

Effects of poverty on the developing brain

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White House Conference on Early Childhood Development and Learning Policy Announcements



On April 17, 1997, the President and First Lady hosted The White House Conference on Early Childhood Development and Learning: What New Research on the Brain Tells Us About Our Youngest Children. The day-long conference highlighted new scientific findings on brain development in very young children and points to the importance of children's earliest experiences in helping them get off to a strong and healthy start and reach their full potential.

Clinton Administration Commitment to Young Children. The Clinton Administration has invested heavily in research to help us



THE MYTH
OF THE
FIRST THREE
YEARS



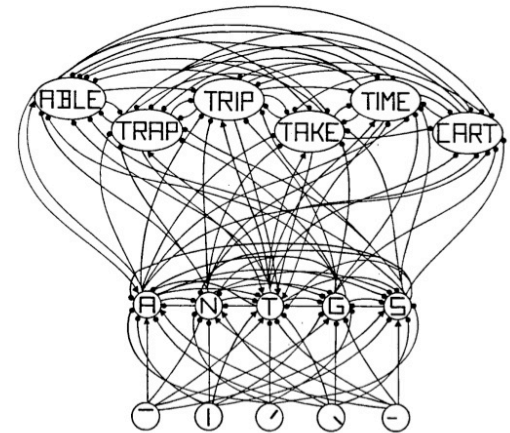
A NEW UNDERSTANDING OF
EARLY BRAIN DEVELOPMENT
AND LIFELONG LEARNING

JOHN T. BRUER, PH.D.



Center for Neuroscience & Society
UNIVERSITY of PENNSYLVANIA

15 years of cognitive, affective and developmental neuroscience



Why apply neuroscience to problems of child poverty?

- Understanding human behavior is hard – need all the sources of understanding you can get!
- There are principles and mechanisms at work that are, at root, neural

More later...



Low SES



Raise children
in poverty

Grow up to
become



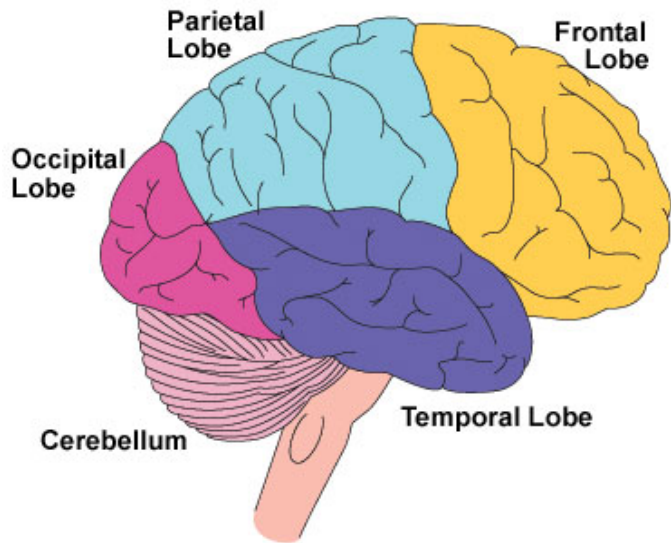
Compromised physical
and mental health



Initial questions

- What aspects of brain function differ between children raised in poverty and children who are non-poor?
- By what mechanisms do these differences emerge?





- Occipitotemporal/ pattern vision
- Parietal/ spatial cognition
- Medial temporal/ memory
- Left perisylvian/ language
- Prefrontal/ executive
 - DLPFC/ working memory
 - ACC/ cognitive control
 - VMPFC/ reward processing

Task battery approach:
Sets of tasks from imaging literature used as probes for system integrity



Over three initial studies...

- Noble et al (2005), Farah et al (2006), Noble et al (2007)
- Different ages, tasks -> generally consistent results
- SES disparities uneven
- Small borderline significant effects found in most systems
- Strongest relationships to:
 - **Language** (all 3 studies)
 - **Executive function** (esp cognitive control and working memory) (all 3 studies)
 - **Declarative memory** (2 out of 3 studies)

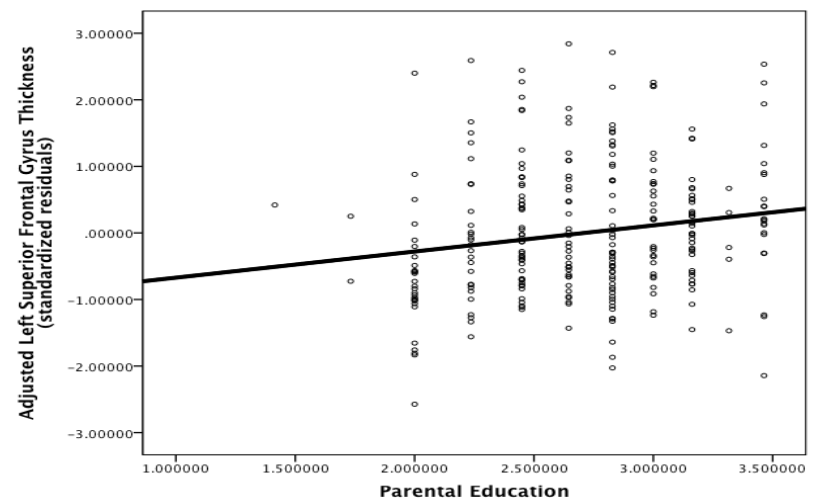
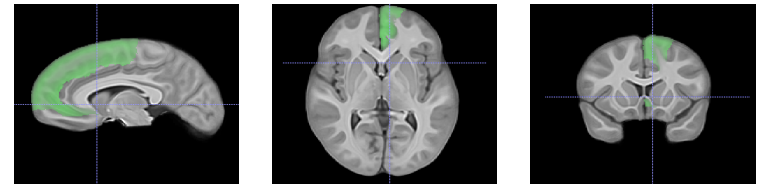
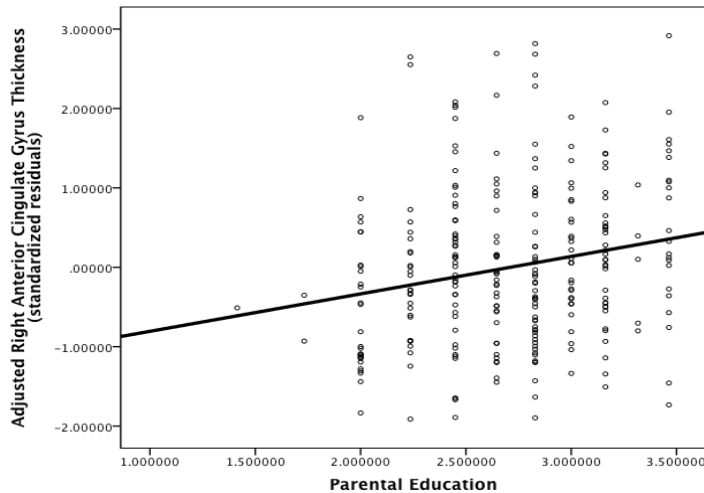
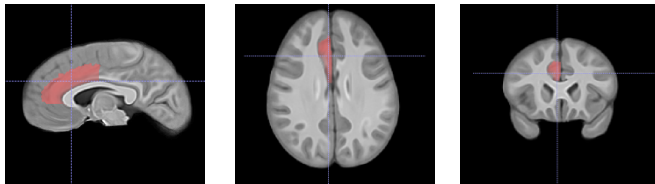


Direct measures of brain structure



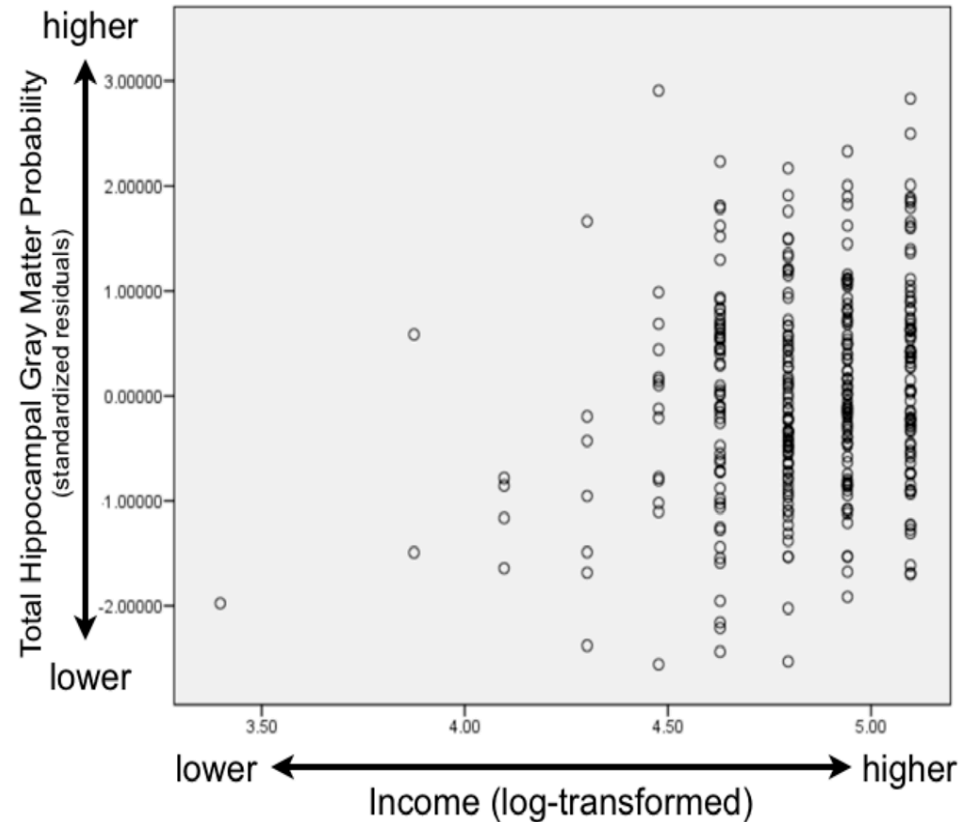
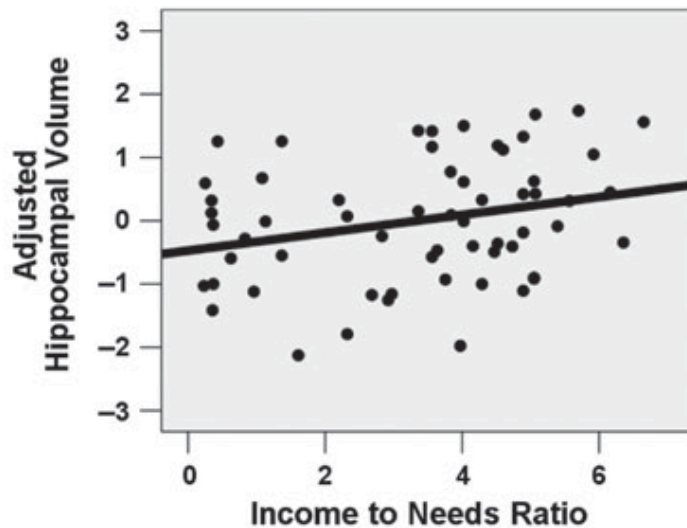
Direct measures of brain structure

- Prefrontal cortex (EF) (from Lawson et al, in press)



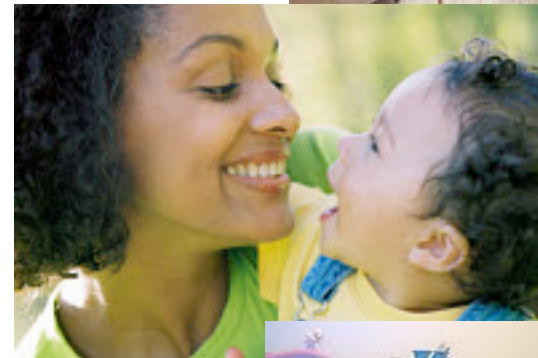
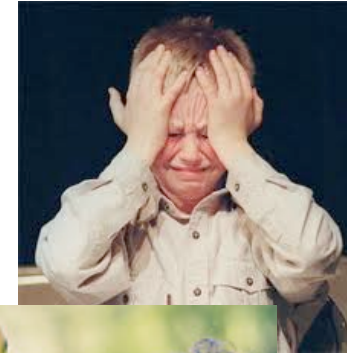
Direct measures of brain structure

- Hippocampus (memory) (from Noble et al, in press and Hanson)



Why?

- Somatic factors: nutrition, environmental toxins, natal and prenatal factors
- Psychological factors include:
 - Stress
 - Parenting
 - Cognitive stimulation



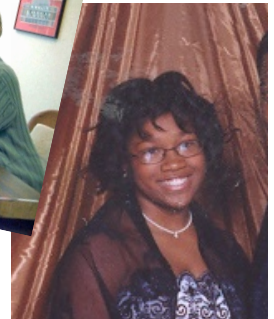
Language and Memory differences

Middle schoolers from Hallam Hurt's longitudinal study of GCE

HOME visits at ages 4 and 8

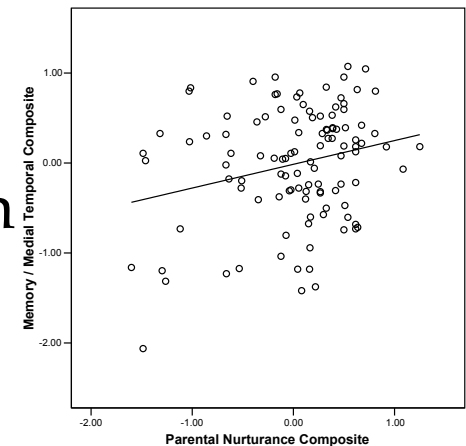
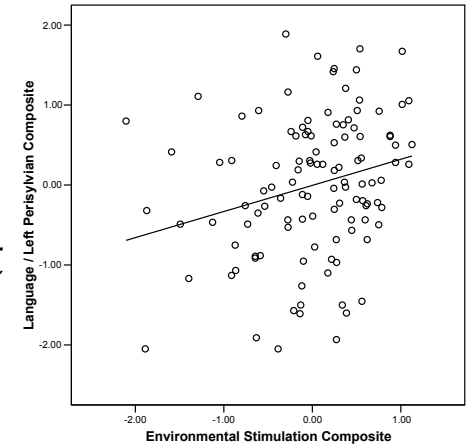
- Cognitive Stimulation composite
- Parental Nurturance composite

Also prenatal substance exposure, mother's IQ, as well as child's gender, current age

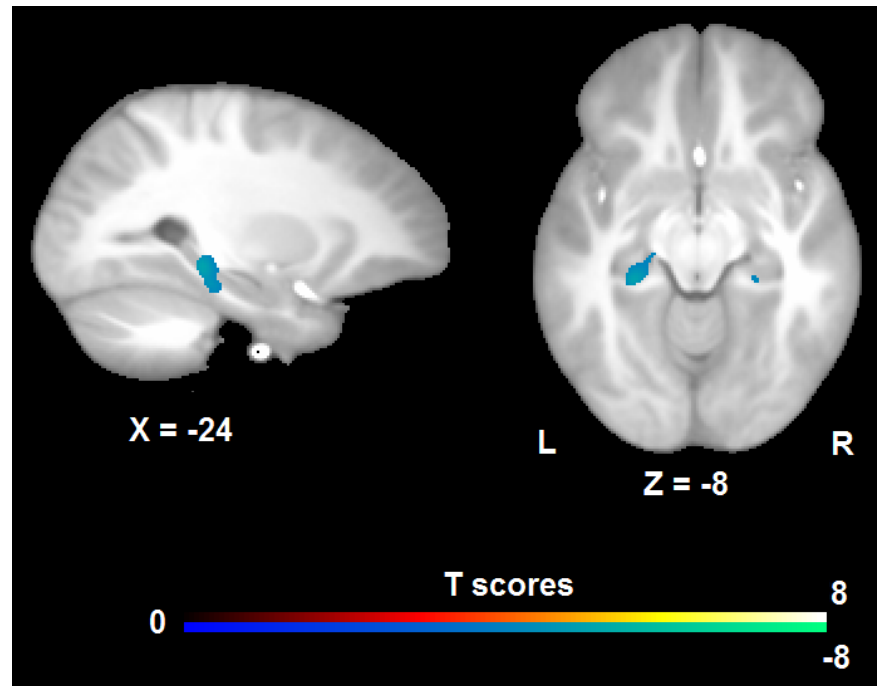


Results

- Language:
 - Environmental stimulation matters
 - Sole factor (along with the child's age at language testing)
- Memory:
 - Parental nurturance matters
 - Sole factor in forward regression (and strongest factor in backward, along with effects of prenatal substance exposure and the child's age at memory testing)



Hengyi Rao et al, 2010, *Neuroimage*



Effect of early experience on hippocampal volume
Parental nurturance, not cognitive stimulation (no gender effect or interaction)



Why does parental nurturance affect memory and hippocampus?



- Maternal care buffers pups' hippocampi from effects of stress, resulting in
 - Better memory
 - Better stress response



Direct test of effects of parental nurturance on human stress response

Arrive, 25 min baseline rest period (watch Dr. Doolittle)

Prepare and give 3-minute talk: Why should someone hire you for a summer job?

Serial subtraction for 3 minutes

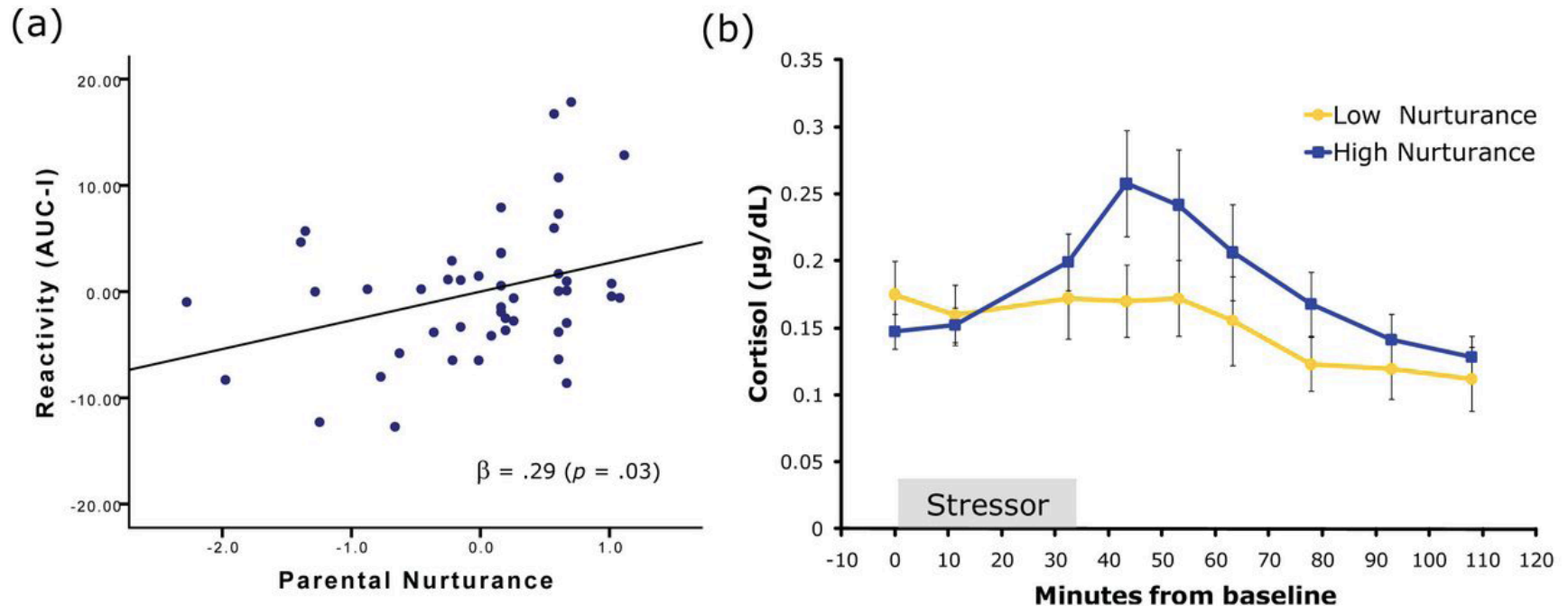
Remain in quiet room for 75 min and finish watching Dr. Doolittle

Saliva samples throughout



Early experience

Parental nurturance, not cognitive stimulation (no gender effect or interaction)



Daniel Hackman et al. (under review)



Why apply neuroscience to problems of child poverty?

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- There are principles and mechanisms at work that are, at root, neural
- Mechanisms are basis for prevention, intervention
- Framing



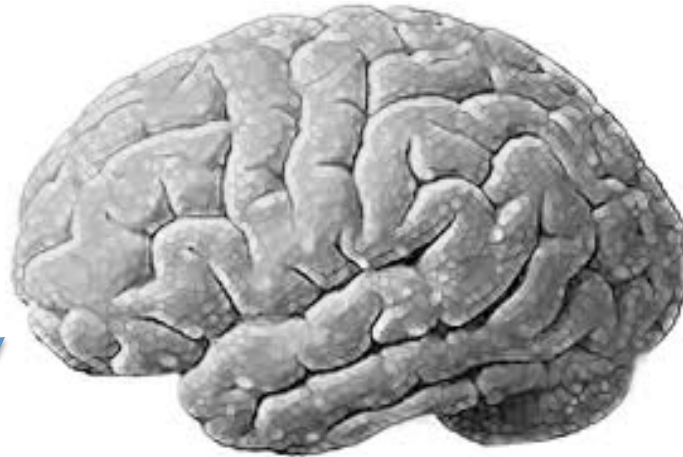
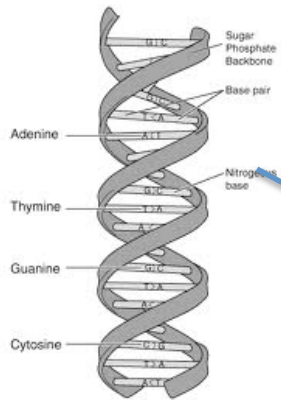
Thank you

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Behavior

Experience

