The Cognitive Impact of Poverty Implications for Teaching

May 2019

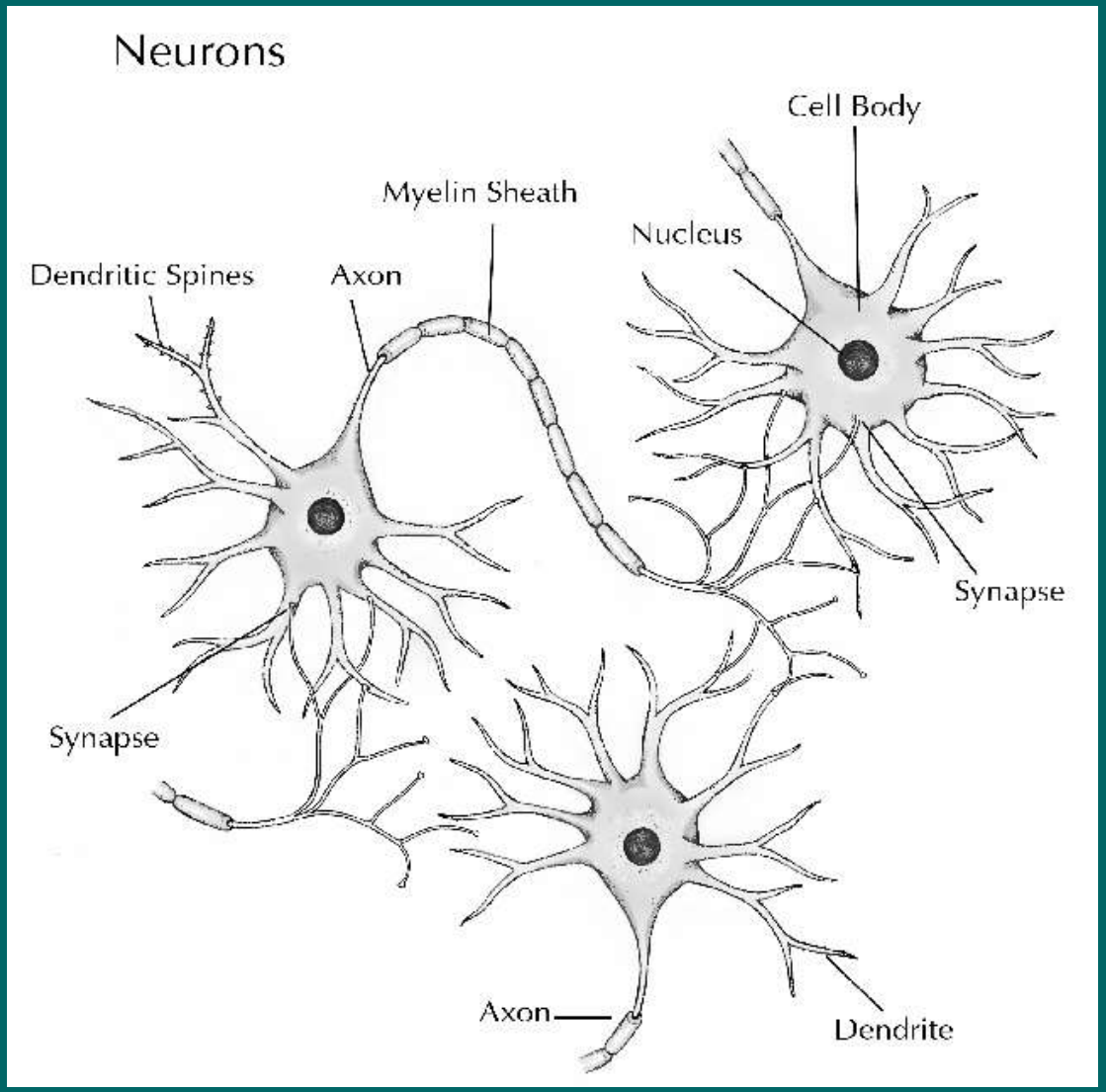
Betsy Hill

Today

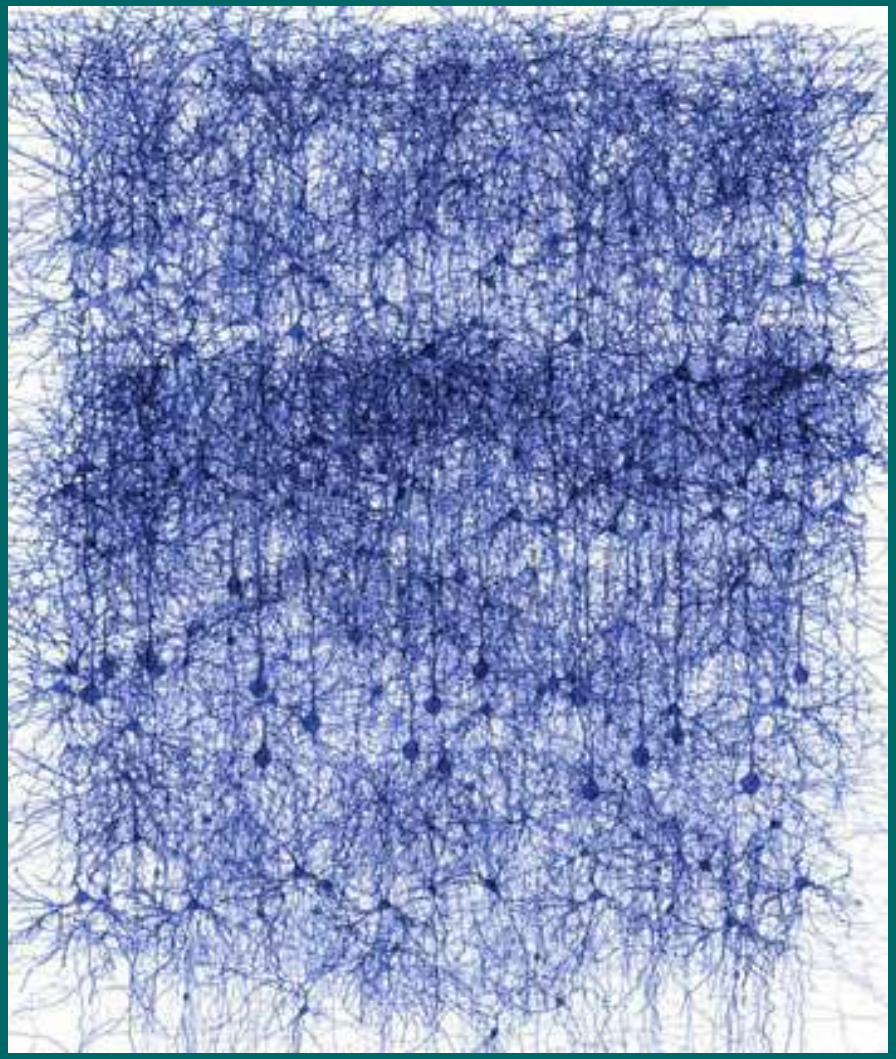
- Research
  - Environmental enrichment/impoverishment
  - Brain imaging
  - Cognitive measures
- Implications for Teaching
  - Understanding mediating factors
  - Teaching in a way that lessens cognitive load (short term)
  - Intervention to help students catch up cognitively (for the long term)
  - Deficits in prior knowledge and experience
  - The role of emotions

Two factors determine how brains develop:

- Genes
- Environment



85 billion neurons communicate with one another at junctures called synapses.

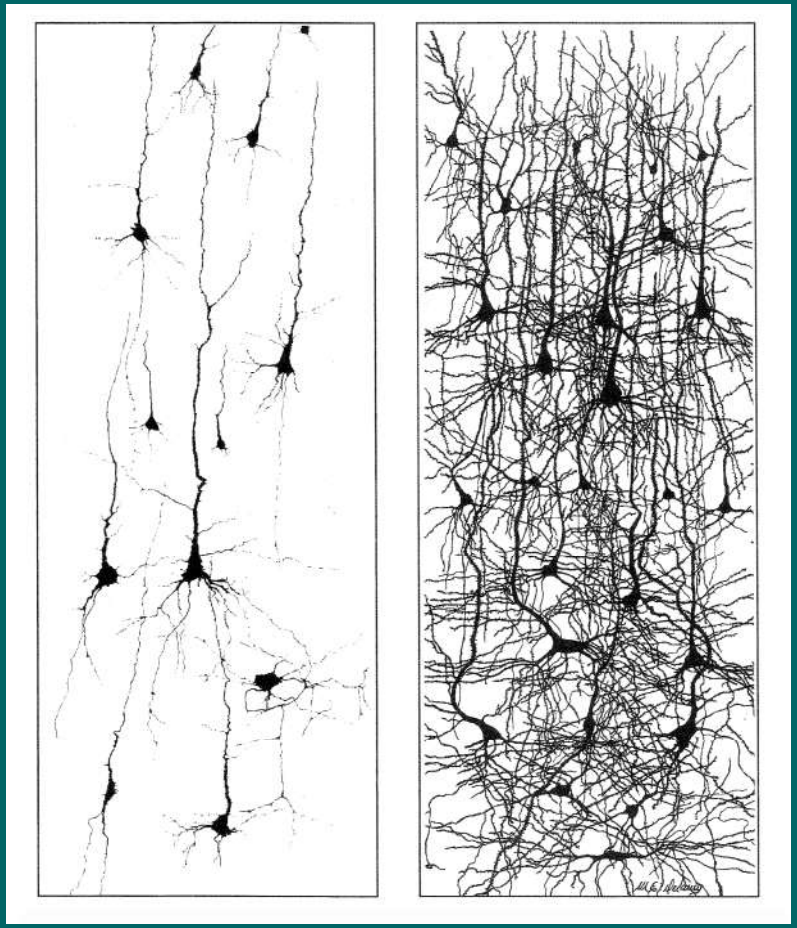


What neurons actually look like in your brain.

How the Brain Grows

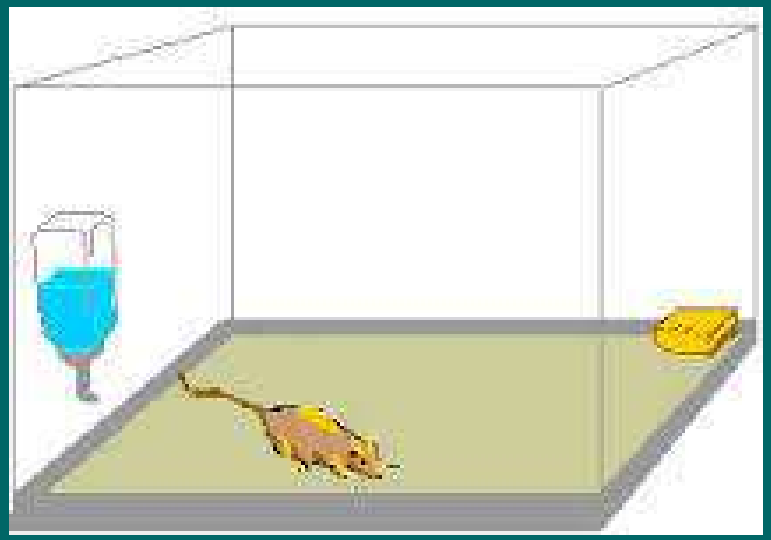
- During the 9 months of fetal development, neurons grow at the rate of 250,000 per minute.
- At birth the brain has approximately 85 billion neurons and weighs about 1 pound. By one year it has doubled and by age 5 or 6 it is 90% of its adult size and weight.
- What causes this tremendous growth in such a short time?

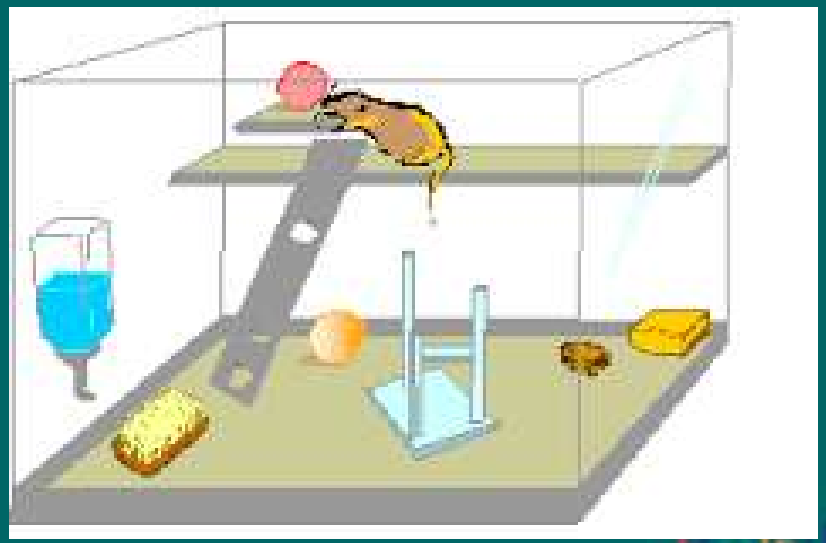
Answer: Growth of Connections (Synaptogenesis)



Cerebral cortex neurons in a newborn and a two-year-old.

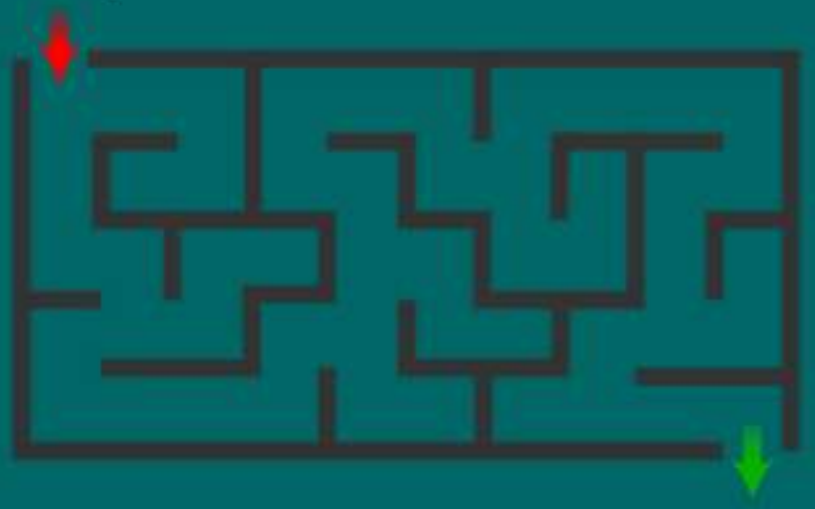
Diamond's Research





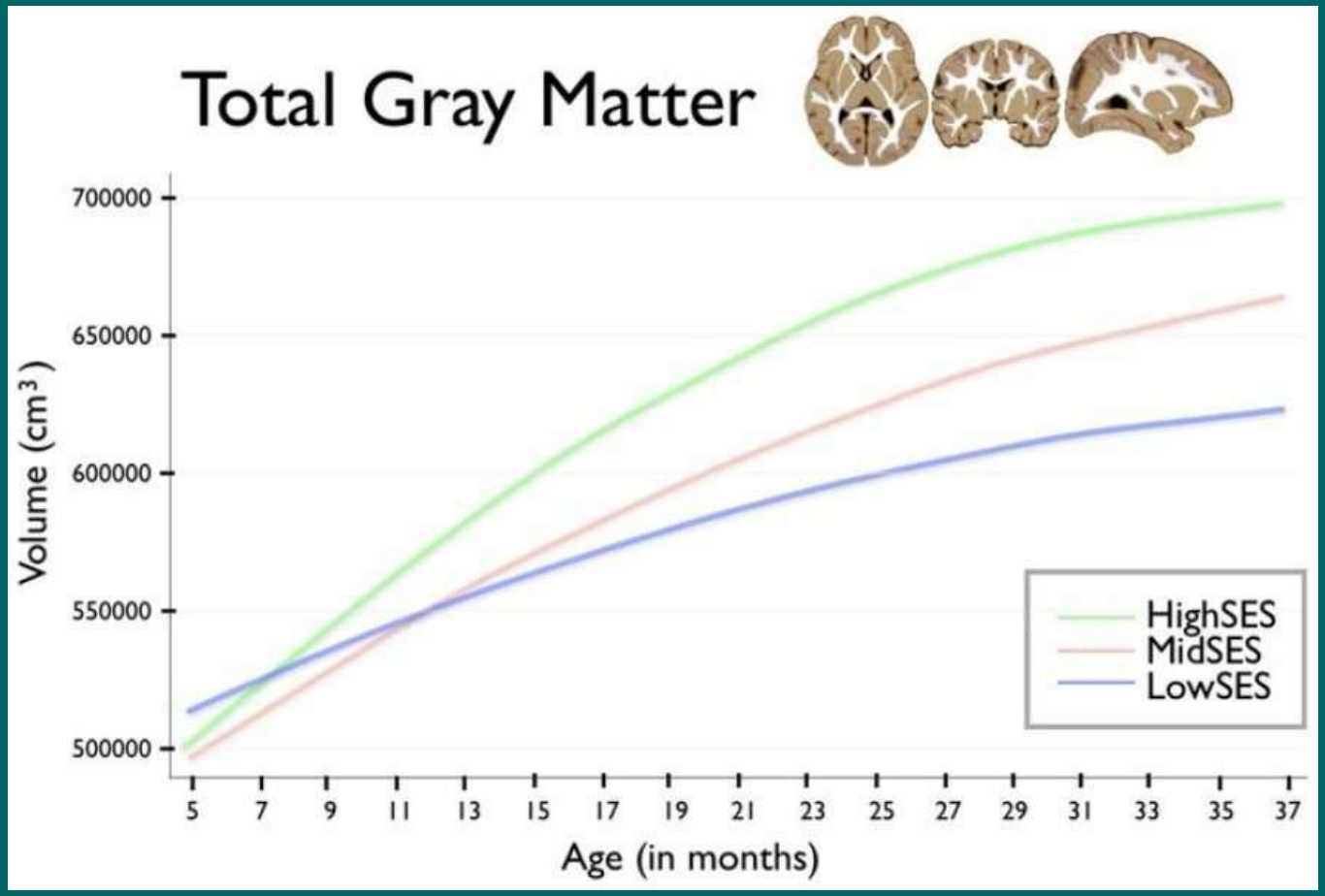
Environment Changes the Brain

Enr**ic**hed environment – increased cell weight, increased branching of dendrites, up to 20%.



Impoverished environment – decrease in cell weight, possible loss of cells, dendrites diminished.

Hanson's Research



Jamie L. Hanson, Nicole Hair, Dinggang G. Shen, Feng Shi, John H. Gilmore, Barbara L. Wolfe, Seth D. Pollak. **Family Poverty Affects the Rate of Human Infant Brain Growth**. *PLoS ONE*, 2013; 8 (12): e80954 DOI: 10.1371/journal.pone.0080954

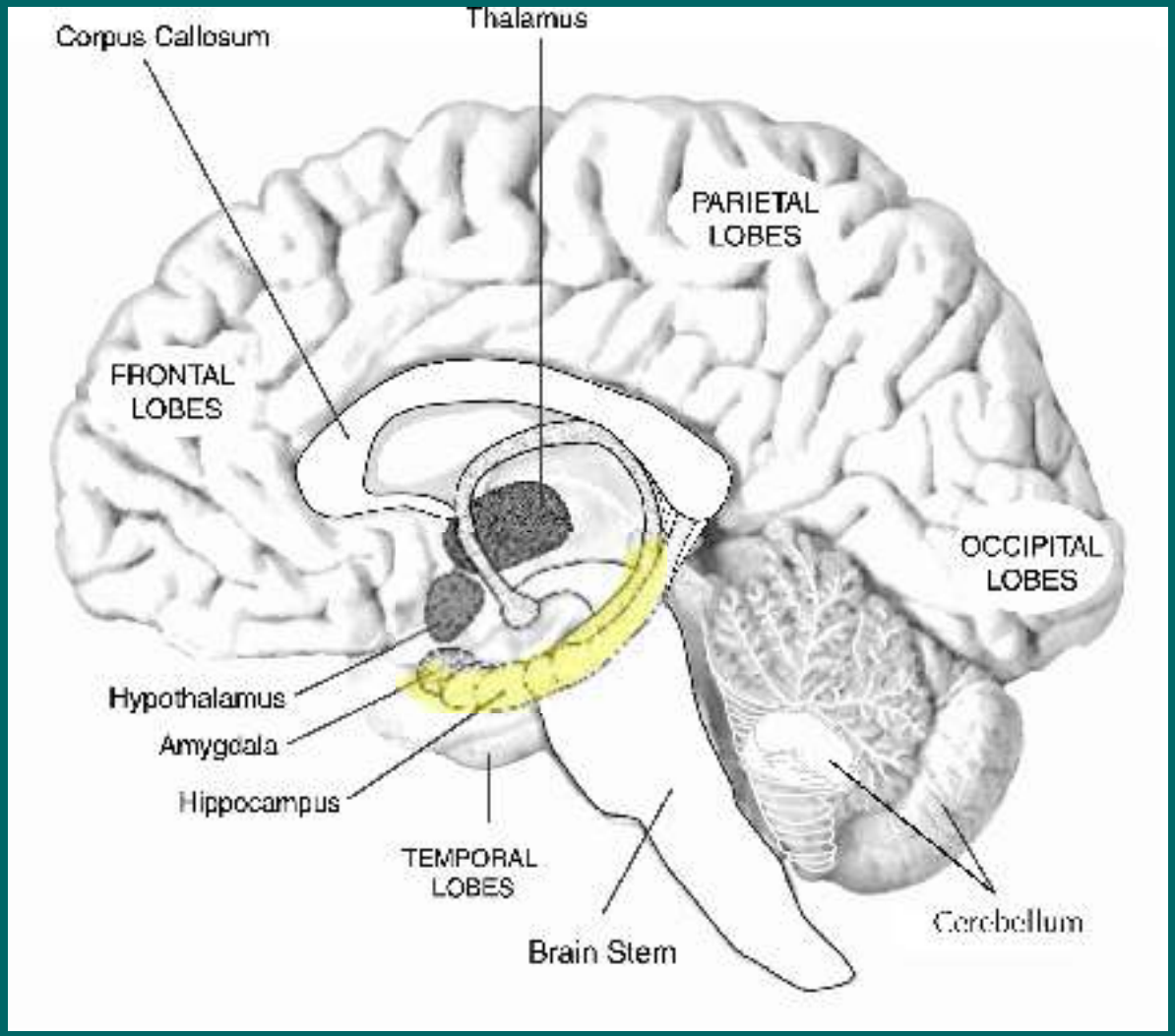
The JAMA Network

From: **The Effects of Poverty on Childhood Brain Development: The Mediating Effect of Caregiving and Stressful Life Events**

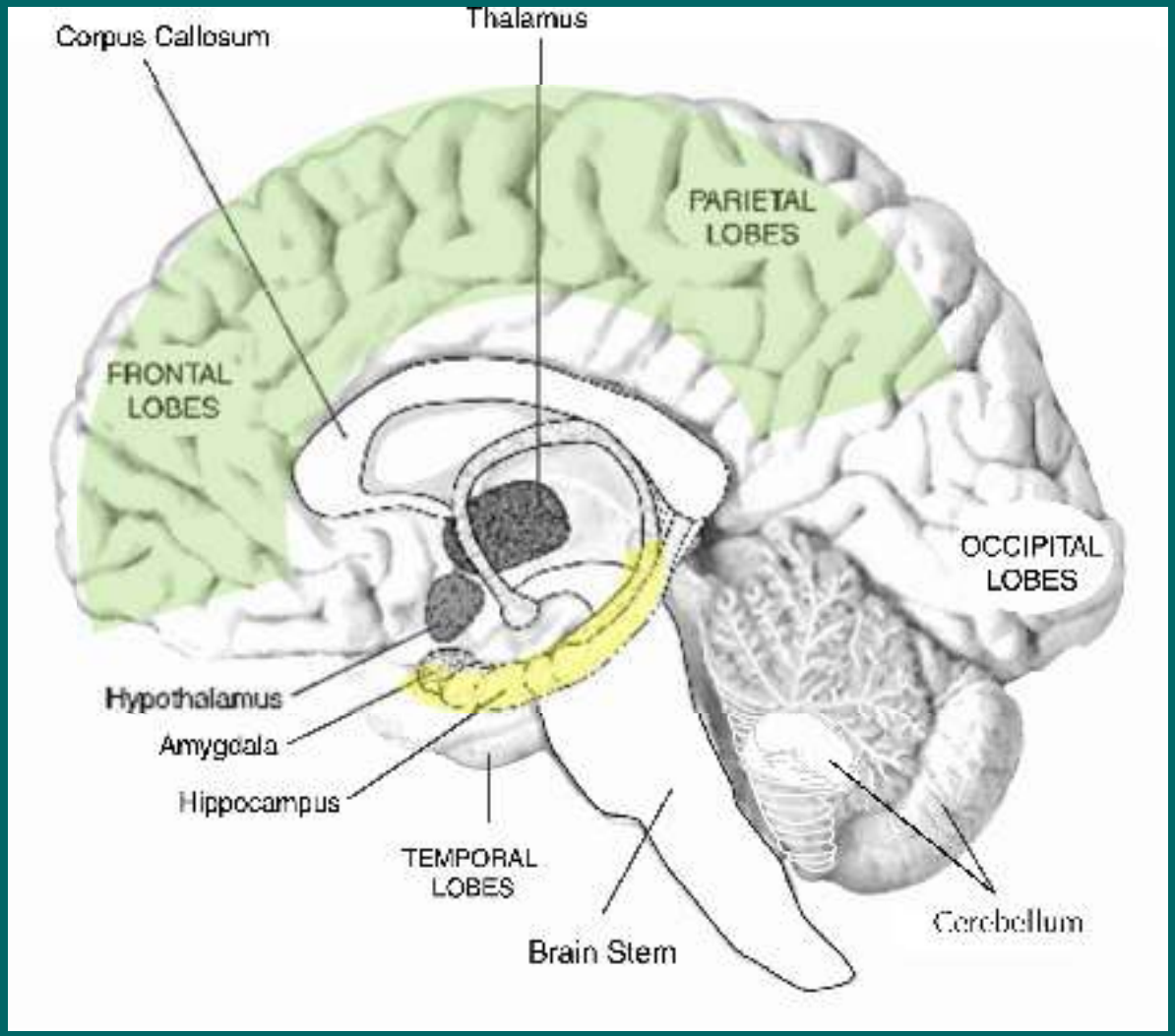
JAMA Pediatr. 2013;167(12):1135-1142. doi:10.1001/jamapediatrics.2013.3139

Income-to-Needs Ratio Predicting Total White Matter and Cortical Gray Matter Volumes

Looking Inside the Brain



Looking Inside the Brain

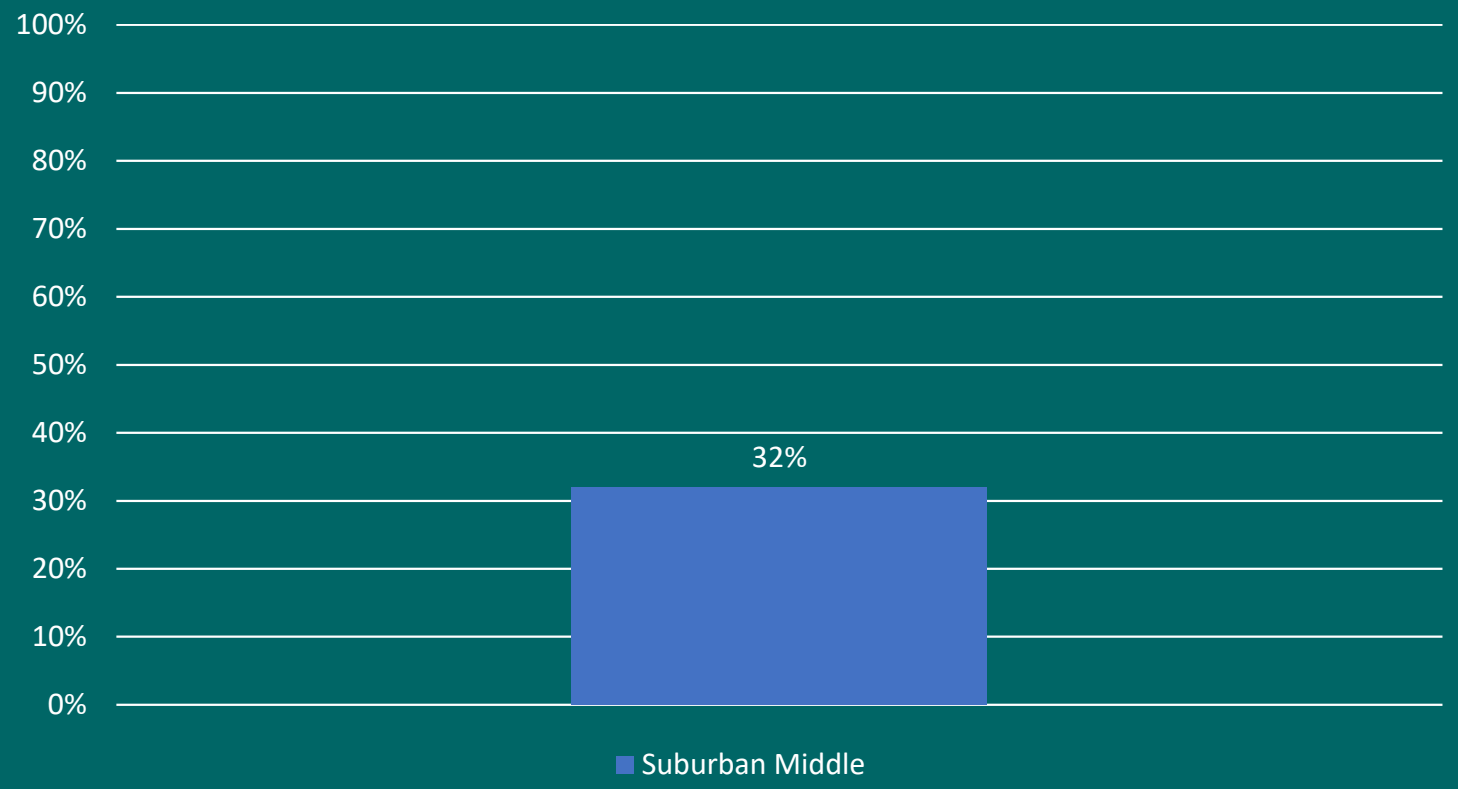


Noble's Research

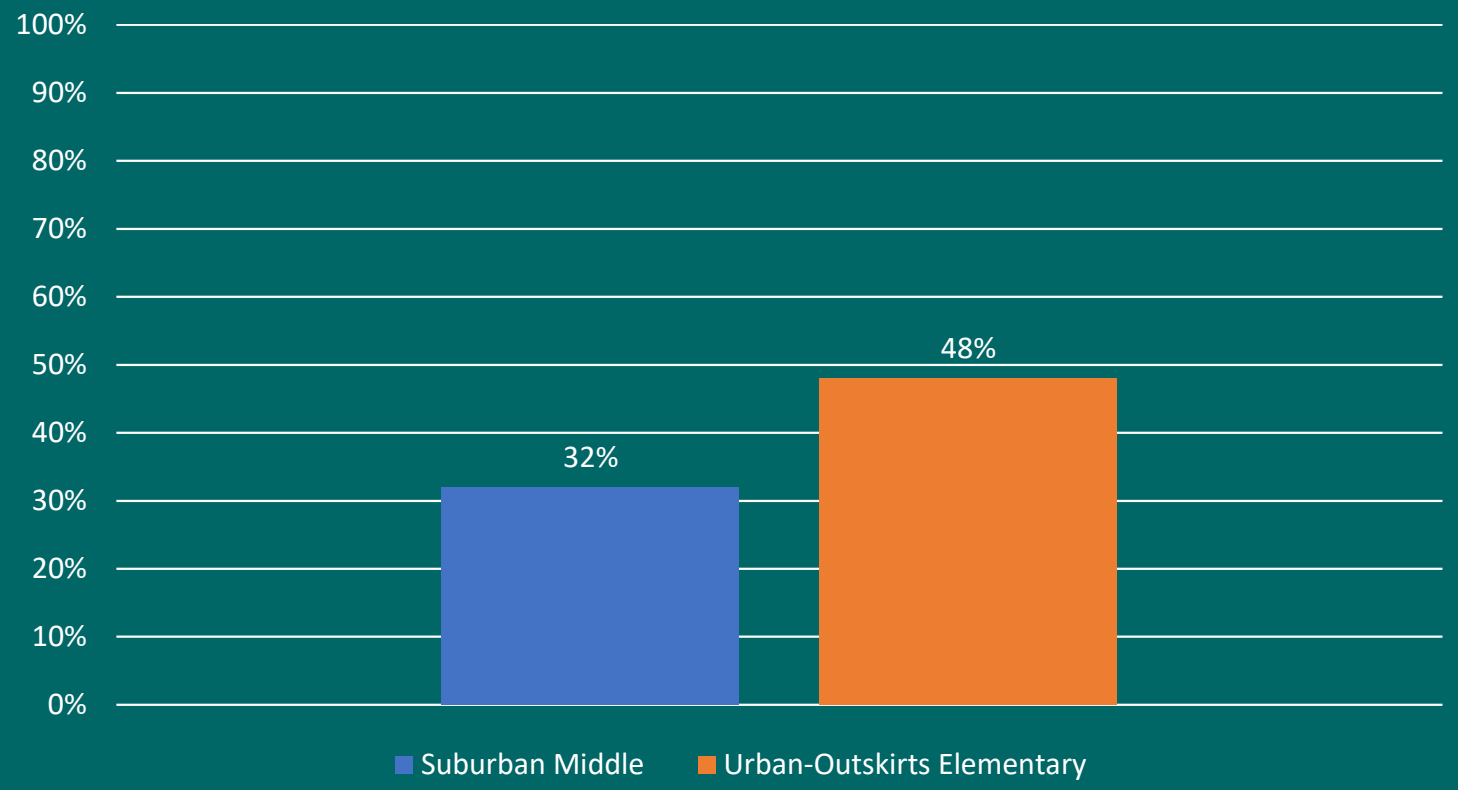
Cognitive System	Cognitive Function
Left perisylvian language system	Phonological awareness, lexical-semantic knowledge, required for reading and communication
Parietal/spatial cognition system	Perception and mental manipulation of spatial relations, required for math and technical subjects
Medial temporal/declarative memory system	Ability to form new memories, assemble memories from storage
Lateral prefrontal/working memory system	Ability to retain and manipulate information over a short duration, essential for complex reasoning and problem-solving
Anterior cingulate/cognitive control system	Ability to suppress or override competing attentional or behavioral responses

Socioeconomic gradients predict individual differences in neurocognitive abilities, Development Science 10-4 (2007)

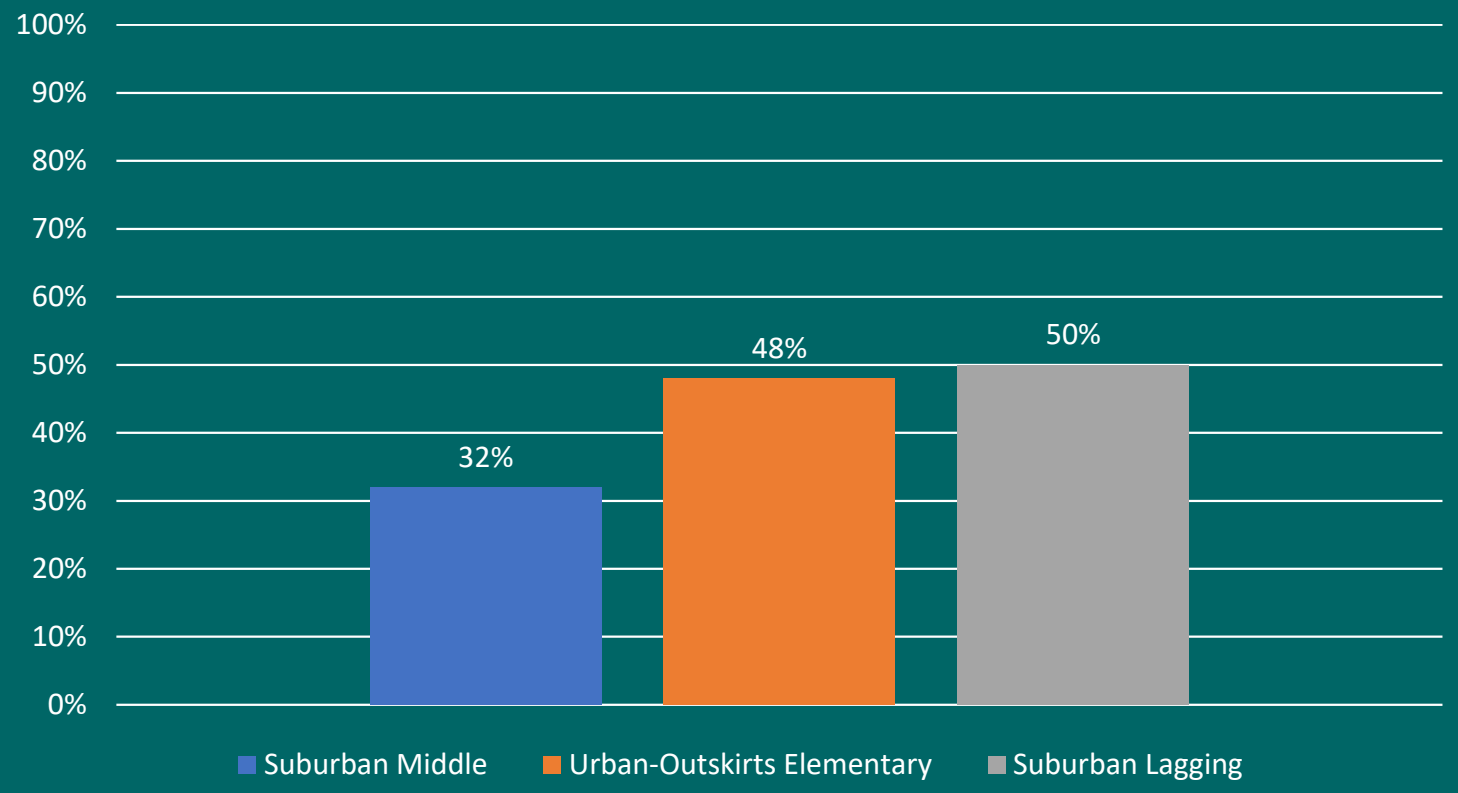
% of Students in the At-Risk Range for Attention and/or Working Memory



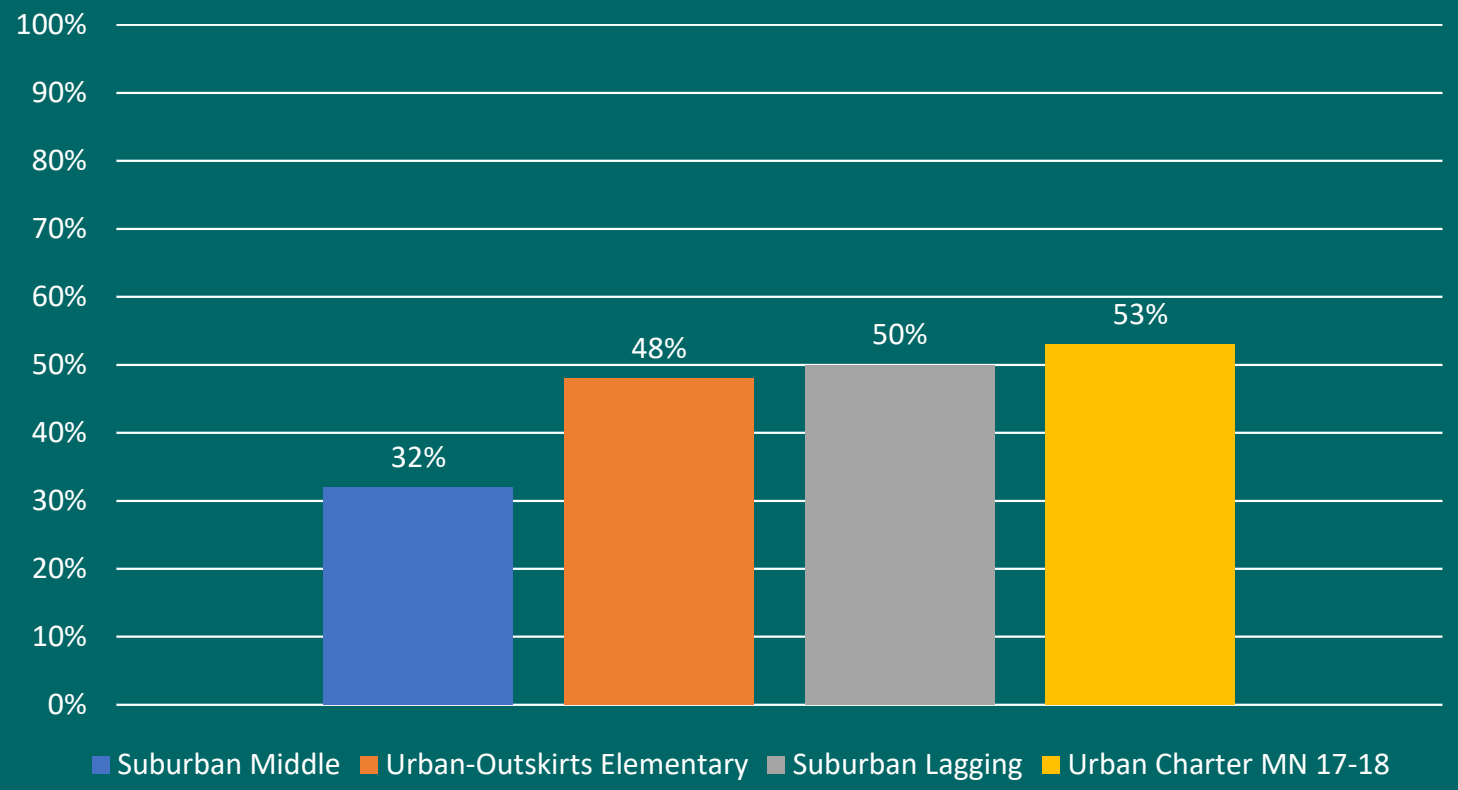
% of Students in the At-Risk Range for Attention and/or Working Memory



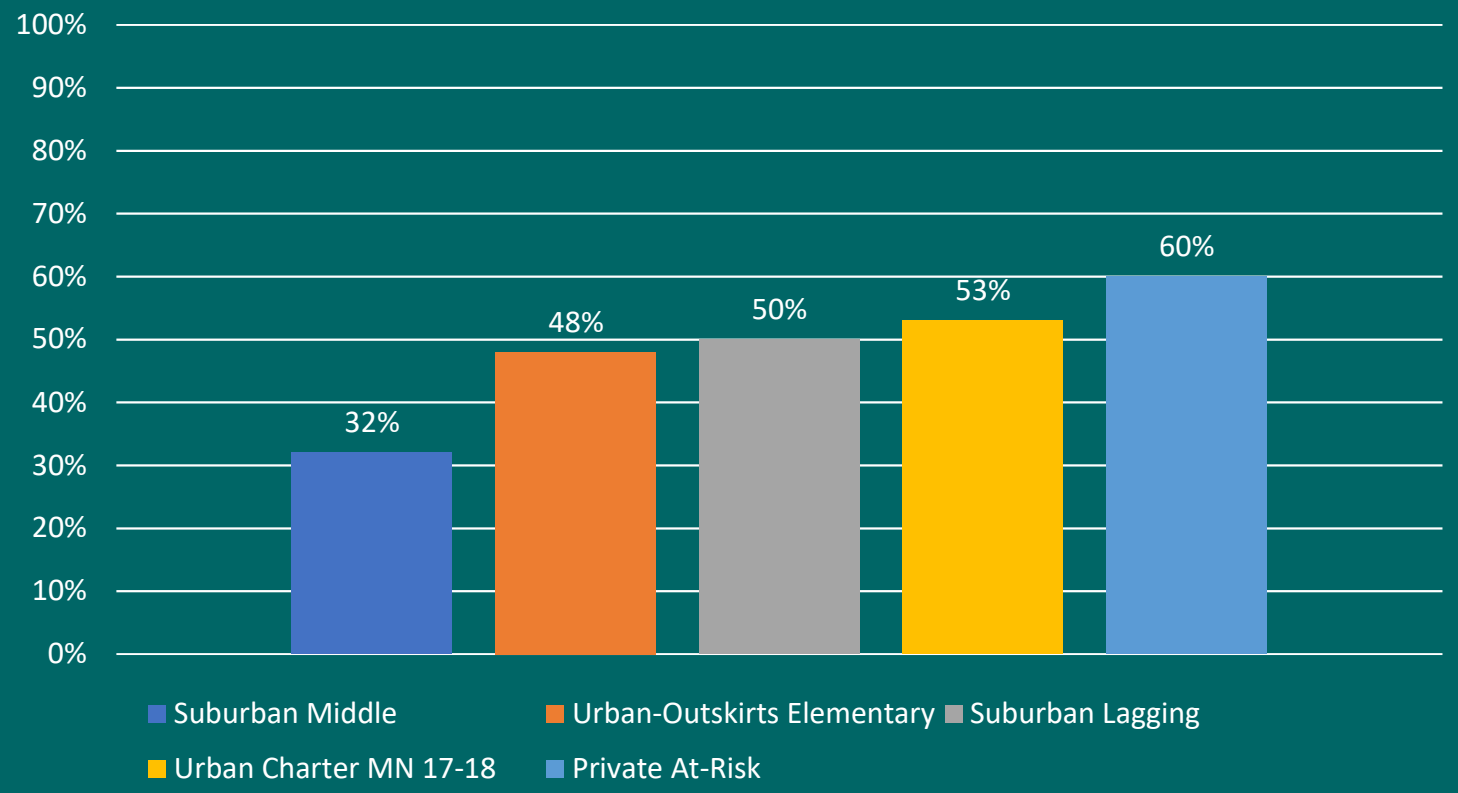
% of Students in the At-Risk Range for Attention and/or Working Memory



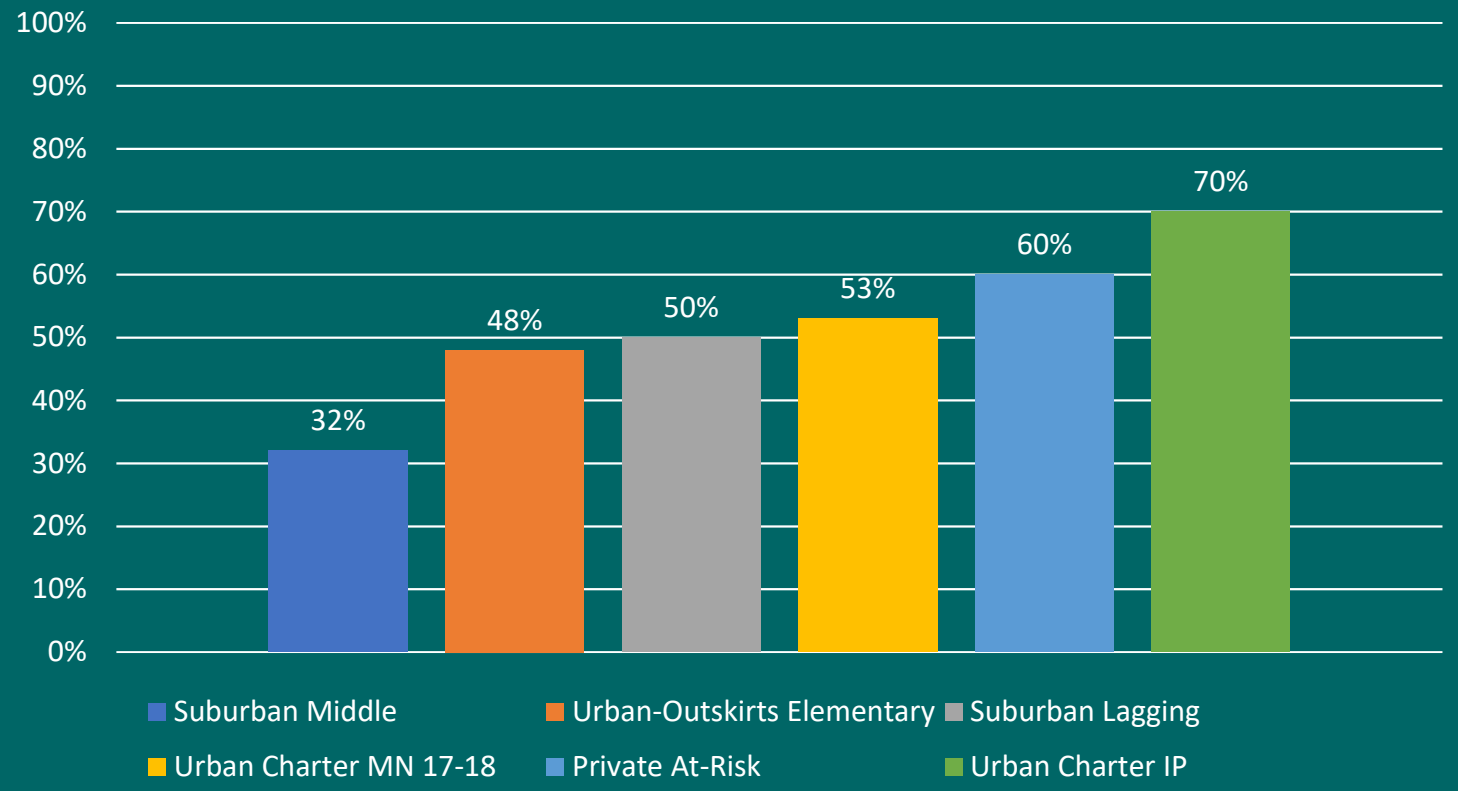
% of Students in the At-Risk Range for Attention and/or Working Memory



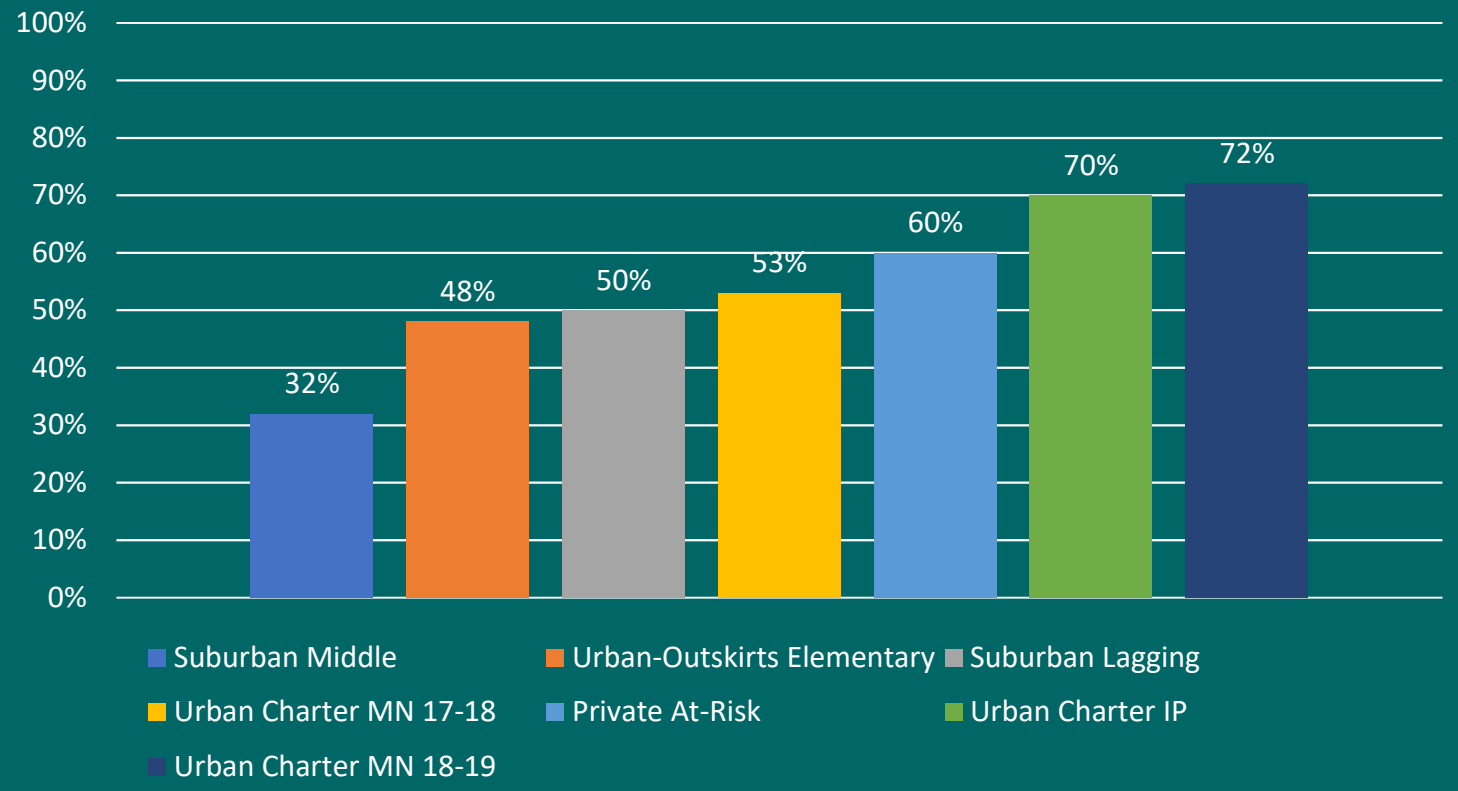
% of Students in the At-Risk Range for Attention and/or Working Memory



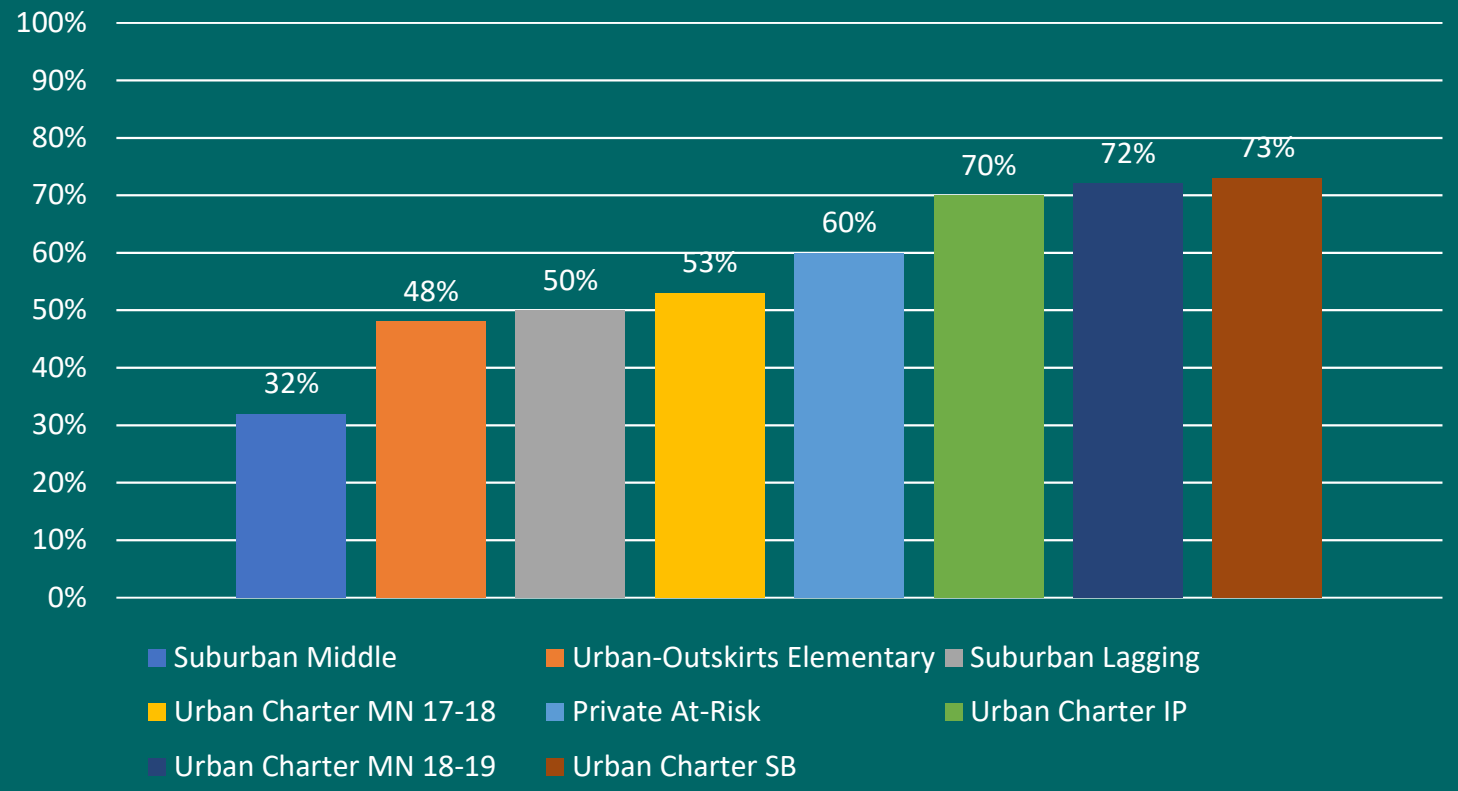
% of Students in the At-Risk Range for Attention and/or Working Memory



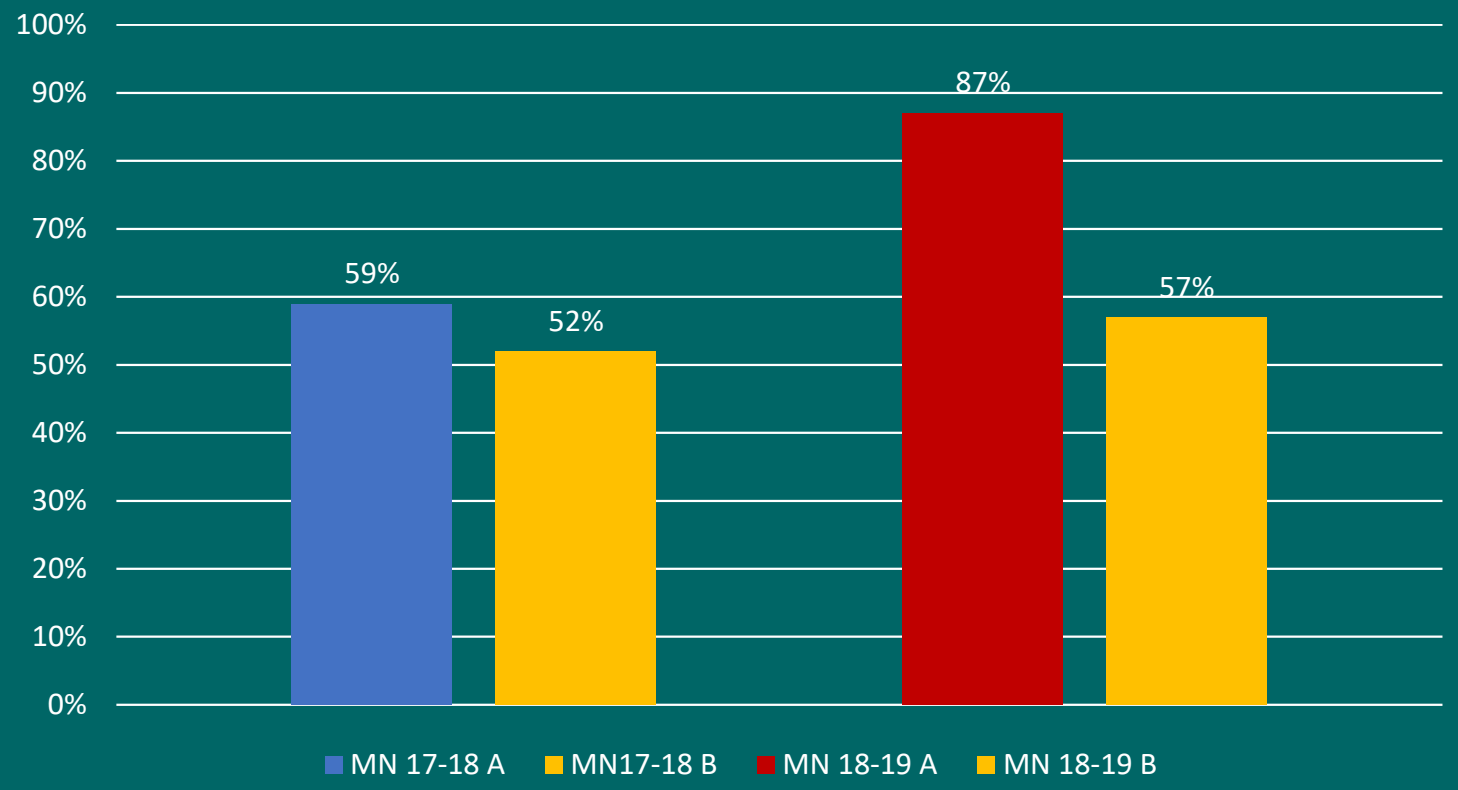
% of Students in the At-Risk Range for Attention and/or Working Memory



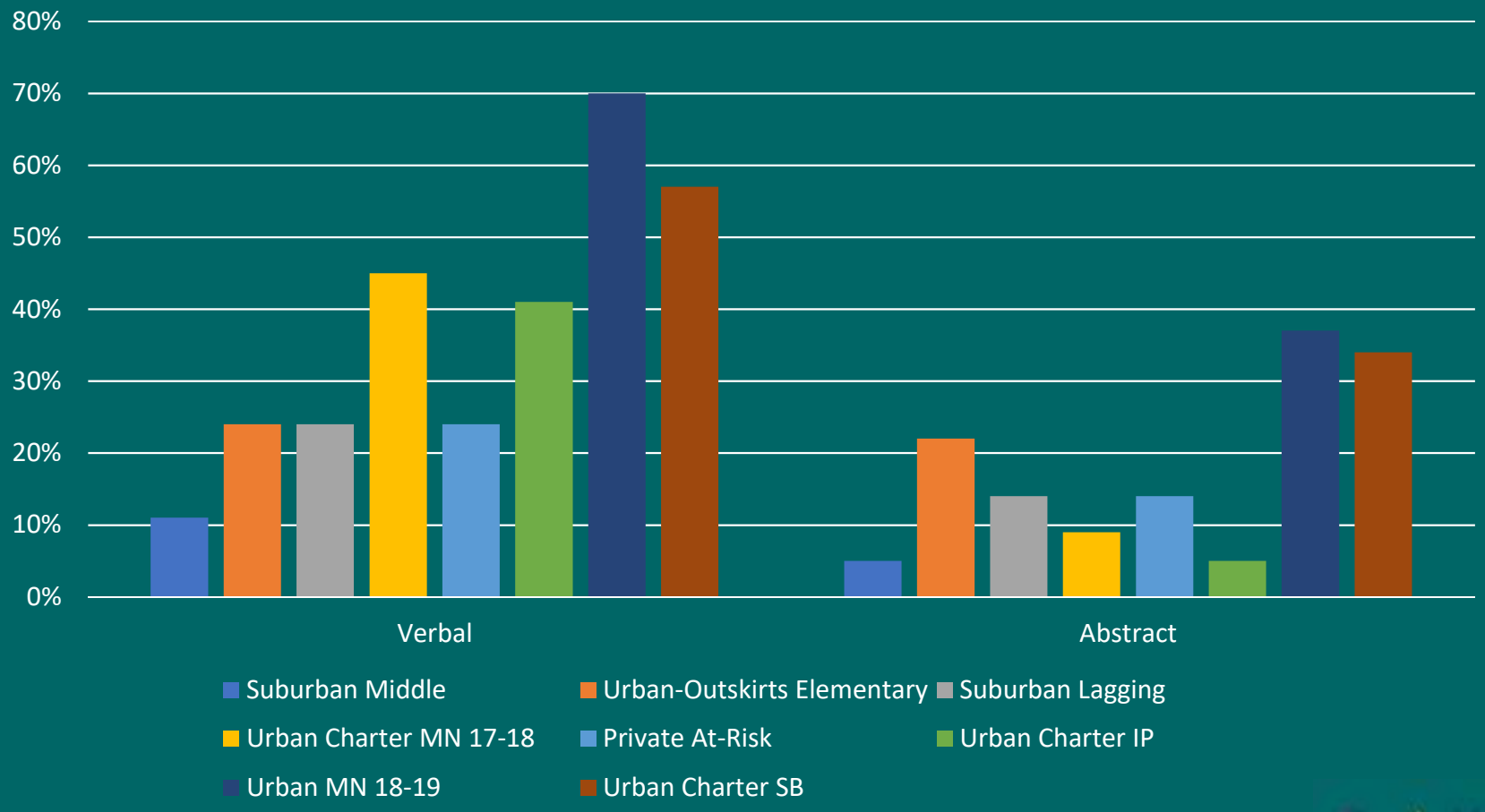
% of Students in the At-Risk Range for Attention and/or Working Memory



% of Students in the At-Risk Range for Attention and/or Working Memory



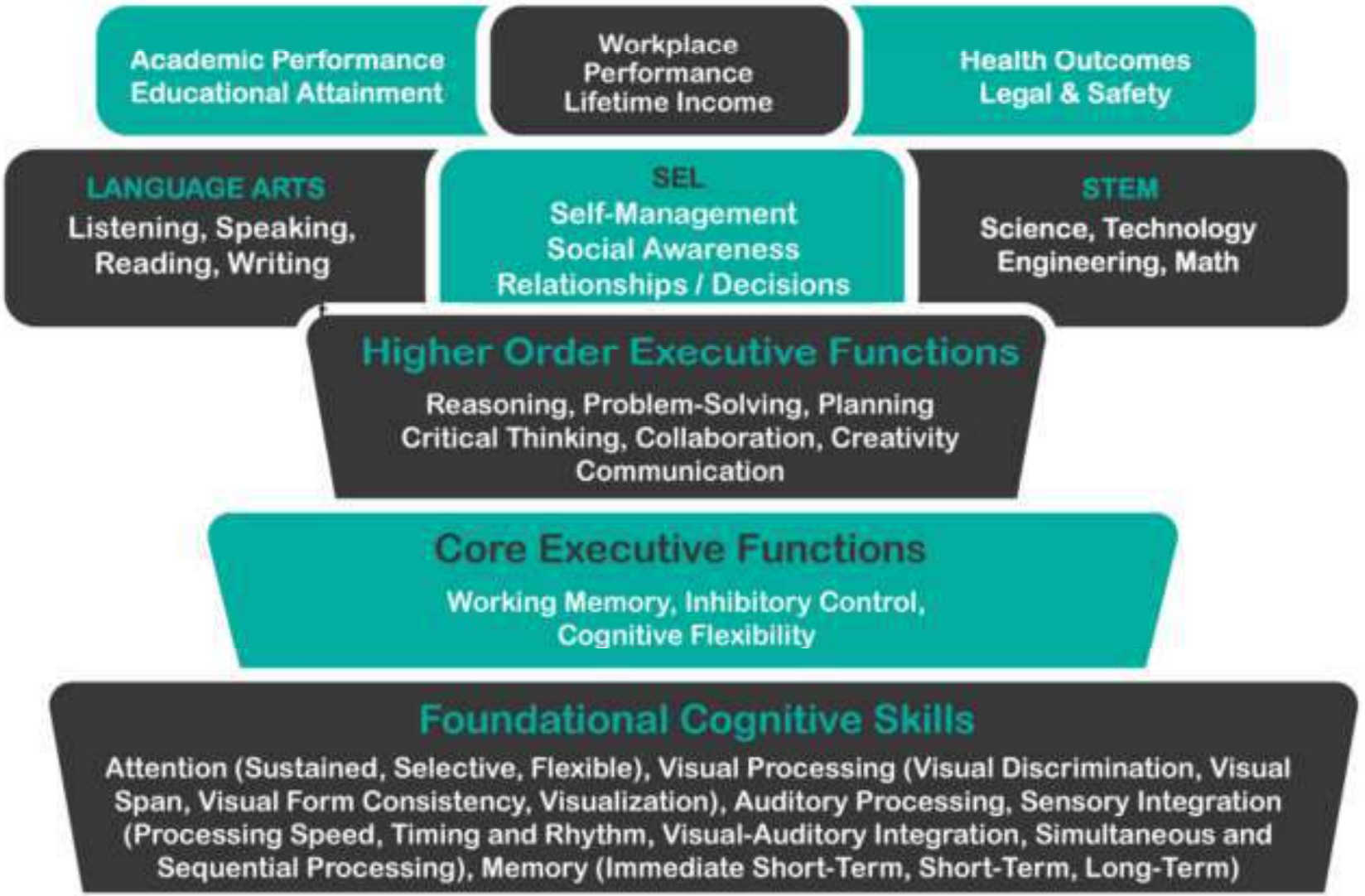
% of Students in the At-Risk Range for Verbal and Abstract Reasoning Skills



Executive Functions

Skill	What it is	Academic Example	Social/Emotional Example
Working Memory	The ability to hold information in our mind while we think about it.	Holding multiple aspects of a problem in mind and keeping track of where we are in a multi-step solution.	Holding someone else's point of view in mind, comparing and contrasting it to other points of view, considering alternative ways to respond.
Inhibitory Control	The ability to suppress a thought or idea, to refrain from doing something we otherwise would.	Not leaping to the first possible solution but questioning assumptions and considering other alternatives.	Not blowing out the candles on someone else's birthday cake. Not blurting out "That's stupid," when you disagree. Also, deferring gratification (longer term).
Cognitive Flexibility	The ability to change our mindset when the rules of the world around us change.	When our original approach to a problem doesn't work, finding other approaches. Looking at problems from different points of view and being able to change direction on the basis of new information.	Looking at personal experiences from different points of view and being able to change direction on the basis of new information.

COGNITIVE SKILLS : THE FOUNDATION FOR LEARNING



There Are Real Differences, but Plasticity Rules!

- The brains of low-SES students are physiologically and functionally different than their more advantaged peers (on average) when they arrive in our classrooms.
- They do not lack potential, but they do lack the developed the cognitive capacity to learn what their classmates are learning at the same pace.
- Cognitive capacity, which facilitates or frustrates the ability to learn, can be developed.
- Students who are behind can catch up, once their cognitive capacity has been developed.

Implications for Teaching

- **Understanding mediating factors**
- Teaching in a way that lessens cognitive load (shorter-term)
- Intervention to help students catch up cognitively
- Deficits in prior knowledge and experience
- Addressing the role of emotions

Mediating Factors

- Positive
  - Caregiving support
  - Trust and authenticity
  - Physical exercise
- Negative
  - Stressful life events
  - Poor nutrition
  - Insufficient sleep
  - Exposure to violence

Implications for Teaching

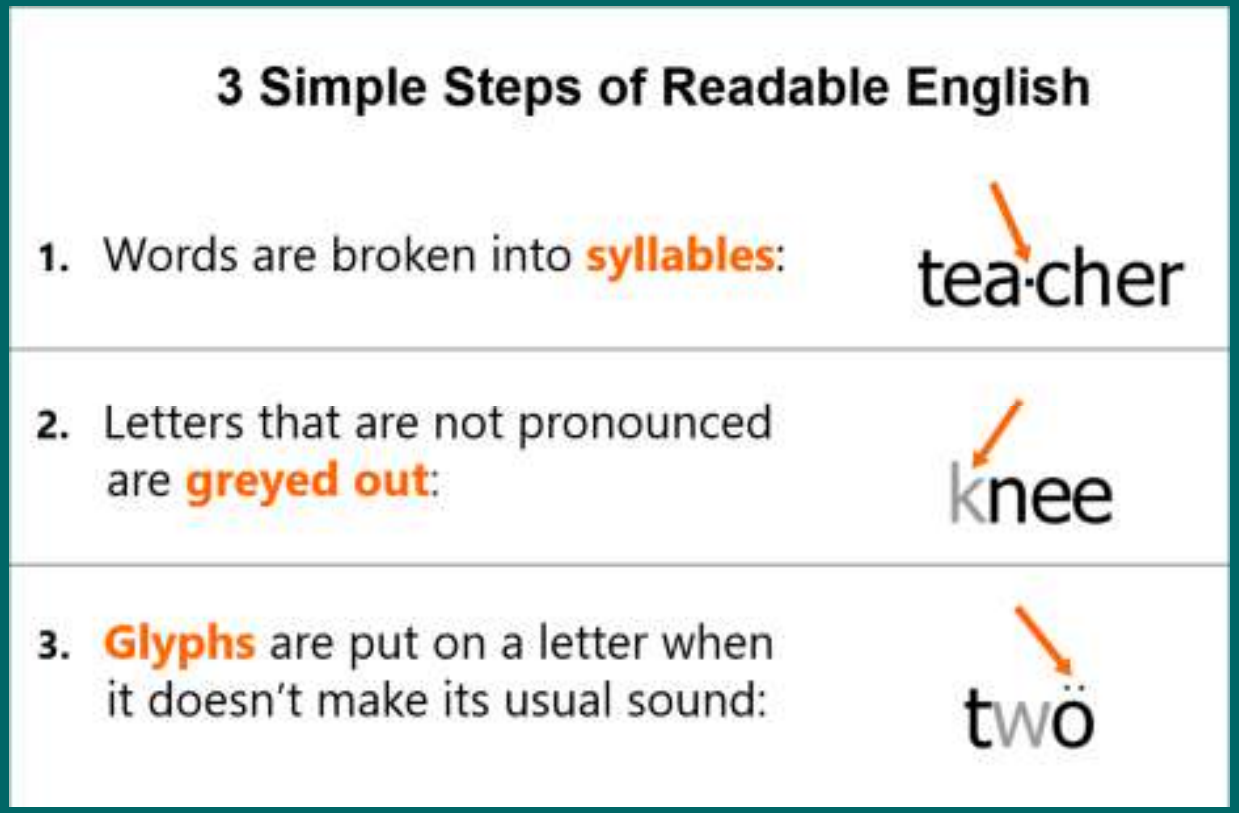
- Understanding mediating factors
- **Teaching in a way that lessens cognitive load (shorter-term)**
- Intervention to help students catch up cognitively
- Deficits in prior knowledge and experience
- Addressing the role of emotions

Supporting Students to Lessen Cognitive Load

- Strategies to Support Students with Working Memory
  - Make sure the student is focused on one task at a time.
  - Encourage them to use scrap paper.
  - Teach them how to double-check their work and use checklists.
  - When reading, teach students to stop and summarize.
  - Automaticity with basic facts and vocabulary will put less stress on working memory.

Mindprint: How Teachers Can Support Working Memory

Supporting Students to Lessen Cognitive Load



Readable English:
3 Simple Steps to Making Decoding Predictable

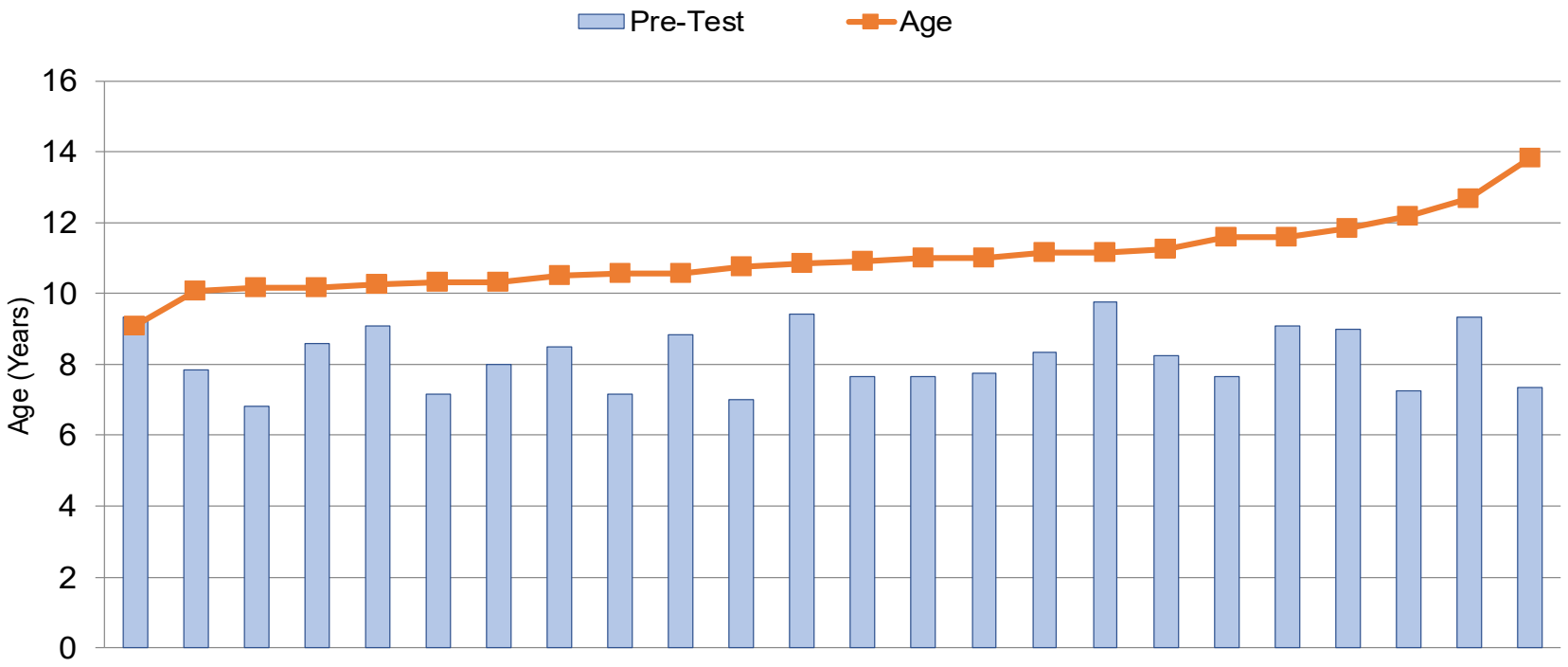
Implications for Teaching

- Understanding mediating factors
- Teaching in a way that lessens cognitive load (shorter-term)
- **Intervention to help students catch up cognitively**
- Deficits in prior knowledge and experience
- Addressing the role of emotions

Cognitive Intervention

- BrainWare SAFARI – software that develops 41 cognitive skills critical for learning
  - Comprehensive
  - Integrated
- Grounded in neuroscience and derived from clinical therapy best practices
- Delivered in an engaging video-game format
- Recommended usage:
  - 10-14 weeks
  - 30-45 minutes
  - 3-5 times/week

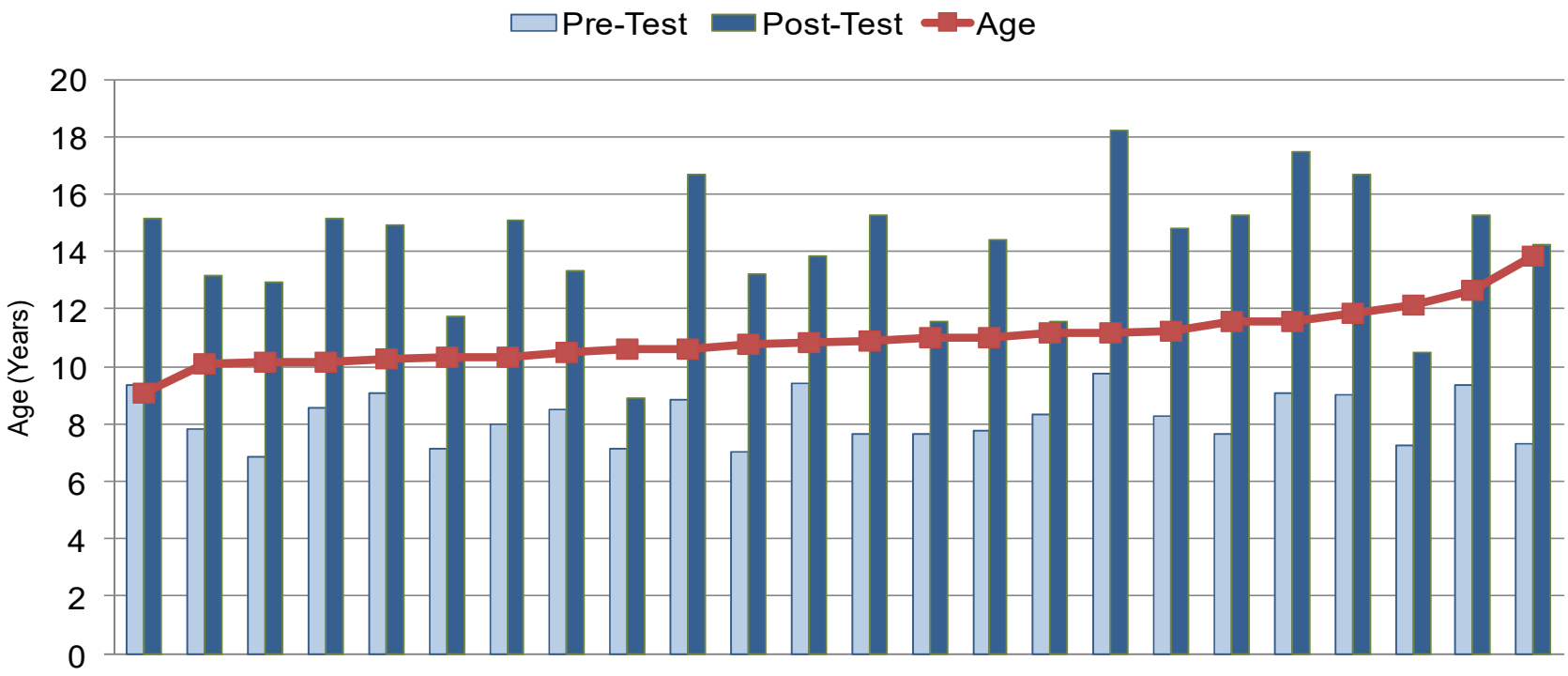
Cognitive Deficits of Low-SES At-Risk Students



4th and 5th Grade Boys, Cognitive Age
as Measured by Woodcock-Johnson III Cognitive Battery

Edgar Evans Academy, Indianapolis, IN

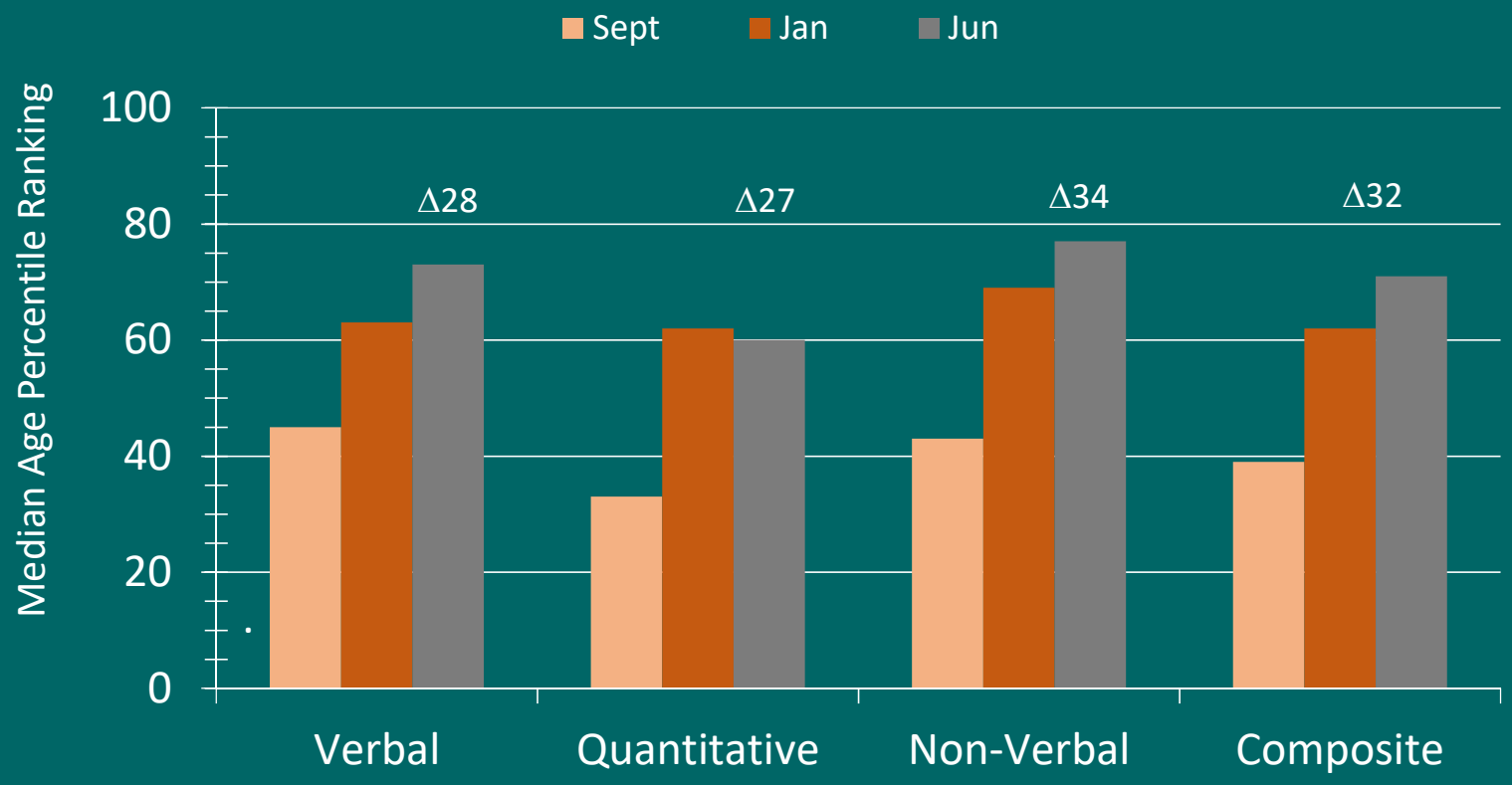
Cognitive Deficits of Low-SES At-Risk Students



Average improvement = 6 years
Time = 3 months
Intervention: BrainWare SAFARI

Edgar Evans Academy, Indianapolis, IN

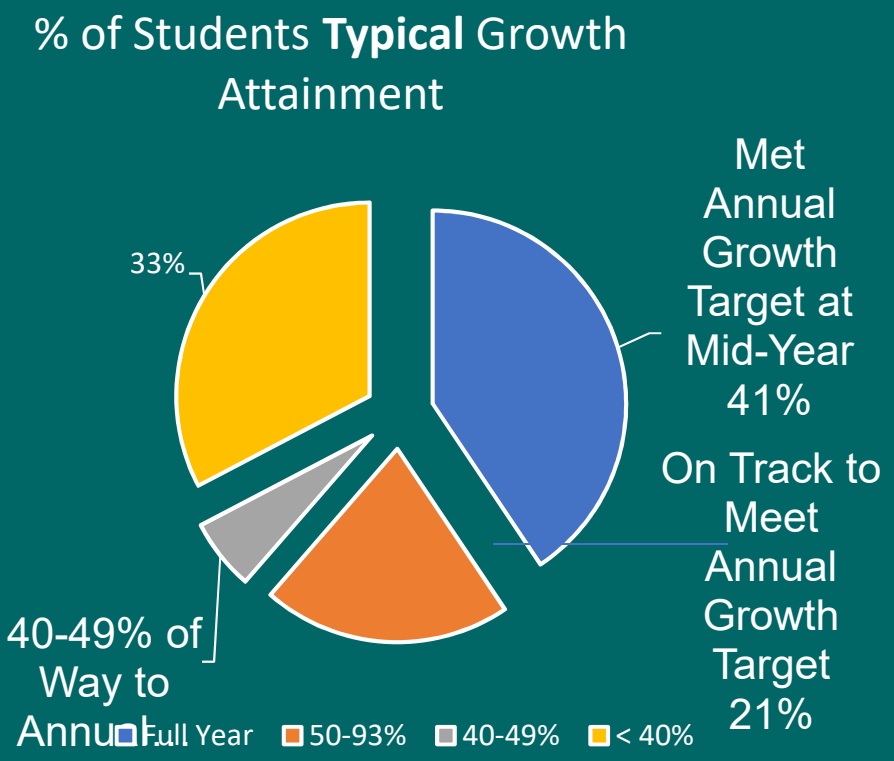
Initial and Sustained Cognitive Gains

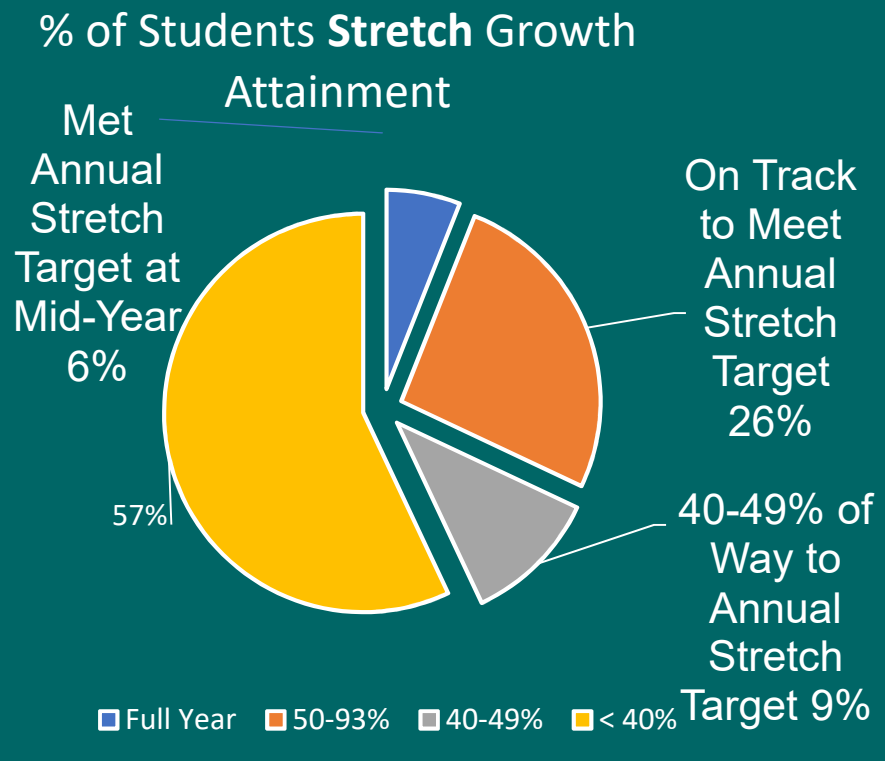


3rd Graders – Range of Abilities, Canadian Cognitive Abilities Test

"Impact of Cognitive Skill Development in Grade 3 on Cognitive and Academic Measures" – www.mybrainware.com/safari/research

Performance on Reading Growth Measures





21 students (62%) are on track to meet annual growth expectation or have already met it

11 students (32%) are on track to meet annual stretch target or have already met it

What Teachers and Parents Observe

- Improved attention span and focus
- Less distractibility
- Fewer careless errors
- Increased attention to detail
- Completion of tasks faster and more accurately
- Faster recall of information
- Increased retention of learned materials
- Improved ability to follow directions
- Increased motivation and effort,
- Higher expectations and aspirations
- Greater ability to handle challenges and setbacks
- Improved academic and work performance
- Increased productivity
- Better communication with parents, peers, and teachers
- Greater self-confidence

Implications for Teaching

- Understanding mediating factors
- Teaching in a way that lessens cognitive load (shorter-term)
- Intervention to help students catch up cognitively
- **Deficits in prior knowledge and experience**
- Addressing the role of emotions

Prior Knowledge

Implications for Teaching

- Understanding mediating factors
- Teaching in a way that lessens cognitive load (shorter-term)
- Intervention to help students catch up cognitively
- Deficits in prior knowledge and experience
- **Addressing the role of emotions**

Emotions and Learning

- Emotions can impede or enhance learning.
- Social and learning encounters can be survival encounters.
  - Stress = Fight or Flight
  - Emotion overrides cognition
- Classroom must be physically and psychologically safe.

Emotions Create Stronger Memories

- Emotions add extra vividness to memories. (Adrenaline is not just a stress response.) They can be used for enhancing positive memories also.
- Engage the emotional/motivational interest and you naturally engage adrenaline… get stronger memories.

Teachers Must Take Care of the Emotional Side of Things

Create a safe environment.

Create a stimulating interactive environment.

No matter how well planned, how interesting, stimulating, colorful or relevant the lesson is, if the teacher does all the interacting with the material, the teacher's—not the student's—brain will grow new connections.

Avoiding and Mitigating Stress

- Avoid putting students on the spot – have them discuss in groups and then share what the group came up with.
- Use "clickers" or "paddles" to get feedback on student understanding without singling anyone out.
- Have students write about their feelings prior to a test.

Fostering Positive Emotions

- Make it real.
  - How does this apply in your students' lives?
  - Role-playing, hands on (brains on), multimedia, games.
- Make yourself real.
- "Something good and new."
- "Tell me a joke."

Today

- Research
  - Environmental enrichment/impoverishment
  - Brain imaging
  - Cognitive measures
- Implications for Teaching
  - Understanding mediating factors
  - Teaching in a way that lessens cognitive load (short term)
  - Intervention to help students catch up cognitively (for the long term)
  - Deficits in prior knowledge and experience
  - The role of emotions

Questions?


Let's stay connected!
Betsy Hill
bhill@mybrainware.com
773-250-6467
www.linkedin.com/in/betsyhill
BrainWare
Learning Company
www.MyBrainWare.com
www.facebook.com/BrainWareLearning/