Effects of Poverty on the Brain and Learning

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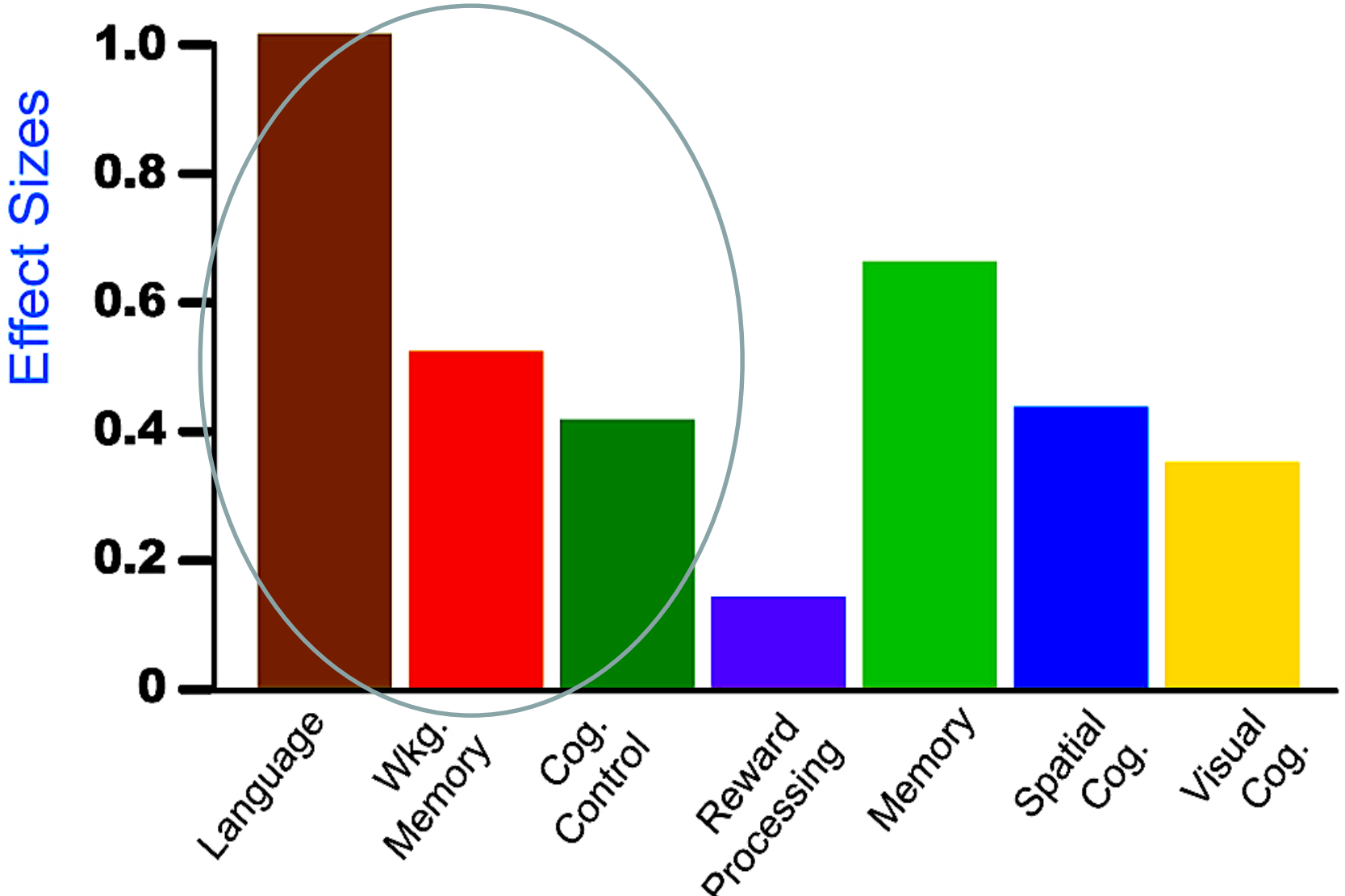
reading assistant™

We have known that income level negatively impacts cognitive functions for over a decade

There are links between family income and memory and attention

How are the brains from poverty different?

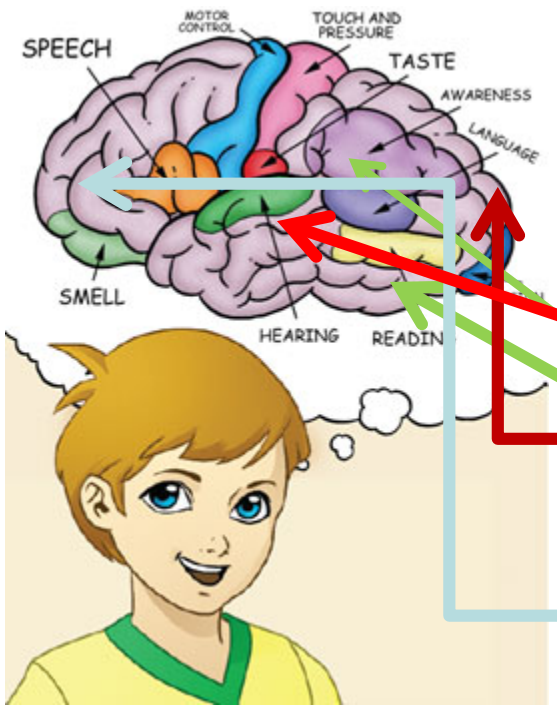


But newer research is specifying why and how the impact of poverty affects learning

Family income, parental education and brain structure in children and adolescents Noble, et. al. *Nature Neuroscience* 30 March 2015

- Among children from lower income families,
  - small differences in income were associated with relatively large differences in surface brain area
- Among children from higher income families, similar income increments were associated with smaller differences in surface area.

Brain structure and poverty (Noble et al, 2015)



- Brain Structure and income level relationships were most prominent in regions supporting
  - ***language***
  - ***reading,***
  - ***executive functions***
  - ***spatial skills***

Noble et al 2015 Conclusion

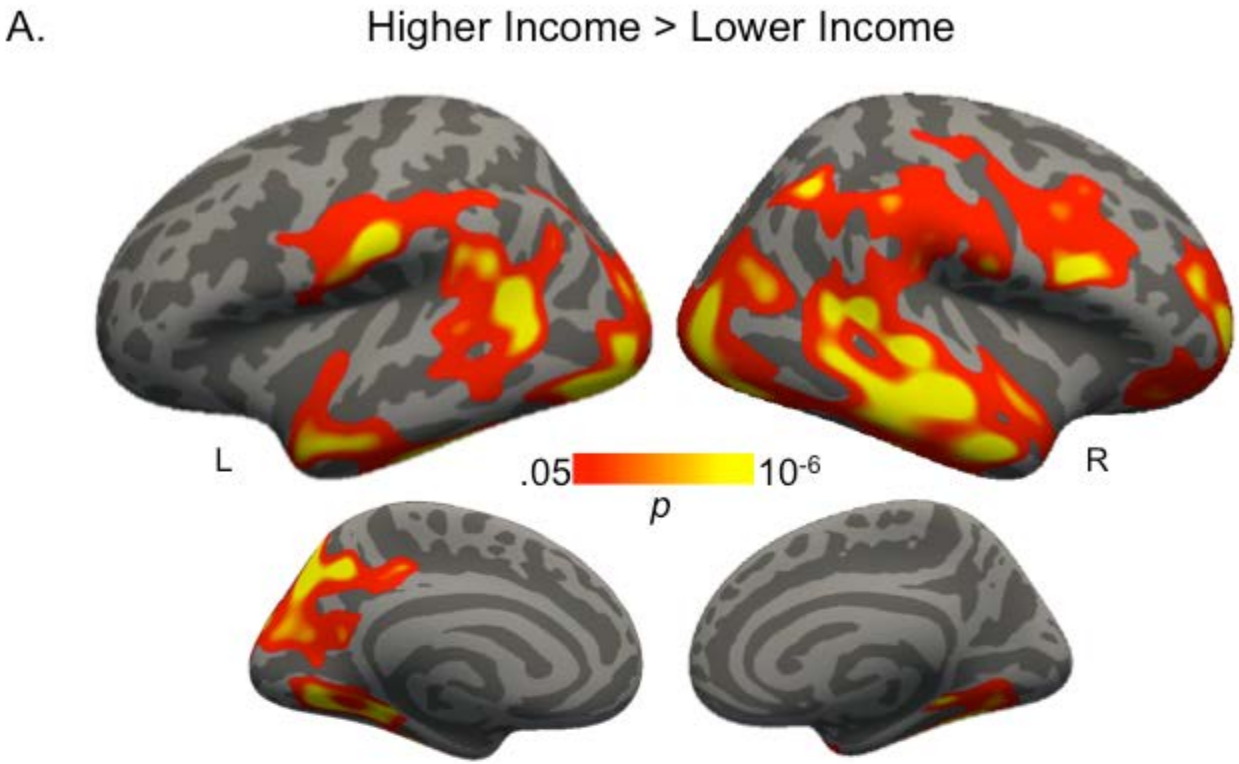
- This research implies that ***income relates most strongly to brain structure among the most disadvantaged children.***

April 2015 – Dr. John Gabrielli's Lab at MIT

- Published research that corroborates Noble 2015 and clarifies the income/achievement gap

- Showing that High Income versus Low Income achievement differences directly correlate to measures of cortical thickness in adolescents

Neuroanatomical Correlates of the Income-Achievement Gap



Mackey, A. P., A. S. Finn, J. A. Leonard, D. S. Jacoby-Senghor, M. R. West, C. F. O. Gabrieli, and J. D. E. Gabrieli. (2015) "Neuroanatomical Correlates of the Income-Achievement Gap." Psychological Science (April 20).

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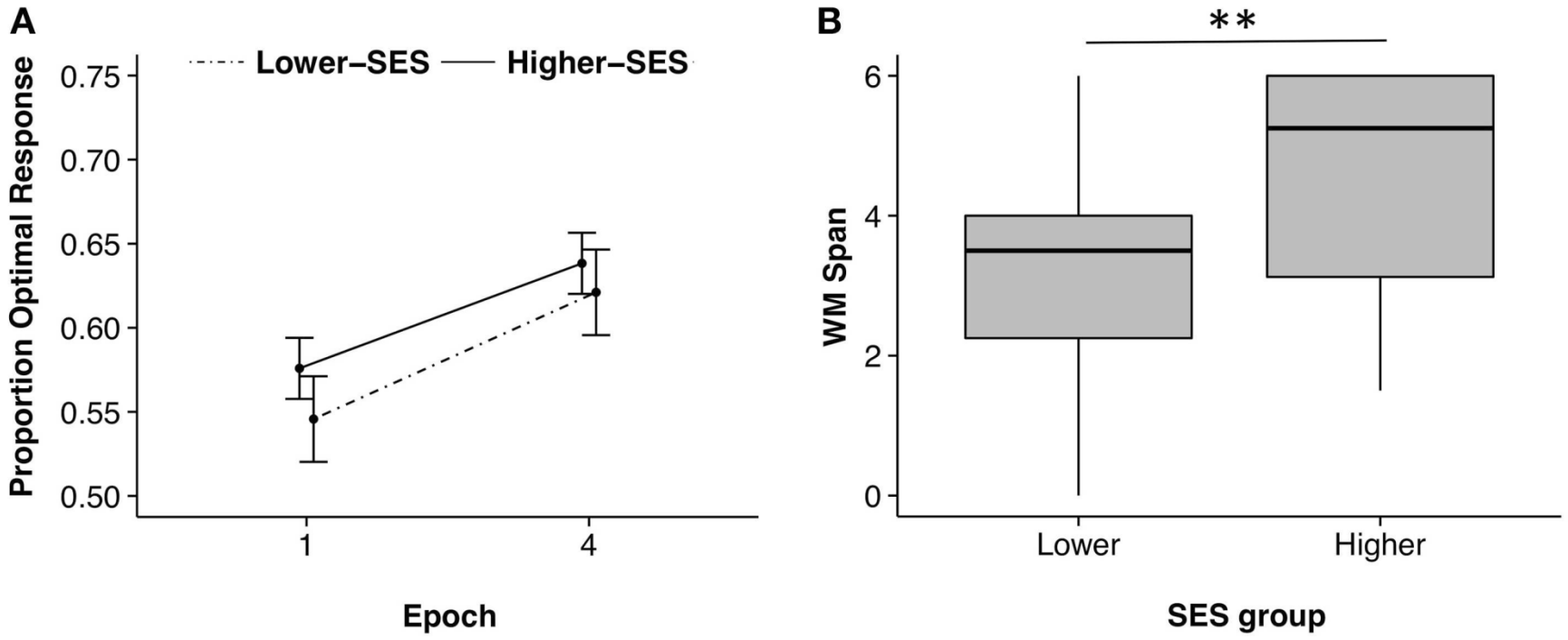
Corroborated by Pollak et al, in June

- 20 percent of the gap in test scores between poor children and middle-class children may be a result of **poor brain development in the frontal and temporal lobes**

Pollak, S., et al. (2015) *JAMA Pediatrics*

In October, differential effects of SES on kinds of memory (working versus procedural memory)



Procedural Memory (probabilistic learning)

Working Memory

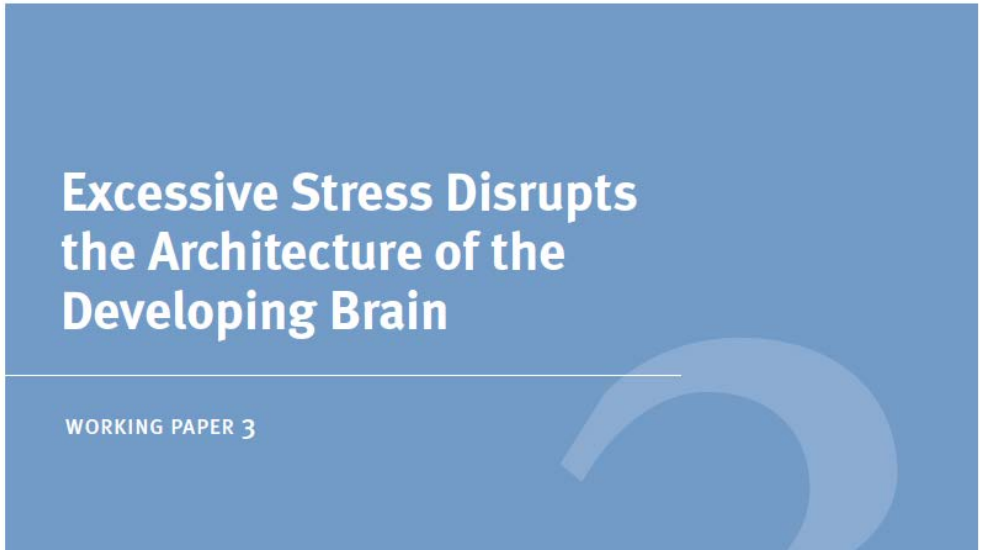
Leonard, J., Mackey, A., Finn, A. & Gabrielli, JE (2015) Front. Hum. Neurosci., 08 October

So… SES does not affect intelligence or ability to learn in general

- Rather SES affects those types of learning important for academic success
- But, why????

A key feature is toxic stress associated with poverty

NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD



http://developingchild.harvard.edu/resources/wp3/

HARVARD UNIVERSITY

Effects on Brain Development

- **The neural circuits for dealing with stress are particularly malleable (or "plastic") during the fetal and early childhood periods**
  - the regions of the brain involved in fear, anxiety, an impulsive responses may overproduce neural connections
  - those regions dedicated to reasoning, planning, and behavioral control may produce fewer neural connections

Damage to health and well-being

This wear and tear increases the risk of stress-related physical and mental illness later in life

- Extreme exposure to toxic stress changes the stress response system
  - **Responds at lower thresholds** to events that might not be stressful to others,
  - **Activates more frequently and for longer periods** than is necessary, like revving a car engine for hours every day.

Adverse Childhood Experiences (ACES) (*n* =1007) [Jimenez et al, 2016)

Variable %	(No.)
Child maltreatment	
Psychological	16 (162)
Neglect	13 (132)
Physical	15 (154)
Sexual	0.6 (6)
Household dysfunction	
Maternal depression	12 (121)
Substance use	15 (149)
Incarceration	18 (181)
Violence toward mother	11 (111)

Total ACEs	
0	45 (451)
1	27 (275)
2	16 (158)
3	8 (84)
4	3 (25)
5	1 (11)
6	0.3 (3)

Jimenez et al. Adverse Experiences in Early Childhood (ACES) and Kindergarten Outcomes

PEDIATRICS Volume 137, number 2 , February 2016

Study Involved A Racially Balanced Population (Jimenez et al, 2016)

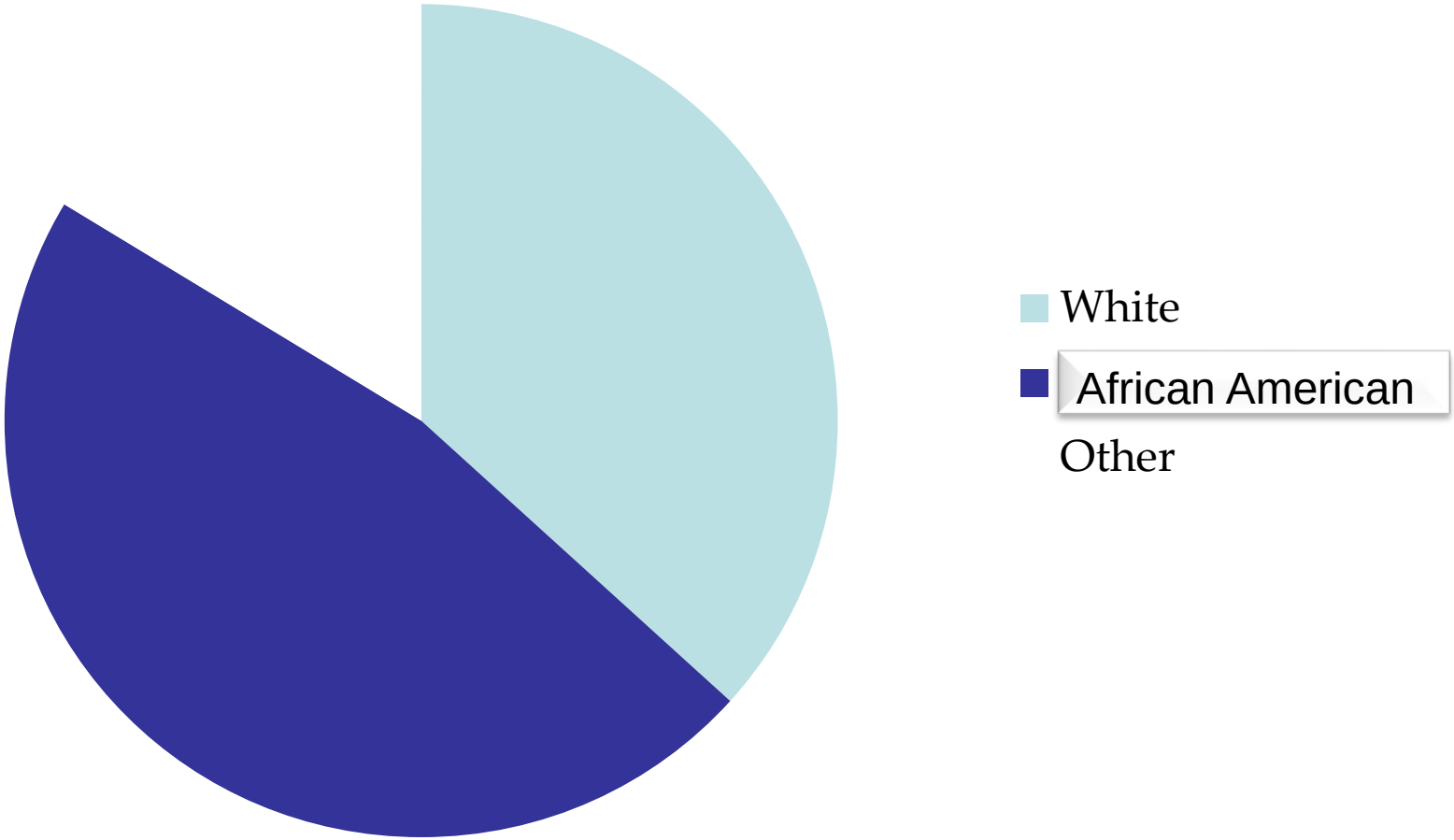


Table 3 Teacher Ratings of Below Average Academic Skills – percentages (Jimenez et al, 2016)

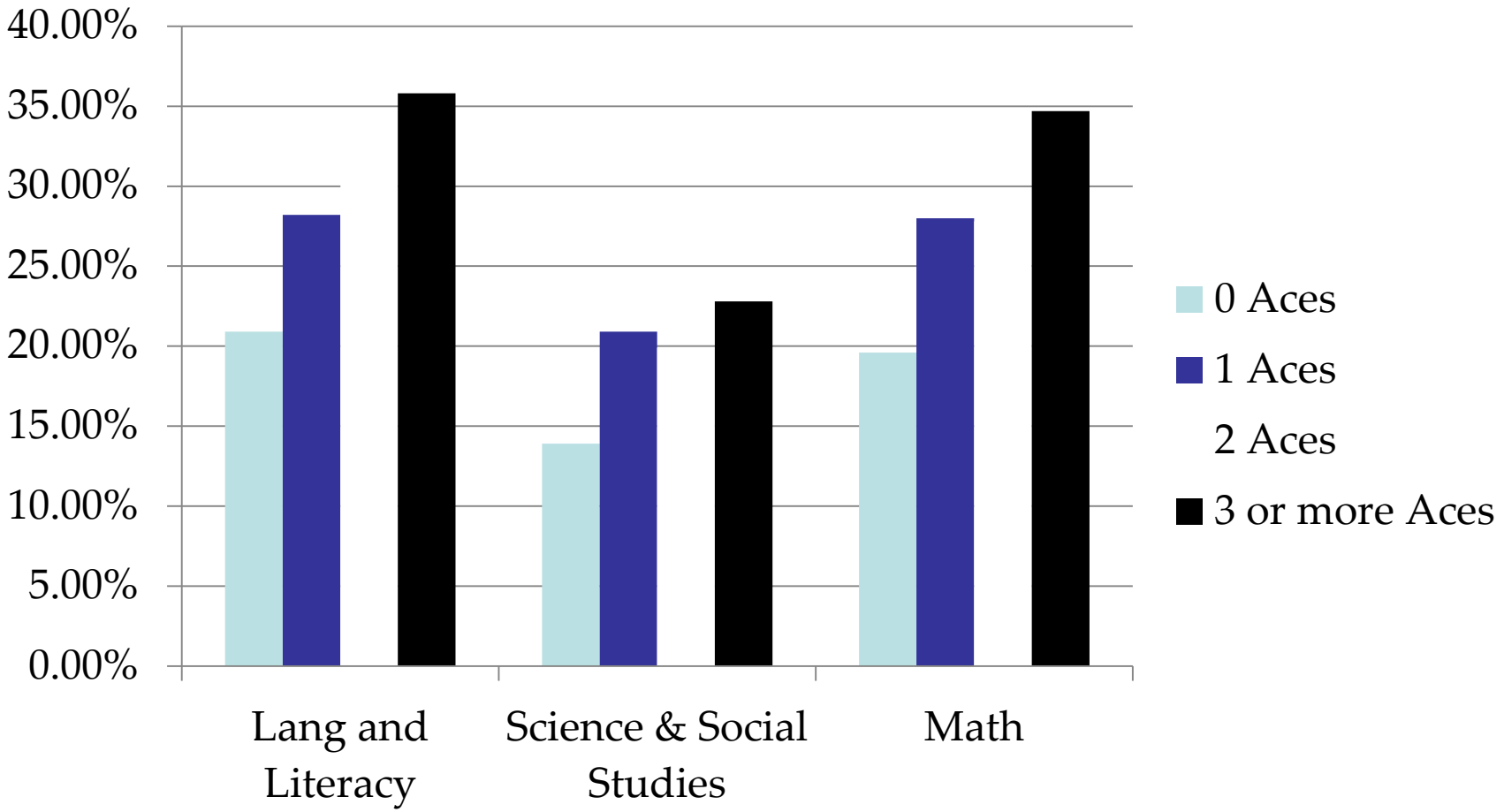
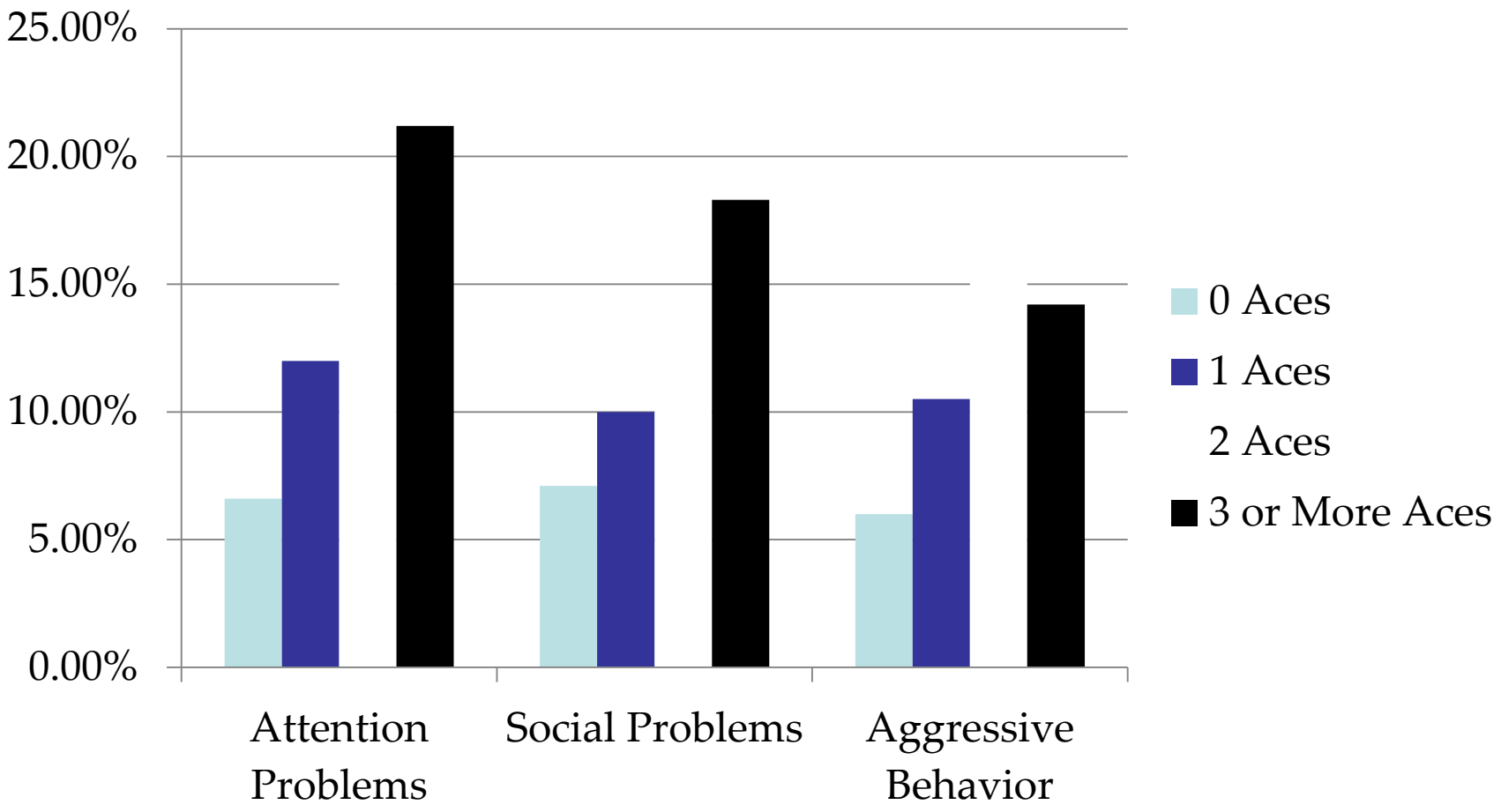


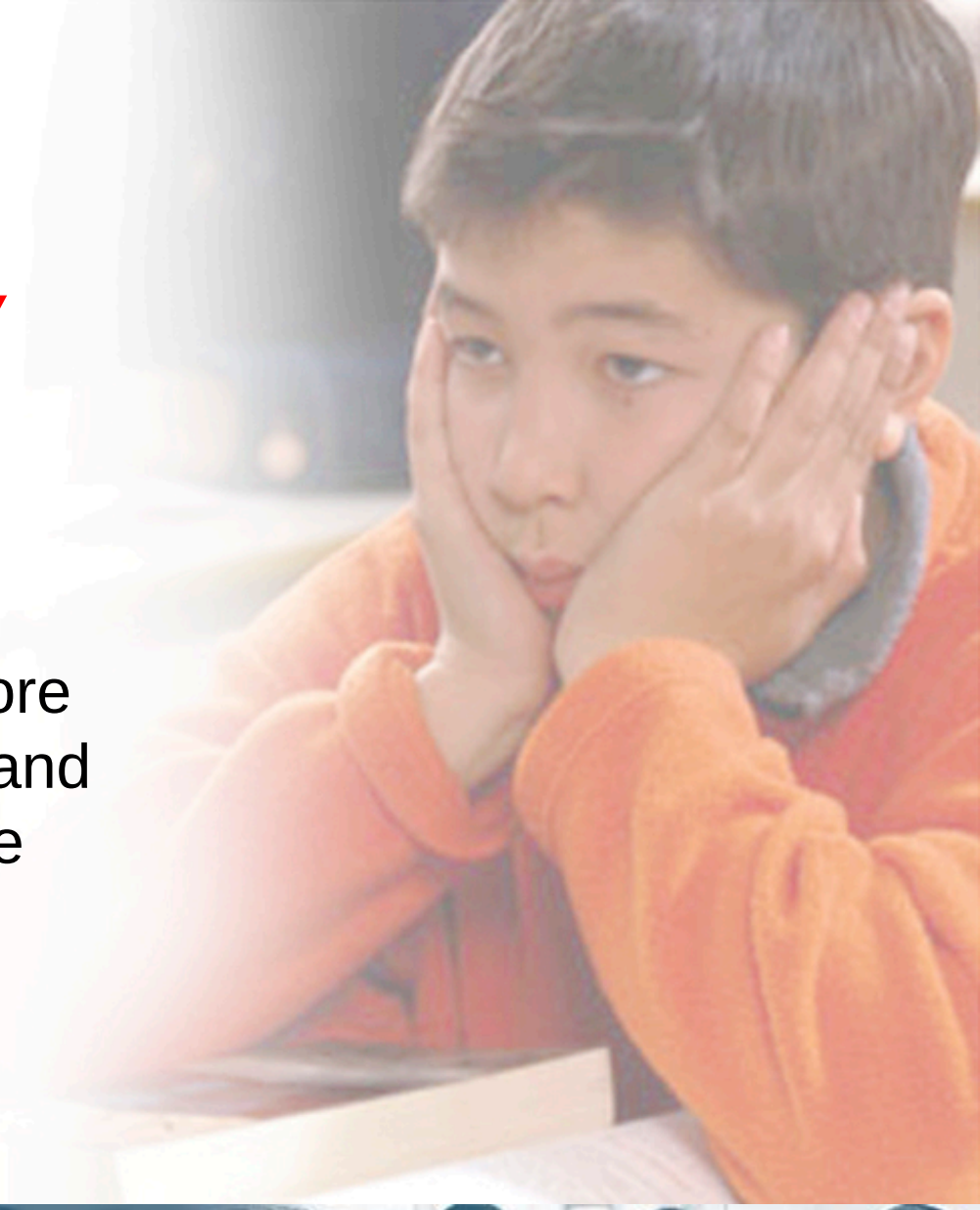
Table 5.Teacher Ratings of Behavior – Percentages (Jimenez et al, 2016)



Conclusion (Jimenez et al, 2016)

- Children experiencing adverse childhood experiences (ACES) places students at significant risk for
  - Poor school achievement
  - And is associated with poor health

ELL
Double Jeopardy



ELL enrollment in schools more than doubled between 1997 and 2008 (National Clearinghouse for English Language Acquisition, 2010).

Hispanic children constitute an urgent demographic imperative (Garcia and Jensen, 2009)

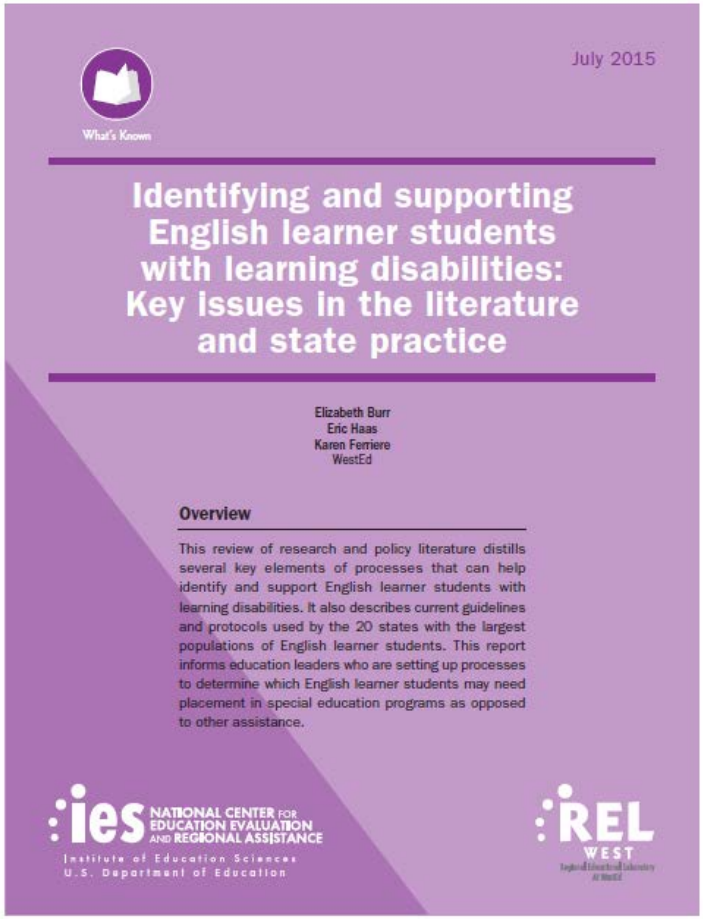
- Hispanic children, who speak Spanish as their first language (L1), make up the largest proportion of ELL students in today's schools (U.S. Census Bureau, 2010).
  - (a) Hispanics are the largest and fastest growing minority group in the United States;
  - **(b) disproportionately high numbers of Hispanic children live in poverty (Chau, Thampi, & Wight, 2010)**
  - (c) Hispanic children, as a group, struggle with relatively poor educational achievement

Disadvantages ELL students may face

- Parenting challenges associated with non-conventional work hours
- Cognitive, language and brain effects of poverty – see especially Noble, 2005 and 2015
- Cognitive, language and brain effects of stress

ELL students often also have a high proportion of unidentified learning disabilities

- Standardized test scores alone cannot distinguish between learning disabilities and other factors
  - such as a student's low level of proficiency in his or her first language,
  - limited prior schooling, and
  - low levels of English proficiency, which may cause an English learner student to perform below standards



Neuron
NeuroView

Neuroscience and the Future of Early Childhood Policy: Moving from Why to What and How

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[1]Center on the Developing Child, Harvard University, Cambridge, MA 02138, USA
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DOI 10.1016/j.neuron.2010.08.032

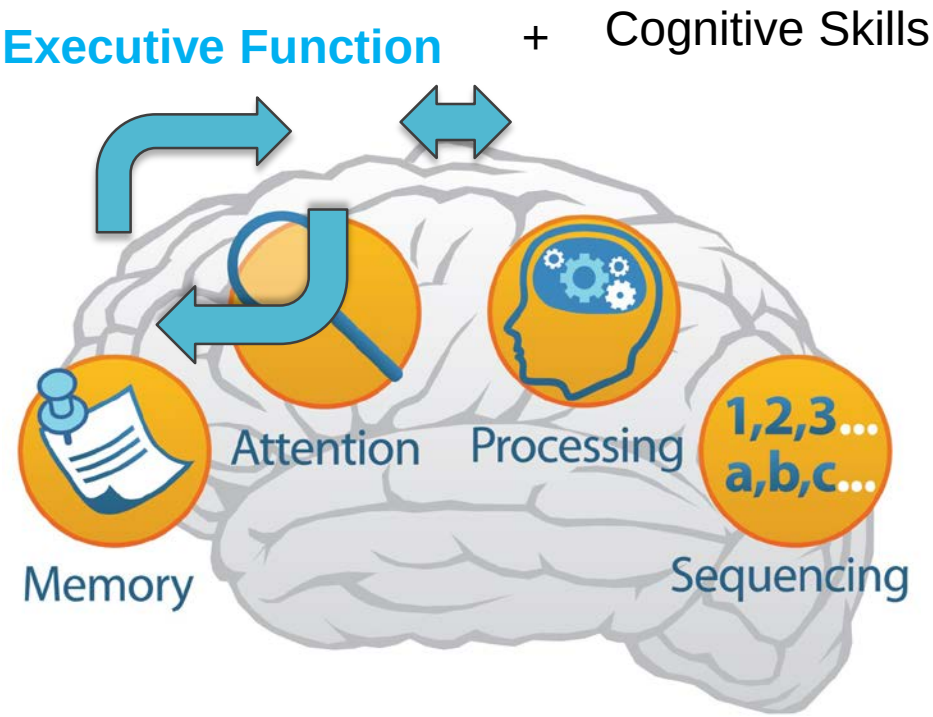
There is a need for greater synergy between advances in neuroscience and the formulation of innovative policies to improve life outcomes for children experiencing significant adversity. Translational developmental neuroscience can inform new theories of change to catalyze more effective interventions that lead to a more productive and healthier society.

Solutions: Neuroscience – Moving from Why to *What and How*

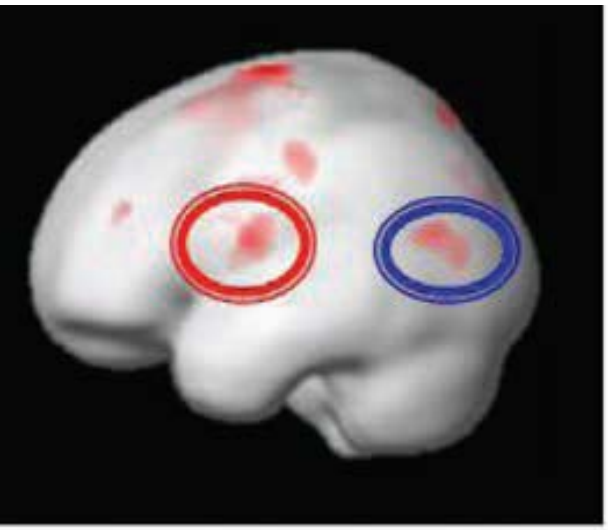
- Positive experiences after infancy have been shown to compensate to some degree for the negative behavioral consequences
  - Being exposed to an environment rich in opportunities for exploration and social play,
  - Caring and positive relationships with adults
- Computer activities designed to target the skills that are impacted can turn around some effects of poverty
  - *Fast ForWord* exercises, because of their specific emphasis on language, attention and memory are particularly effective and offer a cost effective valuable solution

The Role of Neuroscience Technology

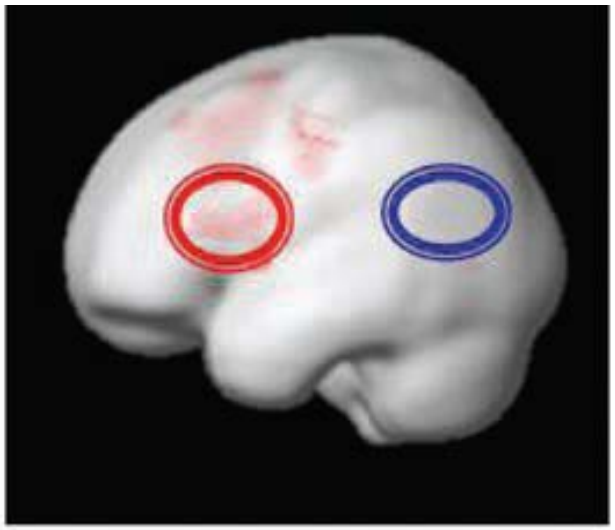
- Well designed neuroscience-based technology
- **builds the underlying capacities that are reduced in some children of poverty or with learning issues**



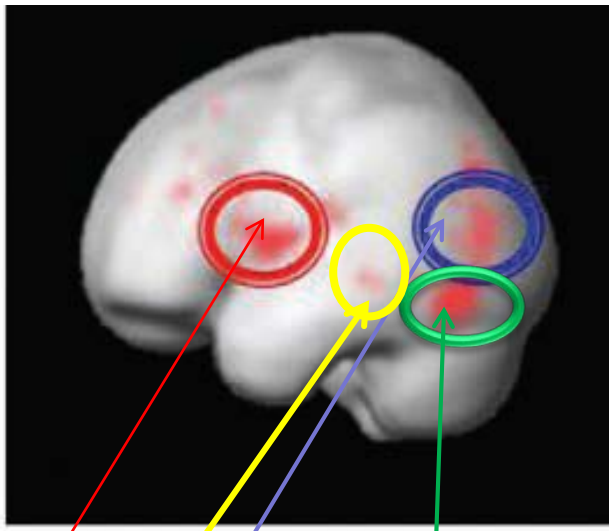
And the Brain Structures affected most by Poverty
LANGUAGE AND READING AREAS ARE ACTIVATED AFTER SIX WEEKS OF FAST FORWORD TRAINING



Typically reading children



Reading Impaired Children



Reading Impaired Children

before remediation

after remediation

Left anterior inferior frontal gyrus IFG

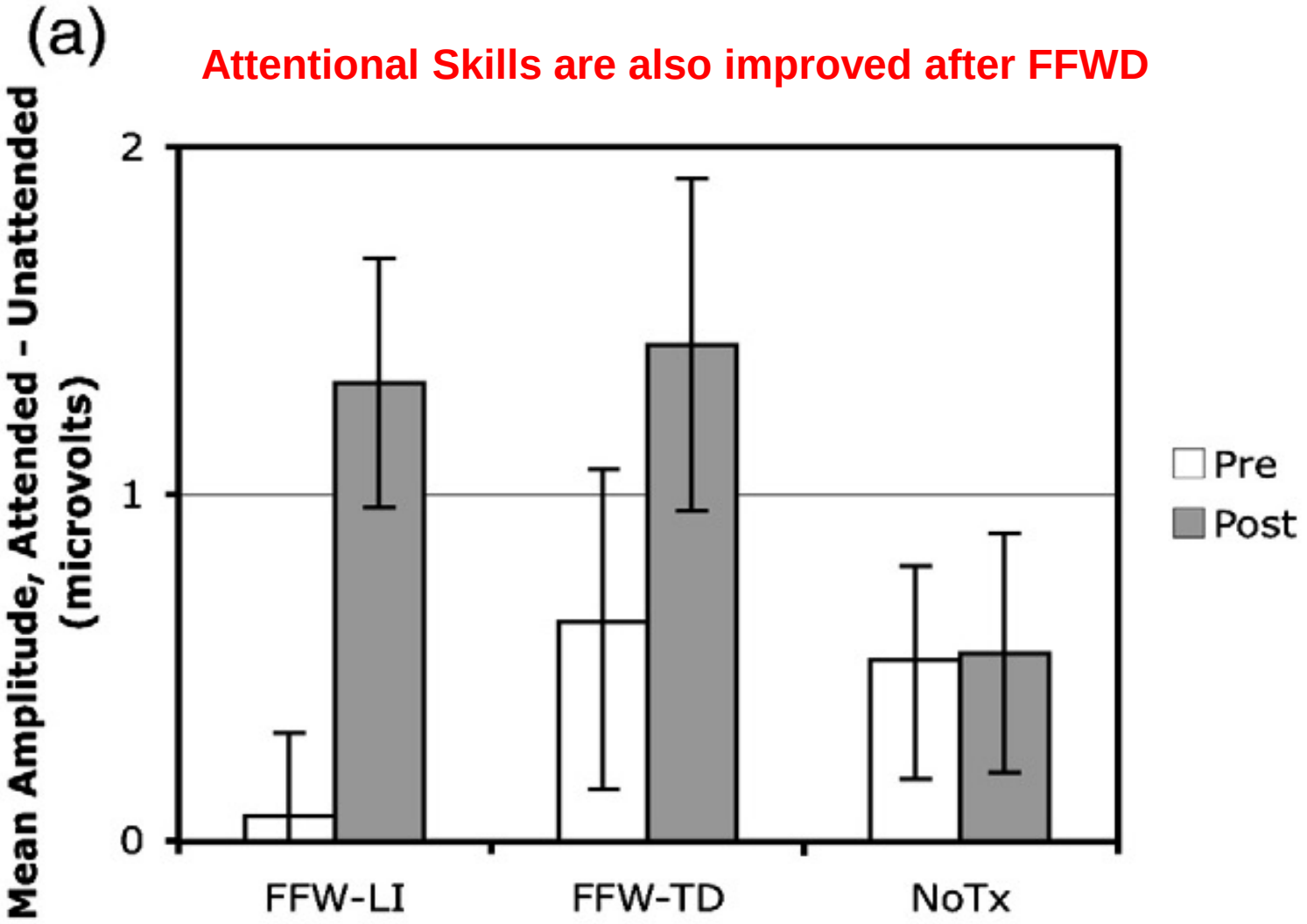
Angular Gyrus AG

Visual Word Form Area

Left Medial Temporal Gyrus

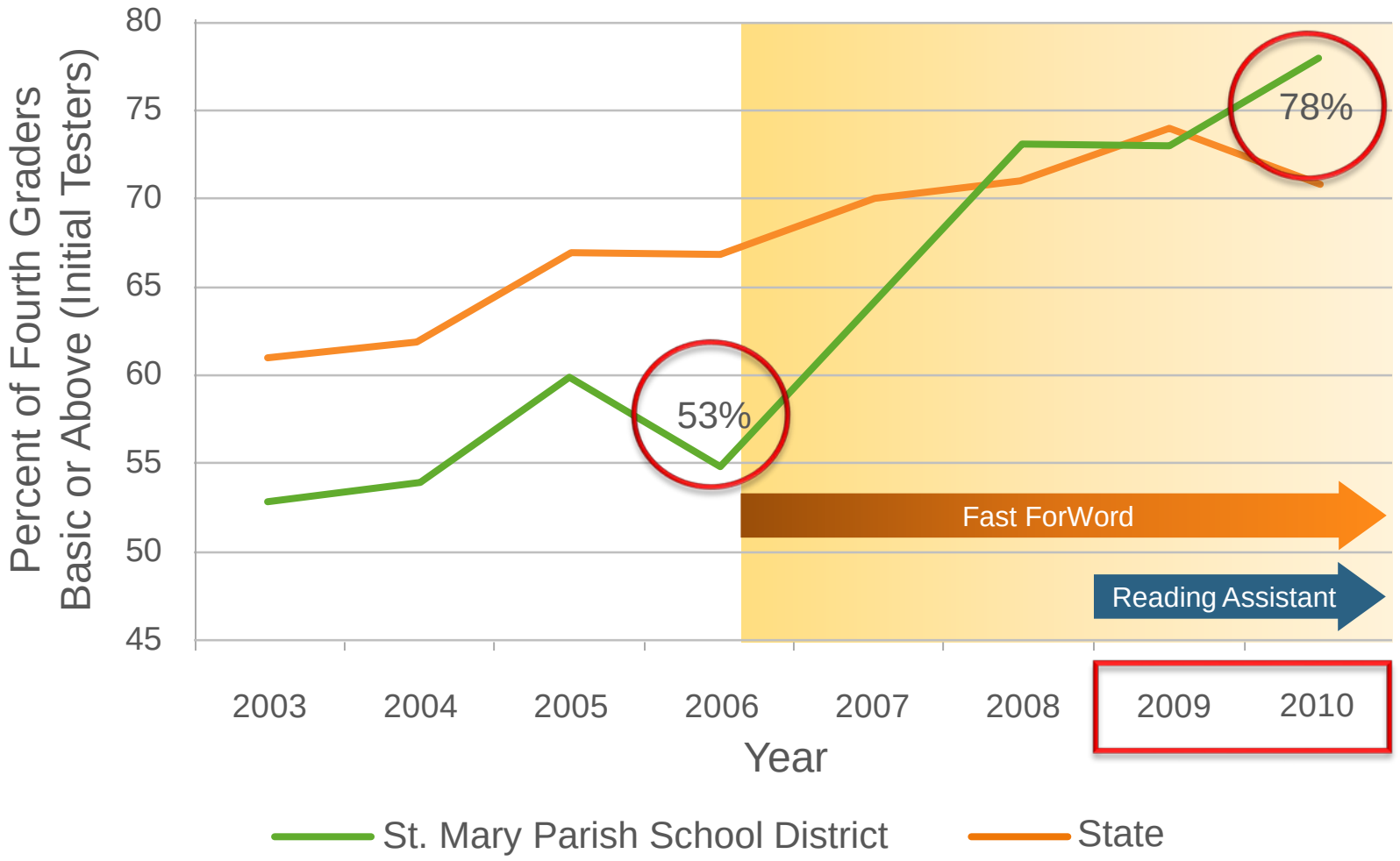
Gabrieli, 2009

Attentional Skills are also improved after FFWD



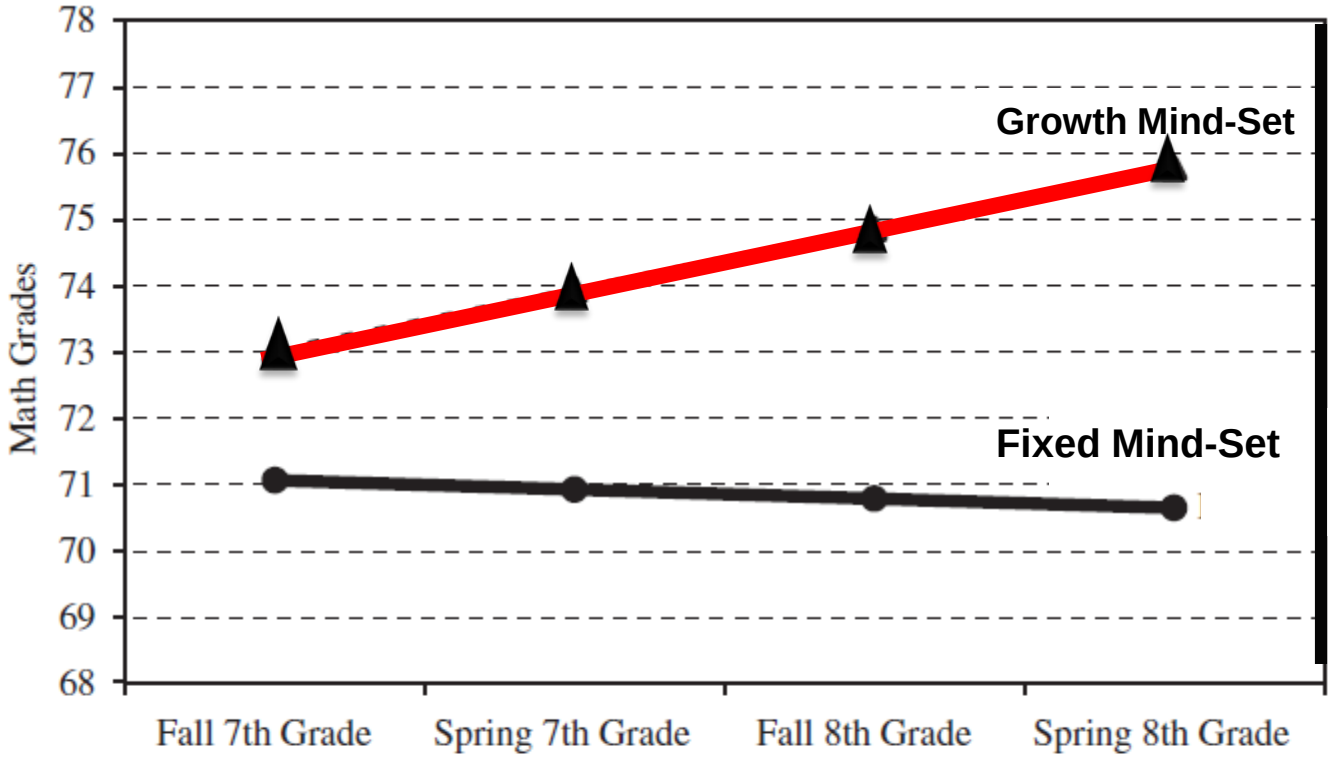
Courtney Stevens, et al. *B R A I N R E S E A R C H* 1 2 0 5 (2 0 0 8) 5 5 – 6 9

In a large urban district with high poverty and ELL students Accelerating Growth – District Wide



The Secret to Raising Smart Kids

Carol S. Dweck, Scientific American, 2013



Students who believe intelligence is malleable (growth mind-set) earned higher math grades in the fall of 7th grade than those who believe in static intelligence (fixed mind-set) even though the groups had equivalent math achievement test scores in the sixth grade. *From Implicit Theories of Intelligence Predict Achievement. L.S. Blackwell et al.,* CHILD Devel., Vol. 78, No. 1

Blackwell, L.S. et al. (2007)