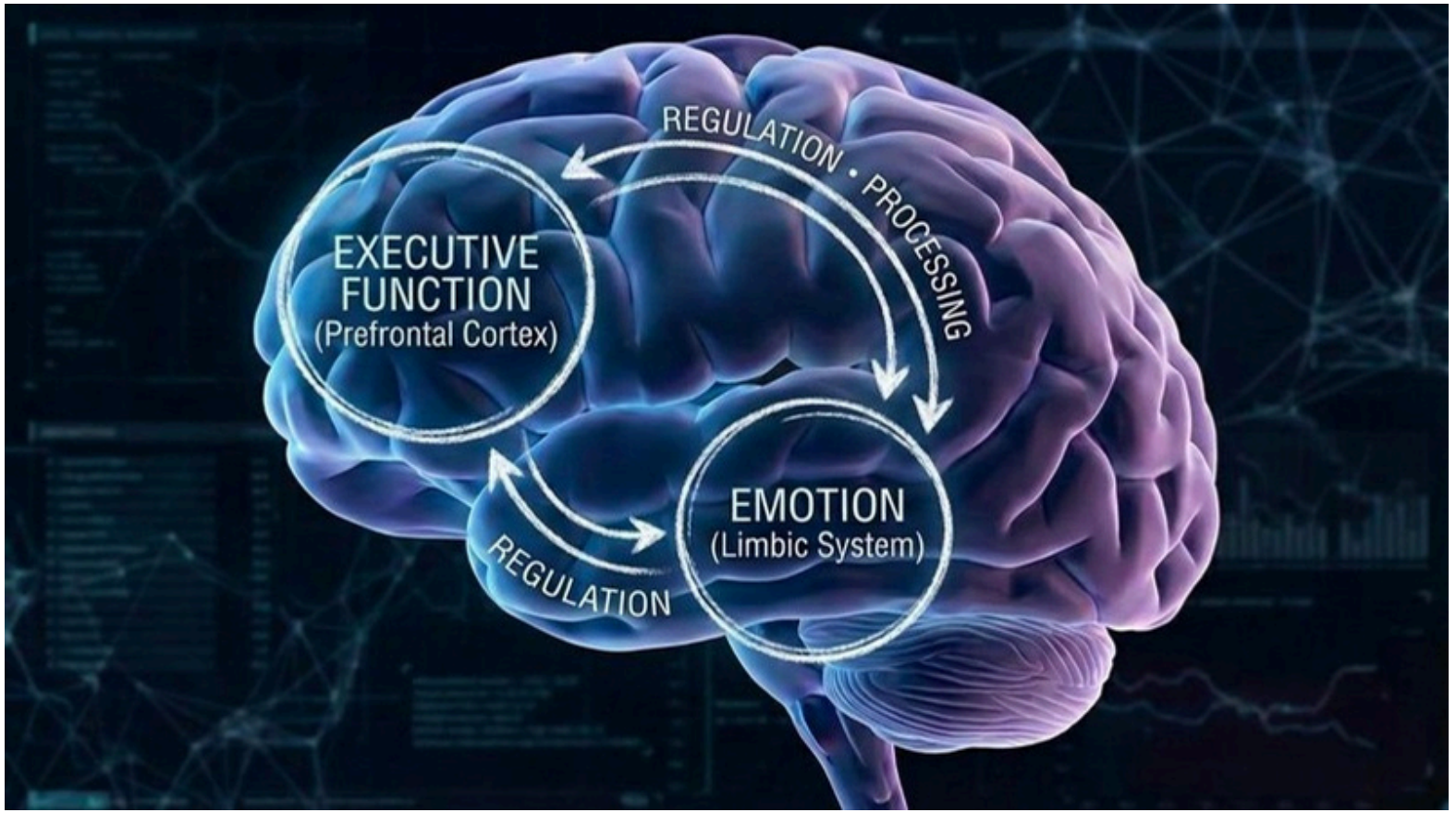
Self-Control

Focus

Memory

Flexibility

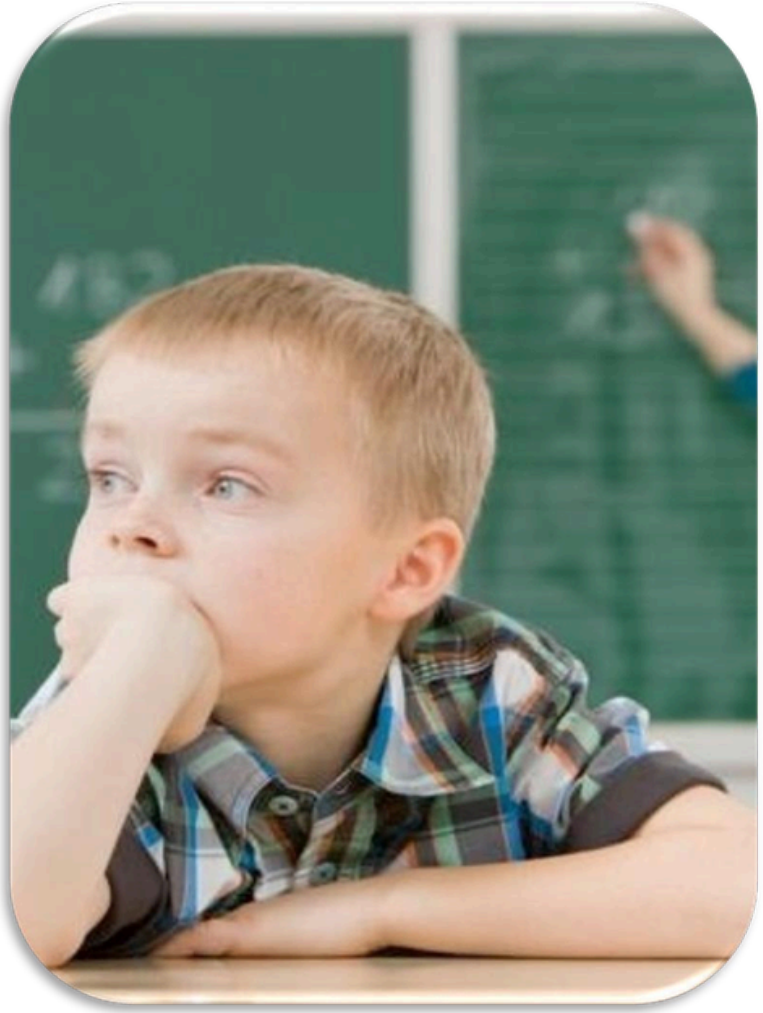
Executive Function in the Brain



Critical relationship between executive functions and emotional regulation

Essential for Learning

- EF may be a better predictor than IQ of school readiness and academic achievement. [1,2]
- Teachers report that the most important determinant of classroom success in kindergarten and early grades is the extent to which children can sit still, pay attention, and follow rules.[3]
- Working memory development is associated with academic achievement, including mathematic skills and reading skills.[4,5]
- Low working memory capacity puts children at risk for poor academic progress.[6,7]
- Children with poor attention skills are 8x more likely not to graduate from high school.[8]



1. Blair et al., 2007;2. Eigsti et al., 2006; 3. McClelland et al., 2007; 4. Bull et al., 2001; 5. Nevo et al., 2011; 6. Alloway et al., 2006; 7. Alloway et al., 2009; 8.Pingault et al., 2011

Essential for Mental Health

- EF compromised in depression, ADHD, substance misuse, bipolar disorder, schizophrenia, ASD
- Low EF compromises:
  - participation in treatment
  - school performance
  - social connectedness
  - connectedness to school and the structure of the school day
- Early EF strengthening may create EF “reserve” to limit severity of mental health problems and illnesses

Individual, Family, and Environmental Factors can Hinder Development

- Limited cognitive stimulation[1,2]
- Family stress[3,4,5]
- Environmental stress[6,7]
- Poor nutrition
- Toxic exposures (lead, tobacco, alcohol)[8-12]

- Learning Disabilities
- ADHD
- Autism Spectrum
- Sensory Processing Disorders

1.Clark et al., 2013; 2. Conger & Donnellan, 2007; 3. Ainsworth et al., 1978; 4. Deater-Deckard & Panneton, 2017; 5. Blair et al., 2011; 6. McLoyd, 1990; 7. Sharkey, 2010; 8. Sharkey et al., 2012; 9. Chiodo et al., 2004; 10. Chiodo et al., 2007; 11. Froehlich et al., 2009; 12. Nigg et al., 2010)

Poverty and Family Stress Impact EF

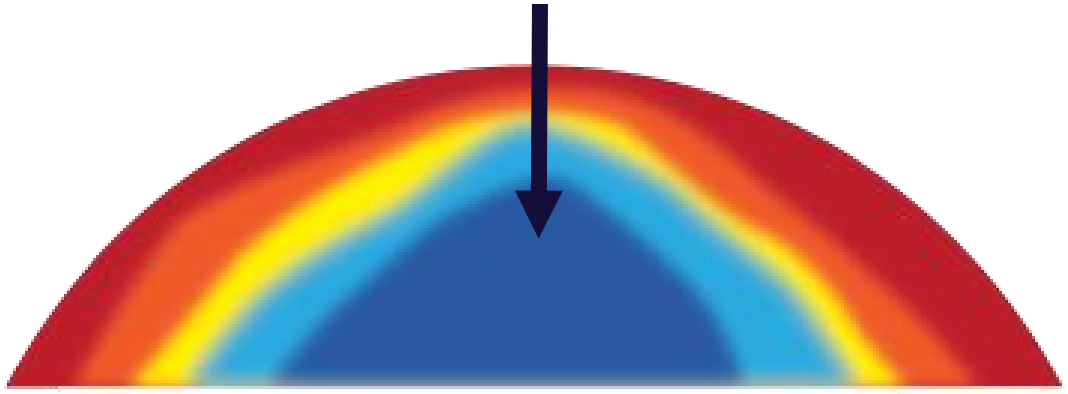
- Experiencing poverty is associated with lower attention, self-control, and working memory.[1,2]
- Decreased parental sensitivity to a child's EF cues.[3]
- Decreased scaffolding of child's problem solving.[4]
- Fewer learning resources, books, and cognitively stimulating experiences.[5-8]

1.Welshet al., 2010; 2. Noble et al., 2007; 3. Ainsworth et al., 1978; 4. Hammond et al., 2012; 5. Clark et al., 2013; 6. McLoyd, 1998; 7. Conger & Donnellan, 2007; 8. Hackman et al., 2015

Poverty is Associated with Lower Infant Brain Activity in Key Learning Regions

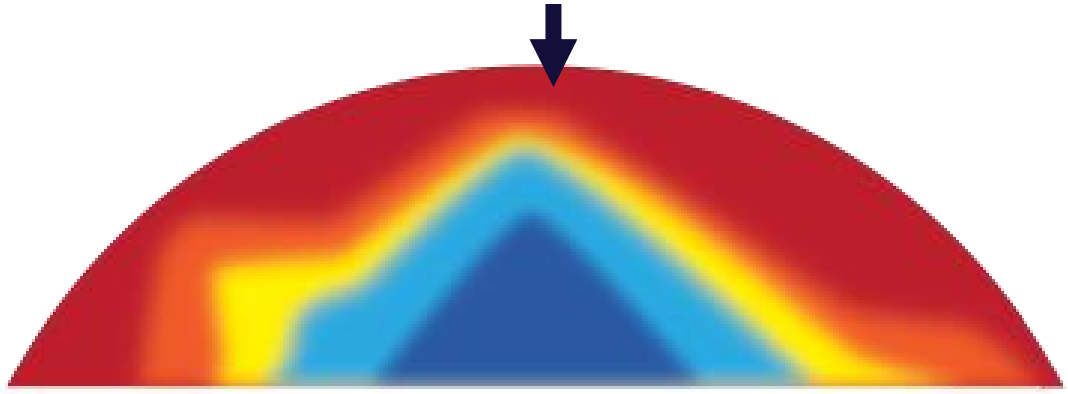
Low Income

Larger area of low gamma power (blue)



High Income

Larger area of high gamma power (red)



Frontal Gamma activity is related to attention and language at 16-18 months, and predicts language at 4-5 years

Tomalski.,et al2013

Trauma/Adverse Childhood Experiences

- Traumatic exposure is associated with decreased working memory, self-control, and focus.[1,2]
- Exposure to marital discord and intimate partner violence associates with slower EF development.[3]
- After a homicide in the neighborhood, children slept 30 minutes less and had higher cortisol levels in the morning.[4,5]

1.DePrince et al., 2009; 2. El-Hage et al., 2006; 3. McLoyd, 1990; 4. Sharkey, 2010; 5. Sharkey et al., 2012

Physical Activity

- Strengthens EF by increasing blood flow, enhanced neurotransmission, and contributing to both structural and functional adaptations in the brain.[1]
- Impact varies by intensity, duration, intervention type, and cognitive demand.
- Cognitively engaging physical associated with stronger EF when compared to traditional PE.[2]

1.Guzmán-Muñoz et al., 2025; 2. Xu et al., 2025)

Good News: Evidence-Based Programs can Harness the Brain's Neuroplasticity to Promote EF Development

New neuroscience-informed programs can enhance the natural growth of neurocognitive systems that support EF, learning, and mental health.
"School lunch" programs for the brain

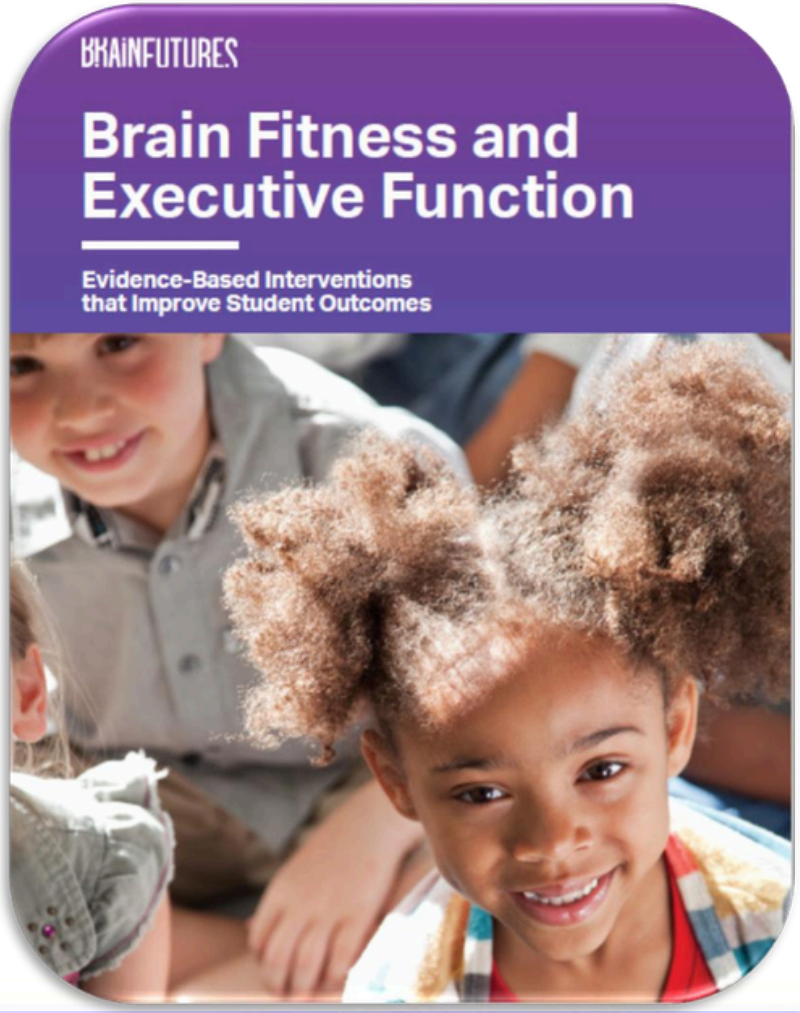
BrainFutures Report: Evidence-Based Programs to Improve Executive Function

BrainFutures 2019 Report identifies scientifically proven programs that increase executive function, primarily in the school setting.

Evaluated more than 40 programs:

- Mindfulness and meditation programs
- Classroom-based curriculum and teacher training
- Digital training platforms

10 programs met the evidence-based standard



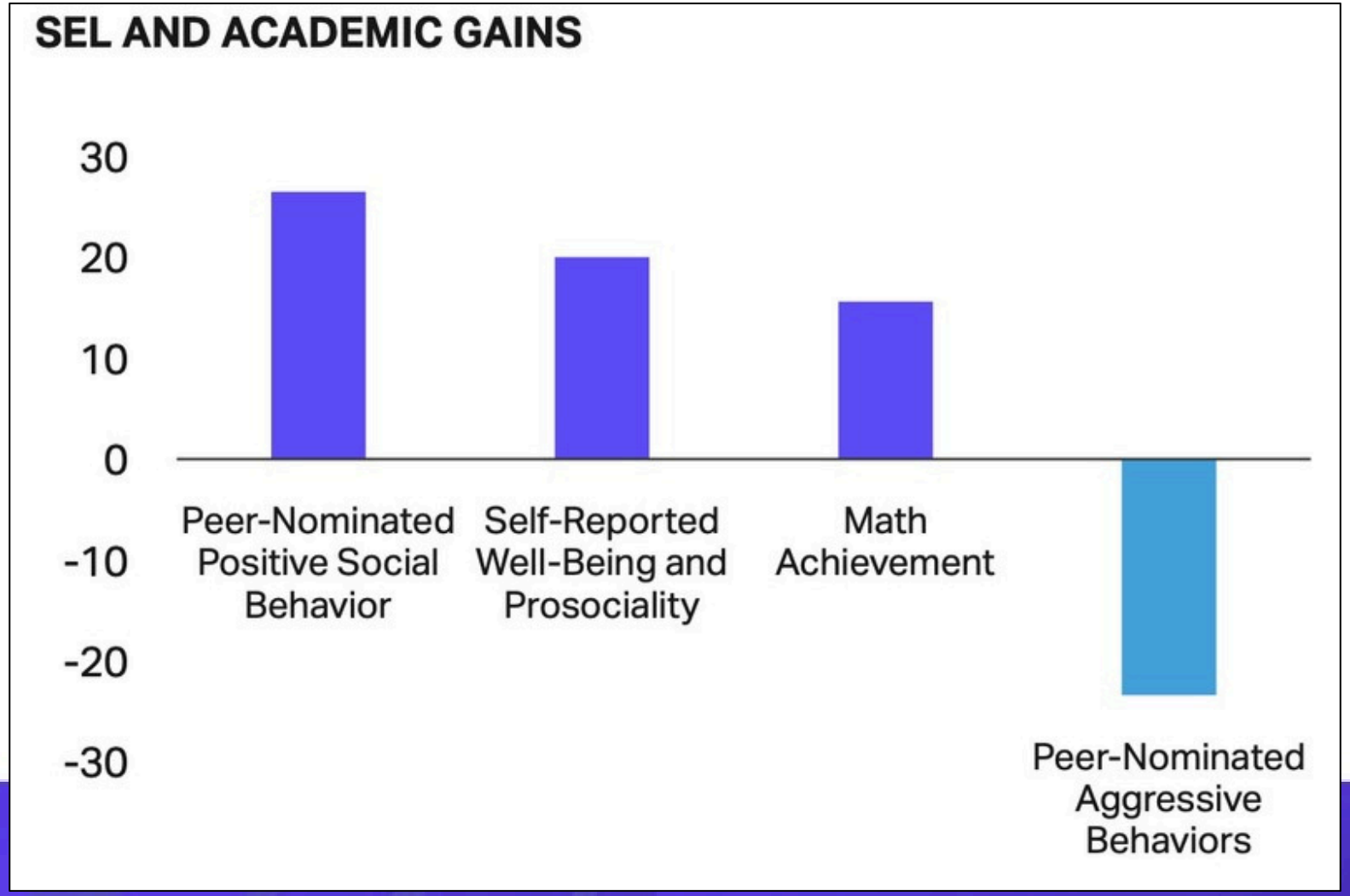
Resource Link: https://www.brainfutures.org/brainfitnessinschools/

Evidence-Based EF Program Outcomes on Academics and SEL/Behavior

- Increases in % of students meeting proficiency on state-mandated tests for math and reading
- Reductions in disruptive classroom behavior
- Increases in prosocial behavior toward self and others
- Statistically significant improvements on:
  - NIH-recommended executive function tests
  - School-administered tests of core subjects

Example: Mindfulness (MindUp)

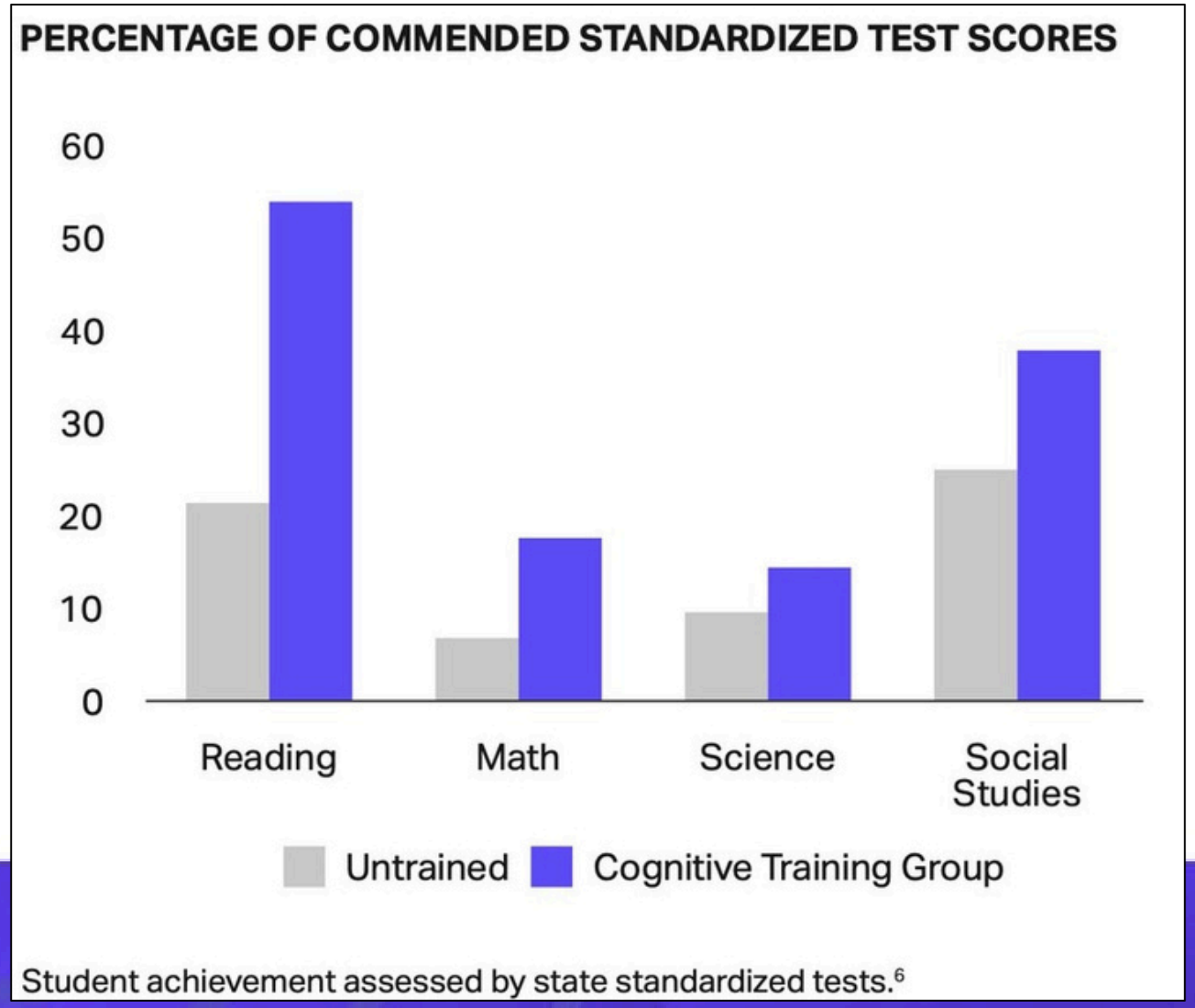
Population: 4th and 5th grade students at a suburban elementary school



- 15% increase in end of year math grades.
- 24% gain in peer-reported prosocial behaviors
- 20% increase in self-reported well-being
- 24% decrease in peer-reported aggressive behaviors

Example: Teacher Training/Curricular Strategy (SMART)

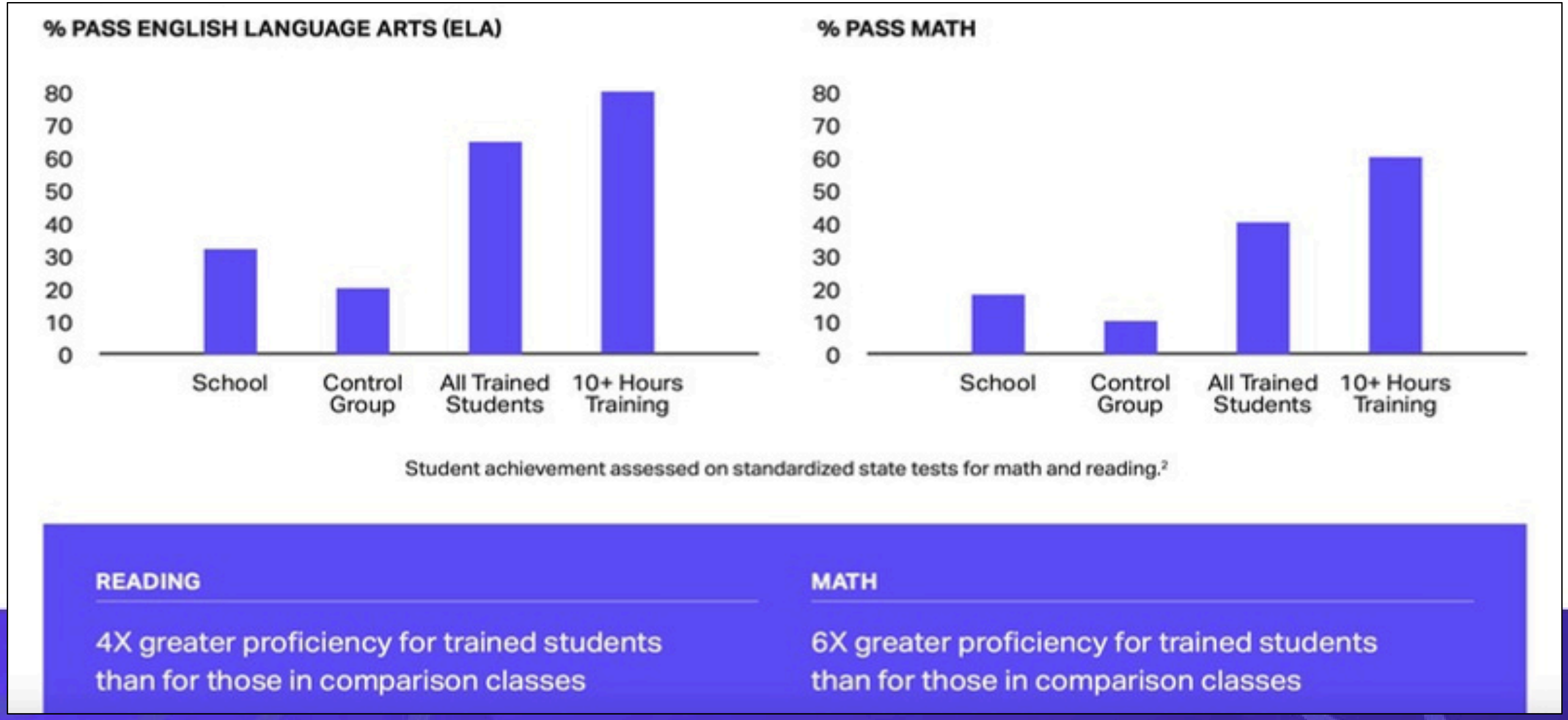
Population: 8th grade students at a low-income urban middle school



- 2.5x as many students achieved mastery in reading
- 2.7x as many students achieved mastery in math
- 1.5x as many students achieved mastery in science
- 1.6x as many students achieved mastery in social studies

Example: ACTIVATE™

Population: Students at a low income urban elementary school



- Computer-presented games to train cognitive skills.
- Classroom-based physical exercises to train the same cognitive skills through whole-body movement and social interaction.
- Gold standard cognitive assessments of focus, self-control, working memory, and risk-taking.
- Real-time data portal for administrators to monitor program usage and student progress in every school and class

Baltimore County Initiative: 2025-26 School Year

Project Goals

Serve at least 1,200 students

Primarily grades 1-5.

Serve up to 10 schools

AllareTitle 1 and Community Schools

Ensure all students reach 600 minutes

The “effective dose”for meaningful impact.

In Classroom and Hybrid Models

Vision: An EF School

- Evidence-based EF interventions pK-12
- Teaching practices to support EF- planning, organizing, self-reflection
- EF skill-building elements incorporated throughout the day (e.g. transitions, PE)
- Robust art, music, dance, theater programs
- Strong SEL to build emotional regulation skills
- Recess and dedicated break time
- Policies- screen and device limits, no restricting recess

What else?