Childhood poverty and neurocognitive development

IOM/NRC Board on Children, Youth and Families
Neurodevelopmental Effects in Children with Chronic and Complex Illnesses
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Poverty is not just about money
Figure 1
Mortality Rate by Socioeconomic Status Level

(a-d) Std mortality ratio
(e,f) Annual death rate
(g,h) Infant mortality

Note. (a) Standardized mortality ratio, observed to expected deaths (SMRI male (Kitagawa & Hauser, 1973). (b) SMR female (Kitagawa & Hauser, 1973). (c) SMR male (Adelstein, 1980). (d) SMR female (Adelstein, 1980). (e) Annual death rate per 1,000 (ADR) male (Feldman, Makuc, Kleinman, & Coroman-Huntley, 1989). (f) ADR female (Feldman et al., 1989). (g) Infant mortality per 1,000 live births (IM) male (Susser, Watson, & Hopper, 1985). (h) IM female (Susser et al., 1985).

Figure 2
Morbidity Rate by Socioeconomic Status Level

Note. (a) Percent diagnosed osteoarthritis (Cunningham & Kelsey, 1984). (b) Relative prevalence of chronic disease (Townsend, 1974). (c) Prevalence of hypertension (Kraus, Borhani, & Franti, 1980). (d) Rate of cervical cancer per 100,000 (Devesa & Diamond, 1983).
National Assessment of Educational Progress 2007, 4th Grade Math Results

Why?

- Physical correlates of poverty
  - Environmental toxins
  - Nutrition
  - Other health behaviors: substance use, sleep, exercise, etc.
  - Operating pre- and postnatally

- Psychological correlates of poverty
  - Social stressors: crowding, neighborhood danger and mistrust
  - Parenting behaviors: Less availability, more punitive, less developmentally oriented
  - Fewer opportunities for cognitive stimulation
Low SES

Raise children in poverty

Grow up to become

Compromised physical and mental health
Goal

Mechanistic understanding to enable

- Rationally designed, and therefore more effective, programs of prevention and intervention
- Anticipation of especially risky co-morbidities
Carving nature at the joints

Brain composed of relatively distinct systems
Which are affected by childhood poverty?
By which specific aspects of poverty?
Parsing the SES disparity

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

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

- Kindergarteners
- First graders
- Middle schoolers
Overall Summary*

Across the three studies (different ages, different sets of tasks):

SES disparities uneven, with strongest relationships to:

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

Working memory

From Evans and Schamberg, 2009, *PNAS*
Less IFG asymmetry w low SES

From Raizada et al., 2008, *Neuroimage*
Growing literature consistent with this neurocognitive phenotype – though plenty of uncertainties remain.

Review of literature: Hackman & Farah, 2009
Why?

- Utility of “parsing” the SES effect into different neurocognitive domains (language, EF, learning)
- Distinct outcomes may well have distinct causes
- Follow-up study of the middle school sample (longitudinal study of full low SES sample)
Longitudinal study in low SES sample

Longitudinal study in low SES sample

“HOME” visits at ages 4 and 8
- Cognitive Stimulation composite
- Parental Nurturance composite

Neurocognitive performance in middle school

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)

Utility of parsing SES disparities rather than using IQ or academic performance
Evans & Schamberg’s WM study

Length of Childhood Poverty → Working Memory
Evans & Schamberg’s WM study

Length of Childhood Poverty → Allostatic Load → Working Memory
Evans & Schamberg’s WM study

Length of Childhood Poverty → Allostatic Load → Working Memory
Broadly consistent with what we know from neuroscience
- Test hypothesis that childhood parental nurturance influences hippocampal development

- Test hypothesis that childhood parental nurturance influences stress reactivity
- In prep w Daniel Hackman
In sum

• Encouraging convergence between human behavioral, imaging, endocrine and animal studies

• But plenty of open questions:
  – Generality across poverty in different contexts
  – Inconsistencies btn animal and human findings
  – Reversibility, sensitive periods
Relevance to public health and policy issues

• Begin by “carving at joints” but anticipate synergisms
  – Among different aspects of poverty
  – Between poverty and illnesses discussed here
• Neuroscience: Conceptual reorientation toward childhood poverty
  – From social justice to public health issue (downplay issue of deserts)
  – But: in public mind, biological ->innate, immutable (suggests futility of intervention)