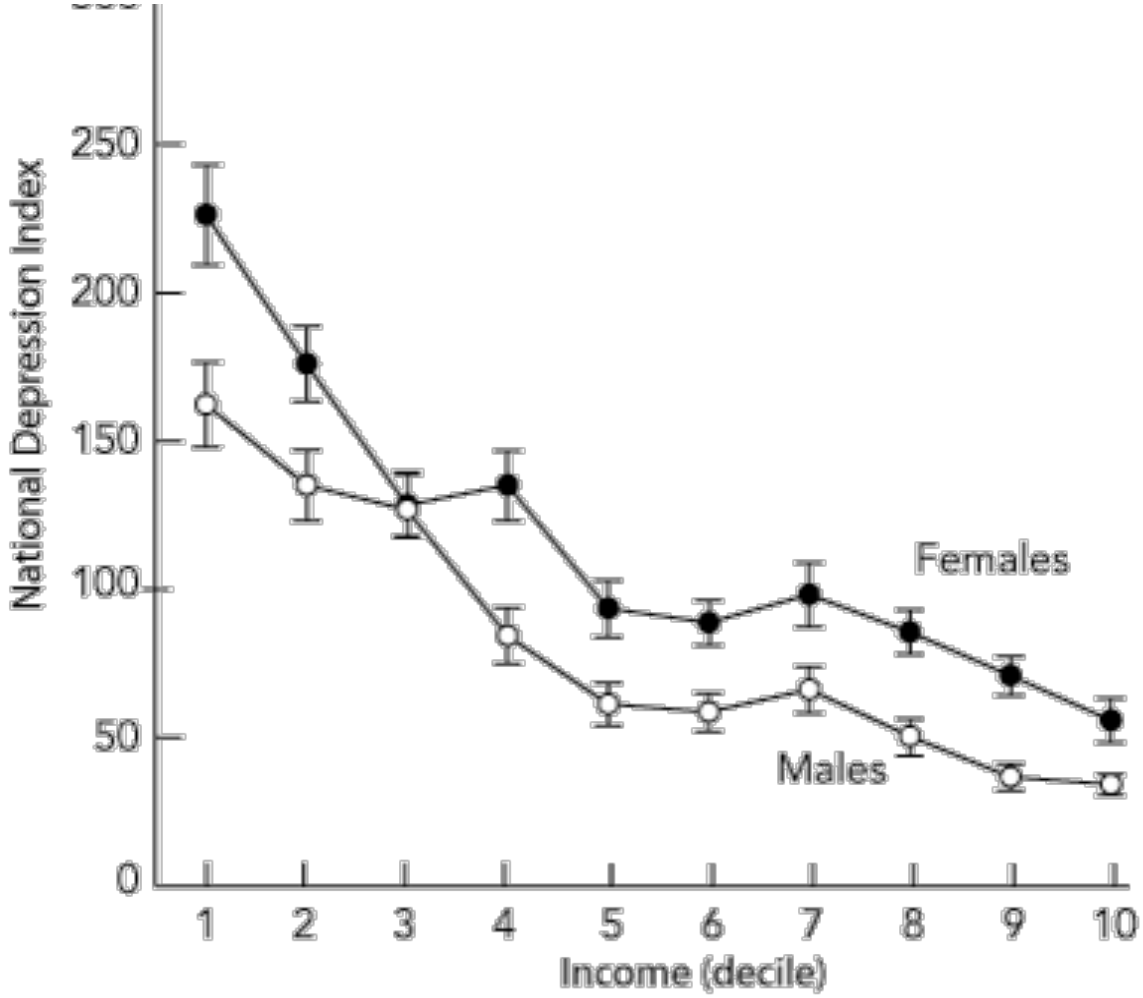
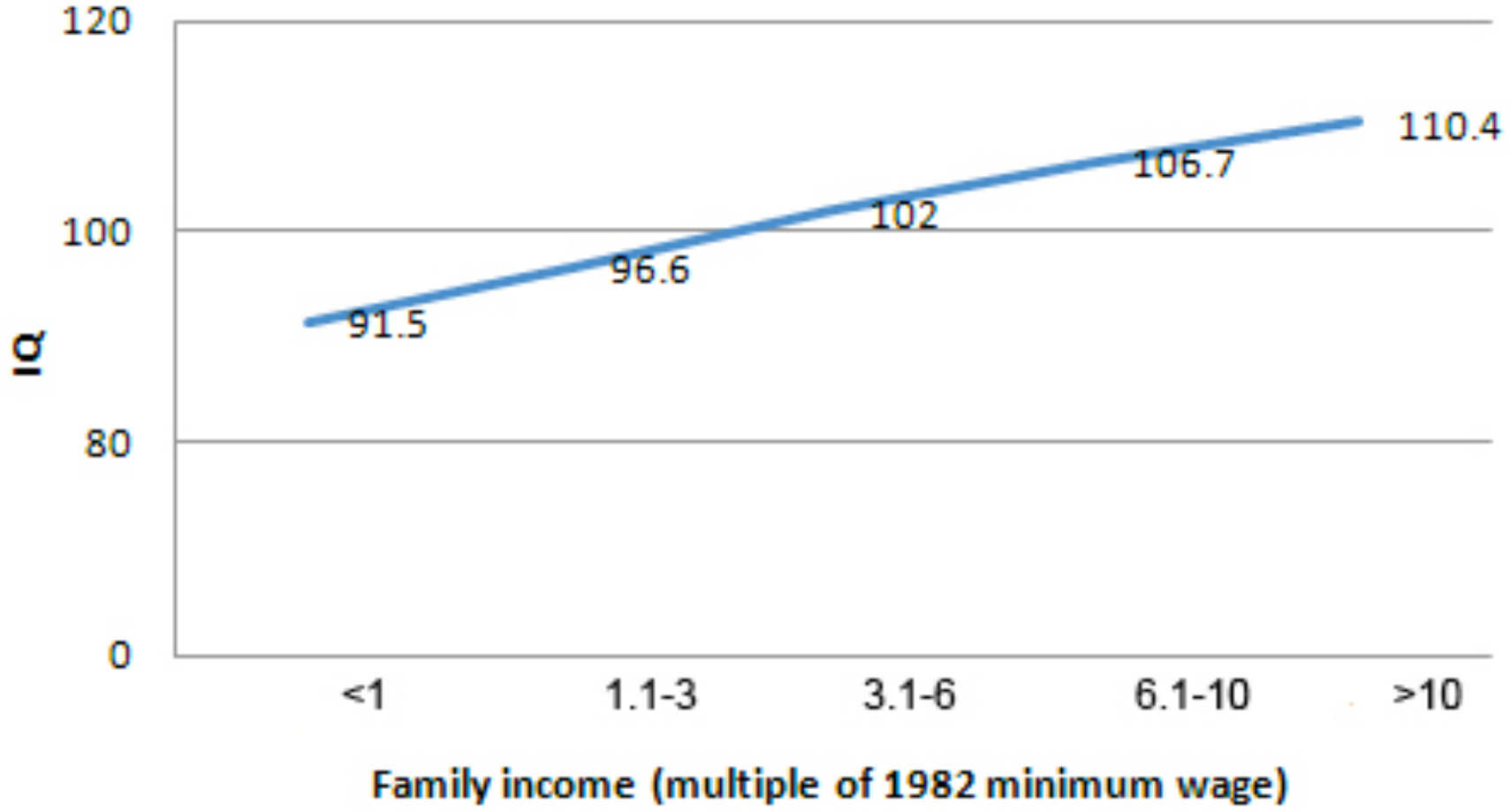
Childhood Poverty and Brain Development: From Science to Policy

Martha J. Farah
University of Pennsylvania

Center for Neuroscience & Society
University of Pennsylvania


National Depression Index
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
Income (decile)
Females
Males

Impact of family income on IQ



Low SES

Raise children in poverty

Grow up to become

Compromised physical and mental health and intellectual development

Questions

Neurocognitive correlates of SES?

Causal pathways?

Value added by neuroscience?

Policy implications?

Questions

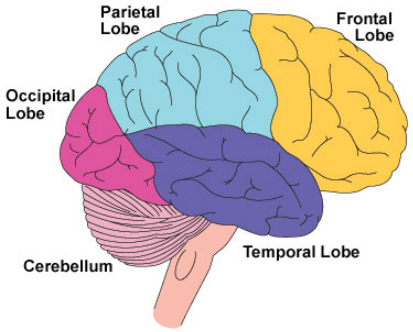
Neurocognitive correlates of SES?

Causal pathways?

Value added by neuroscience?

Policy implications?

Neurocognitive profile of SES disparities



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

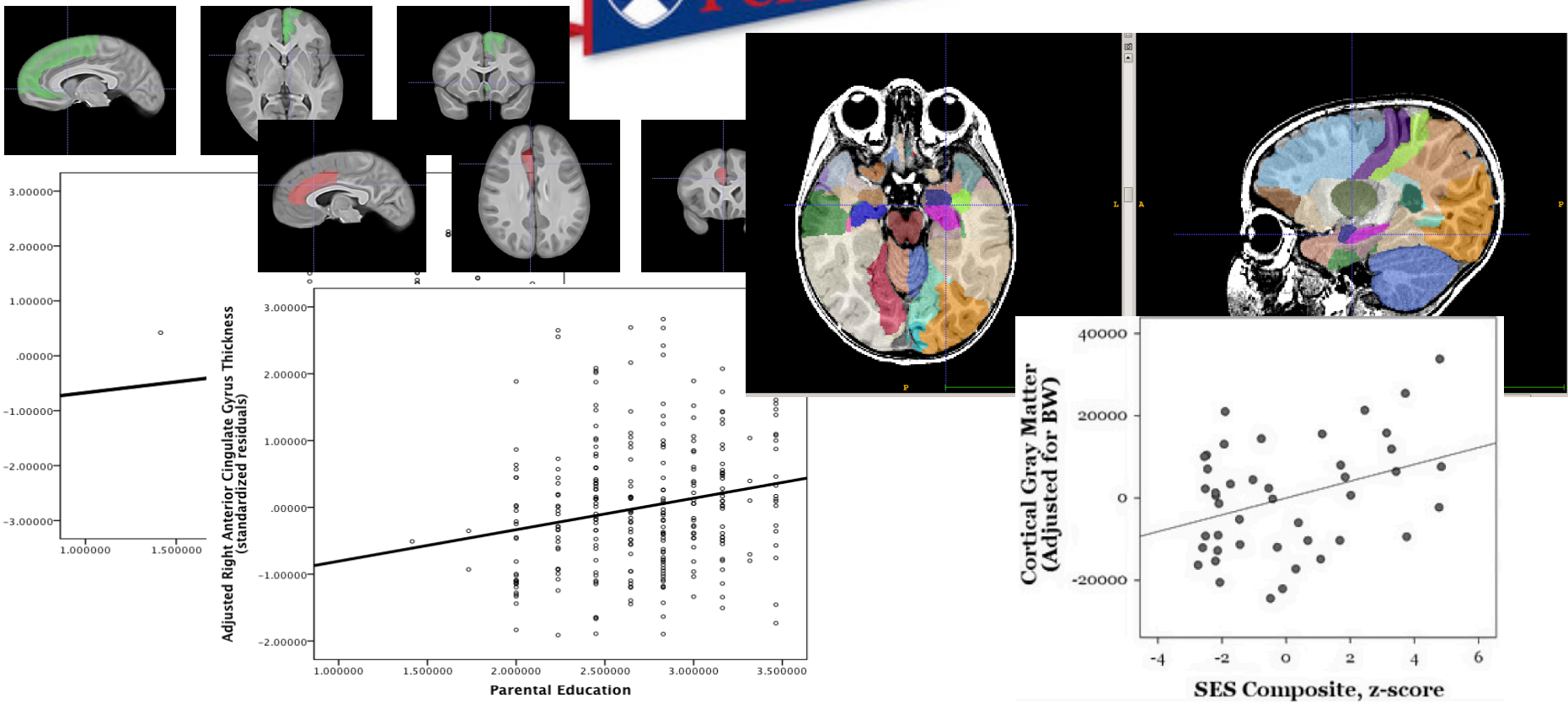
Across the three studies (w Kim Noble, Hallam Hurt and others):

At different ages, w different sets of tasks:

SES disparities uneven, with strongest relationships to:

- Language
- Executive function (esp cognitive control and working memory)
- Declarative memory

Anatomy


Adjusted Left Superior Frontal Gyrus Thickness (standardized residuals)
3.00000
2.00000
1.00000
.00000
-1.00000
-2.00000
-3.00000
1.000000
1.500000
Adjusted Right Anterior Cingulate Gyrus Thickness (standardized residuals)
3.00000
2.00000
1.00000
.00000
-1.00000
-2.00000
1.000000
1.500000
2.000000
2.500000
3.000000
3.500000
Parental Education
Cortical Gray Matter (Adjusted for BW)
40000
20000
0
-20000
-4
-2
0
2
4
6
SES Composite, z-score

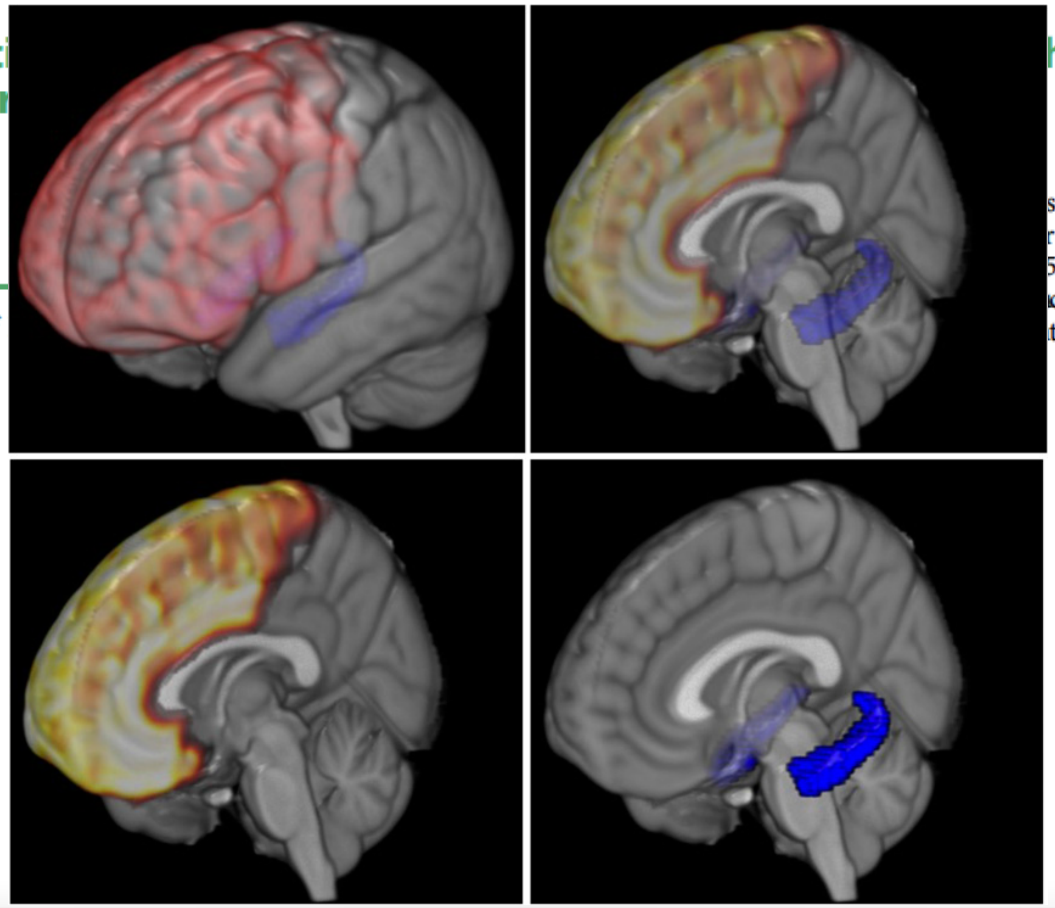
Anatomy

PNAS

News Feature: The neuroscience of poverty

Neuroscienti… hapes children's br…

Alla Katsnelson
Science Writer



…s in ways that diminish …r escaping poverty?
…5 years ago, and from the …ucational psychologists, and …thusiasm about the idea of

It wasn't the birth of

Questions

Neurocognitive correlates of SES?

Causal pathways?

Value added by neuroscience?

Policy implications?

Potential causes

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

APPLIED COGNITIVE PSYCHOLOGY, VOL. 11, 113–120 (1997)

Memory Performance and Socio-Economic Status

DOUGLAS HERRMANN
Indiana State University

MARY ANN GUADAGNO
National Center for Health Statistics

Table 2. Examples of differences in memory performance for low and high SES subjects

	Low SES	High SES	High/low SES performance ratio
III. *Event long-term memory*			
Rote memory			
Paired associates (CBS)	2.2	4.4	2.00
Pairs (VM)	0.32	0.54	1.69
Weschler Paired Associates Test (D *et al.*)	76.4	92.7	1.21
Word recall (CBBS)	3.1	5.9	1.90
Categorized word list (H)	47.8	58.8	1.23
Recall-MMSE (OPTBR)	1.6	1.8	1.13
Word list (VM)	0.19	0.43	2.26
Mean ratio			*1.63*

Why?

"The explanation of the positive correlation between SES and memory performance is not possible at this time.

...the relationship may be due to the heritability of acquired memory ability across SES...

Alternatively, the positive correlation between SES and memory may be due to a variety of environmental influences: variations in physical health across SES and emotional adjustment... access to quality education across SES that affect the acquisition of memory strategies... SES may influence motivation to perform memory tasks..."

APPLIED COGNITIVE PSYCHOLOGY, VOL. 12, 593–609 (1998)

Socio-Economic Status, Social Class and Memory Performance: A Critical Response to Herrmann and Guadagno (1997)

JOHN T. E. RICHARDSON*

Brunel University, UK

SUMMARY

Herrmann and Guadagno (1997) reviewed evidence concerning the relationship between memory performance and socio-economic status (SES). As a measure of social stratification, SES is narrow and ethnocentric, and it ignores the role of social prestige, power and status. The selection of research for quantitative analysis and the measure of effect size used by Herrmann and Guadagno are criticized. Across the available corpus of studies, there is a highly significant relationship between SES and memory performance, but this varies systematically from one task to another and between different research studies using the same task. This indicates that the effects of SES on memory are mediated by the content and the context of learning.

Why?

"[H&G] apparently regarded SES as a set of characteristics that resided in someone's personality, self-concept and behavior. To that extent, theirs is an essentialist view of social class: SES is something that people have or are; and low-SES and high-SES people differ in their memory function simply because they are low-SES or high-SES people..."

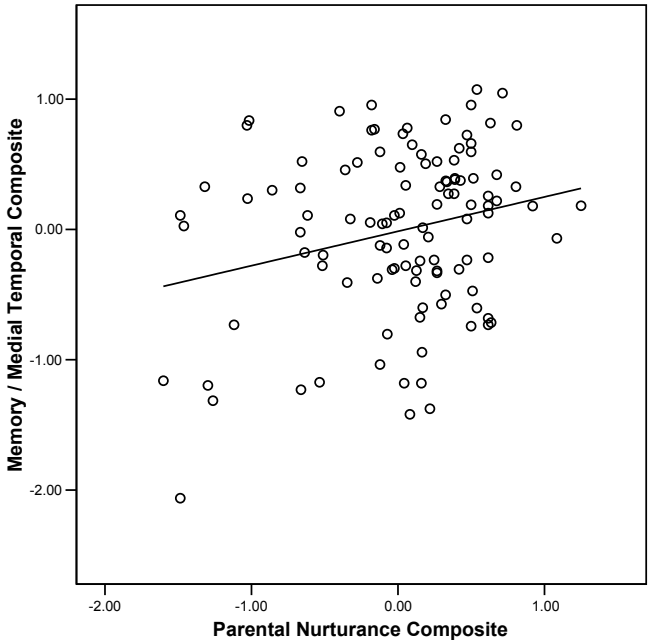
"class-related differences in memory performance are actually constituted in particular relationships between researchers and their participants. "

Why? A clue from neuroscience

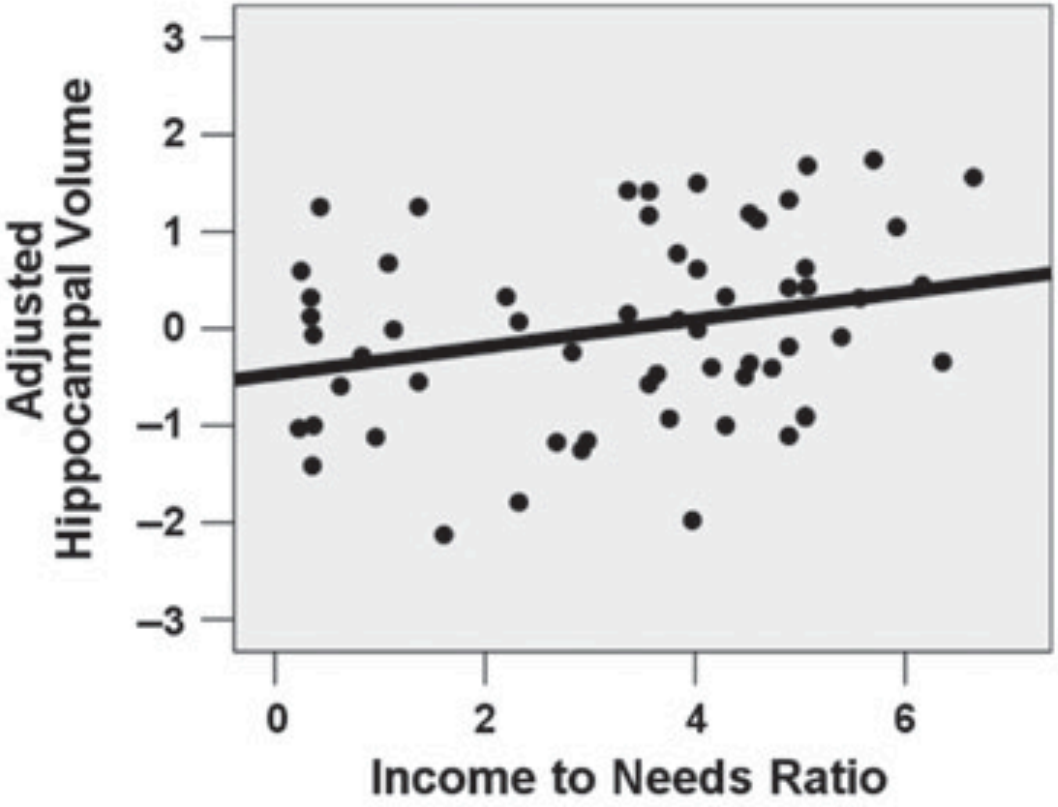
- Maternal care buffers pups' hippocampi from effects of stress, resulting in
  - Better memory
  - Better stress response

Early parental nurturance and later memory

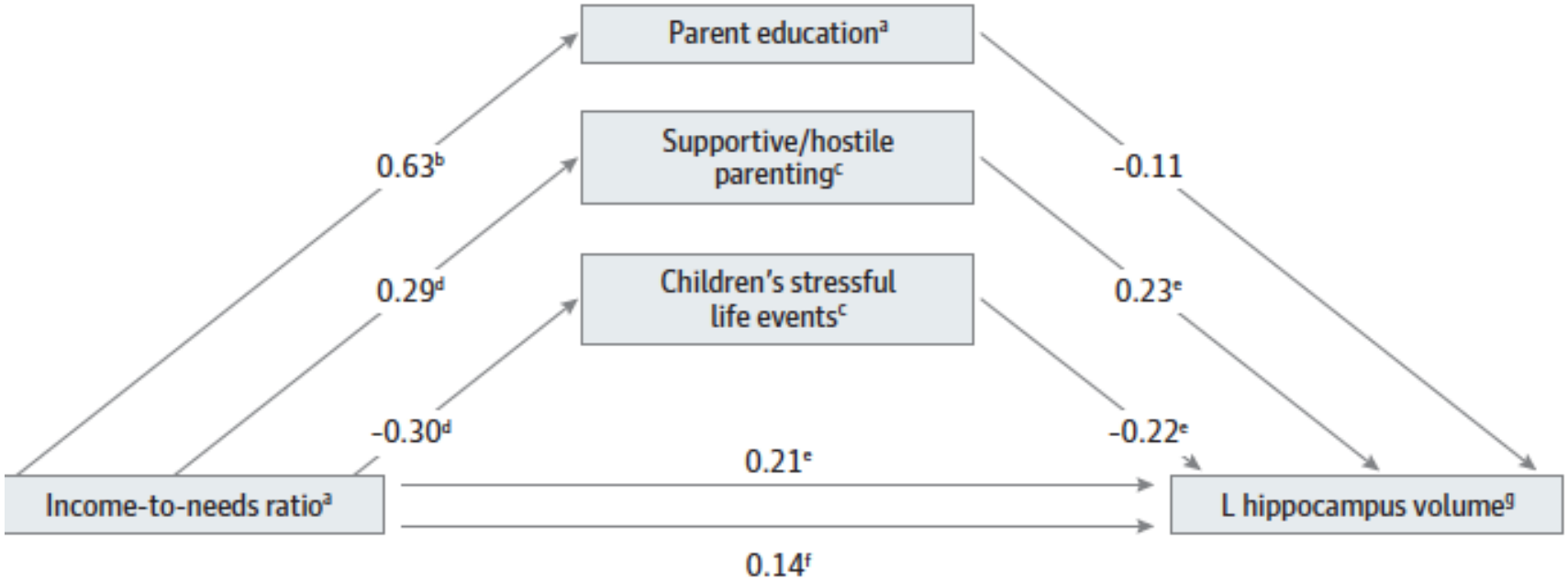
- Memory:
  - Parental nurturance matters
  - Sole factor in forward regression (and strongest factor in backward, along with effects of prenatal substance exposure and the child's age at memory testing)



Hippocampus (from Noble et al, 2012)



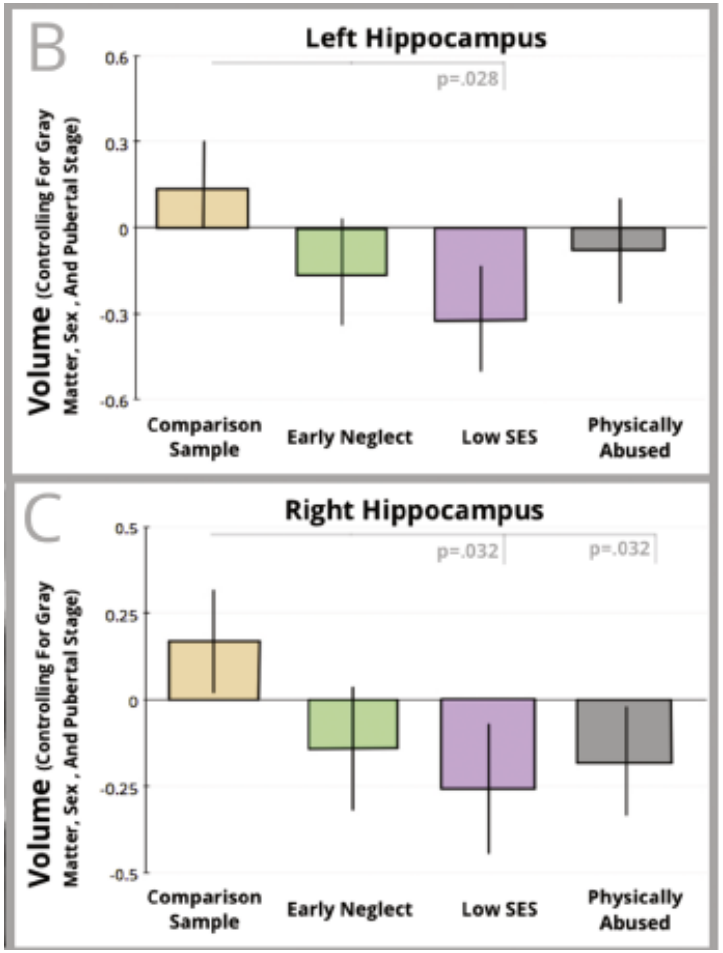
From Luby et al., 2013



So, low SES is like high ACE*?

*Adverse Childhood Experience

Hanson et al.
Biological Psychiatry, 2014



So, low SES is like high ACE?

Region of Interest	Predictor	Beta	*p*
Left hippocampus			
	Childhood SES	-.01	.97
	Childhood maltreatment	**-.28**	**.03**
	Total Brain Volume	.61	< .001
	Male	.06	.71
	Age	.11	.42
	BMI	.11	.37
Right hippocampus			
	Childhood SES	.11	.32
	Childhood maltreatment	-.21	.06
	Total Brain Volume	.72	< .001
	Male	-.02	.87
	Age	.01	.94
	BMI	.11	.32

Ages 25-35
In prep

Questions

Neurocognitive correlates of SES?

Causal pathways?

Value added by neuroscience?

Policy implications?

Utility of neuroscience

- Encouraging progress but a long way to go
  - Consistencies across labs and methods, but inconsistencies as well
- Question is not either/or
  - Expect neuroscience solve all the problems, or eschew neuroscience
  - Poverty's effects on child development are complex; we need all hands on deck!

Utility of neuroscience

- En
  - C
    i
- Qu
  - I
    e
  - I
    c

Questions

Neurocognitive correlates of SES?

Causal pathways?

Value added by neuroscience?

Policy implications?

Policy and intervention

- Framing vs substance
- Framing
  - Less blame
  - More interest
- Substance
  - Near-term, not much help beyond rhetorical advantages
  - First practical use may be for biomarkers, personalized interventions

Thank you to my collaborators!

- Kristin Arena
- Brian Avants
- Laura Betancourt
- Josh Camins
- Phil Cook
- Jim Gee
- Jeff Duda
- Daniel Hackman
- Hallam Hurt
- Gwen Lawson
- Kim Noble
- Laura Wisse
- Lucas Wittman

…and others (who will please forgive my forgetfulness!)