Effects of Poverty on Learning

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The Real 21st-Century Problem in Public Education is Poverty

• A new study showing explosive growth in student poverty suggests we have misidentified the problem

• The Washington Post, November 6, 2013, by Elaine Weiss

• In 2000, ½ the student body in 4 states eligible for free or reduced meals

• Just eleven years later — over half of public school students are poor in 17 states (all but two Southern states and most Western)

• Student poverty is the dominant reality — in three of the biggest states – California, Texas and Florida — and nearly the majority in New York, Michigan and Illinois.

Brains, Schools and a Vicious Cycle of Poverty

• May 13, 2015

• By ALISON GOPNIK

• A fifth or more of American children grow up in poverty, with the situation worsening since 2000, according to census data.

• And that is widening the income/achievement gap in our schools

Wall Street Journal
FIGURE 2. Development of Income Achievement Gaps in Reading, Kindergarten–8th grade
Reardon, SF (2013) The Widening Income Achievement Gap. Educational Leadership Volume 70 | Number 8 Faces of Poverty Pages 10-16

Key Points

• Children raised in poverty are exposed to millions of fewer spoken words at home
• Income level negatively impacts cognitive functions
• There are links between family income and memory and attention
• Poverty is associated with chronic stress which can have a toxic effect on brain architecture
• ELL’s often have a triple jeopardy – language barrier to learning, history of poverty, learning disabilities
• Computer games designed to target the skills that are impacted can turn around some effects of poverty

Language Experiences
Language Experiences by Group

![Graph showing differences in cumulative words addressed to children by age and income group.](Image)

**Meaningful Differences in the Everyday Experience of Young American Children**

*by Betty Hart & Todd R. Risley.*


<table>
<thead>
<tr>
<th>Age Child in Months</th>
<th>Working-class</th>
<th>Welfare</th>
<th>Professional</th>
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<tbody>
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<td></td>
<td>26 Million</td>
<td>13 Million</td>
<td>45 Million</td>
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**The Effects of Weaknesses in Oral Language on Reading Growth**

(Hirsch, 1996)

- High Oral Language in Kindergarten: Reading Age Level 16
- Low Oral Language in Kindergarten: Reading Age Level 5

5.2 years difference

There are links between family income and memory and attention.
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.

Income Effects on Brain Development (Noble et al, 2015)

• Among low income families, small differences in income were associated with relatively large differences in surface area.

• Among children from higher income families, similar income increments were associated with smaller differences in surface area.

The relationships were most prominent in regions supporting language, reading, executive functions and spatial skills; surface area mediated socioeconomic differences in certain neurocognitive abilities.

Brain structure and poverty (Noble et al, 2015)

• Brain Structure and income level relationships were most prominent in regions supporting language, reading, executive functions and spatial skills.
Noble et al 2015 Conclusion

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

A month later – Gabrielli’s Lab at MIT

- Published research 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**

Neuroanatomical Correlates of the Income-Achievement Gap


By October see differential effects of SES on kinds of memory (working versus procedural memory)

So... SES does not affect ability to learn or intelligence

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

And two months ago—Reuters

Health Mon Jul 20, 2015 3:32pm

- Effect of poverty on brains may explain poor kids' lower test scores
- 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

Stress

- death or serious illness of a loved one,
- a frightening accident,
- an acrimonious parental separation or divorce,
- persistent discrimination,
- or other serious events
Tolerable stress

- Has the potential to negatively affect the architecture of the developing brain,
- but if occurring over limited time periods
  - Allows for the brain to recover and thereby reverse potentially harmful effects
  - *Always in the context of ongoing, supportive relationships with adults.*

Toxic Stress

- Strong, frequent, or prolonged activation of the body’s stress management system.
  - Stressful events that are chronic, uncontrollable, and/or experienced without children having access to support from caring adults
  - For example, severe, chronic abuse, especially during early, sensitive periods of brain development

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, and 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

- 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.

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

Biology

(1) the sympathetic-adrenomedullary (SAM) system, which produces adrenaline in the central part of the adrenal gland

(2) the hypothalamic-pituitary-adrenocortical (HPA) system, which produces cortisol in the outer shell of the adrenal gland

Both adrenaline and cortisol are produced under normal circumstances and help prepare the body for coping with stressors.

LANGUAGE AND READING AREAS (TWO OF THE AREAS MOST IMPACTED BY POVERTY) ARE ACTIVATED AFTER SIX WEEKS OF FAST FORWARD TRAINING

Typically reading children

Children with dyslexia before remediation

Children with dyslexia after remediation

Gabrielli, 2009

Left anterior inferior frontal gyrus IFG
Gyrus AG
Visual Word Form Area
New Research on the Gender Gap
October 21, 2015

Boy-Girl Gaps by Family Characteristics

D. By SES Quartile

C. By Marital Status at Birth
New Research on negative brain effects of stress related to how we teach

- What Neuroscience Reveals About Bullying by Educators
- *EDUTOPIA* SEPTEMBER 21, 2015

- When parents and educators understand just how permanent and damaging bullying is to the brain, it won't seem extreme to argue that teachers and coaches should be held legally accountable as well
Maternal Stress during pregnancy is also pernicious

- Significant maternal stress during pregnancy and poor maternal care during infancy
  - affects the developing stress system
  - alters genes that are involved in brain development.

Socioeconomic Risk Factors NCES Found Effects Kindergarten Readiness

- having a single parent,
- having a mother who didn’t graduate high school,
- living below the federal poverty line, and
- living in a household where English was not spoken as the first language

Risk Factor Effect on Academic Skill Level in Reading and Math

Bernstein, S. et al. (2014)
For SPED Students

- School districts are now required to demonstrate RDA (Results Driven Accountability) for children who qualify for Special Education
  - This means the academic performance of children in SPED programs is required
  - No longer is compliance alone satisfactory

ELL ISSUES EXTEND BEYOND THE LANGUAGE BARRIER

Learning a second language after the critical period

Learning a second language during the critical period
ELL enrollment in schools more than doubled between 1997 and 2008 (National Clearinghouse for English Language Acquisition, 2010).

A large proportion of ELL students are also from low SES environments.

And, ELL students often 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—that may cause an English learner student to perform below standards.
Establishing English Proficiency as early as possible is essential

- ELL children who become fully proficient in English,
- And who do so earlier in their educational career,
- Do better later in school than those who continue to struggle with English proficiency (Halle, Hair, Wandner, McNamara, & Chien, 2012).

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
A Meta-Analysis of the Research

• IS NEUROSCIENTIFIC RESEARCH USEFUL FOR EDUCATORS?
• DOES THE CONTENT OF THE INTERVENTION MATTER?
• HOW LONG-LASTING ARE THE REMEDIAL GAINS IN THE BRAIN?

IS NEUROSCIENTIFIC RESEARCH USEFUL FOR EDUCATORS? (Ylinen and Kujala, 2015)

• Neuroscientific research shows that improved behavioral performance is coupled with change in both brain function and brain anatomy.
• Especially in the study of dyslexia, neuroscientific studies have illuminated the location of aberrant brain functions, which enables us to specify the models of the impairment.

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
Effects of Fast ForWord on Attentional Skills


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Improving Fluid Intelligence with Training on Working Memory

Susanne M. Jaeggi, Martin Buschkuehl, John Jonides, and Walter J. Perrig.
*Proceedings of the National Academy of Sciences*. May, 2008

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Working Memory Training Improves Reading Processes in Typically Developing Children

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. LS Blackwell et al., CHILD Dev., Vol. 78, No. 1