

Poverty Goes Straight to the Brain

By Brandon Keim

Published on wired.com March 30, 2009

Growing up poor isn't merely hard on kids. It might also be bad for their brains. A long-term study of cognitive development in lower- and middle-class students found strong links between childhood poverty, physiological stress and adult memory.

The findings support a neurobiological hypothesis for why impoverished children consistently fare worse than their middle-class counterparts in school, and eventually in life.

"Chronically elevated physiological stress is a plausible model for how poverty could get into the brain and eventually interfere with achievement," wrote Cornell University child-development researchers Gary Evans and Michelle Schamberg in a paper published Monday in the *Proceedings of the National Academy of Sciences*.

For decades, education researchers have documented the disproportionately low academic performance of poor children and teenagers living in poverty. Called the achievement gap, its proposed sociological explanations are many. Compared to well-off kids, poor children tend to go to ill-equipped and ill-taught schools, have fewer educational resources at home, eat low-nutrition food, and have less access to health care.

At the same time, scientists have studied the cognitive abilities of poor children, and the neurobiological effects of stress on laboratory animals. They've found that, on average, socioeconomic status predicts a battery of key mental abilities, with deficits showing up in kindergarten and continuing through middle school. Scientists also found that hormones produced in response to stress literally wear down the brains of animals.

Evans and Schamberg's findings pull the pieces of the puzzle together, and the implications are disturbing. Sociological explanations for the achievement gap are likely correct, but they may be incomplete. In addition to poverty's many social obstacles, it may pose a biological obstacle, too.

"A plausible contributor to the income-achievement gap is working-memory impairment in lower-income adults caused by stress-related damage to the brain during childhood," they wrote.

To test their hypothesis, Evans and Schamberg analyzed the results of their earlier, long-term study of stress in 195 poor and middle-class Caucasian students, half male and half female. In that study, which found a direct link between poverty and stress, students' blood pressure and stress hormones were measured at 9 and 13 years old. At 17, their memory was tested.

Given a sequence of items to remember, teenagers who grew up in poverty remembered an average of 8.5 items. Those who were well-off during childhood remembered an average of 9.44 items. So-called working memory is considered a reliable indicator of reading, language and problem-solving ability — capacities critical for adult success.

When Evans and Schamberg controlled for birth weight, maternal education, parental marital status and parenting styles, the effect remained. When they mathematically adjusted for youthful stress levels, the difference disappeared.

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In lab animals, stress hormones and high blood pressure are associated with reduced cell connectivity and smaller volumes in the prefrontal cortex and hippocampus. It's in these brain regions that working memory is centered. Evans and Schamberg didn't scan their human subjects' brains, but the test results suggest that the same basic mechanisms operate in kids.

"Brain structures change with stress and are affected by early-life stress in animal models," said Rockefeller University neuroendocrinologist Bruce McEwen. "Now there are beginnings of work on our own species. The Evans paper is an important step in that direction."

McEwen also noted that, at least in animals, the effects of stress produce changes in genes that are then passed from parent to child. Poverty's effects could be hereditary.

The findings, though compelling, still need to be replicated and refined. "They're not really saying which causal events were stressful. They're just measuring biological markers of stress," said Kim Noble, a Columbia University psychobiologist who studies the relationship between child poverty and cognition. Other mental consequences of poverty also need to be measured.

"I think that different cognitive outcomes have different causes," said Noble. "Something like working memory might be more associated with stress, whereas language might be associated with hours spent reading to your children."

But Noble still said the study "was very well-done. They have an impressive data set." And though some details remain incomplete, she said, evidence of connections between poverty and neurobiology are strong enough to justify real-world testing.

"Policy changes that affect environments that might affect cognitive development and brain change — that's the ultimate future of the field," she said.

Citation: "Childhood poverty, chronic stress, and adult working memory." By Gary W. Evans and Michelle A. Schamberg. Proceedings of the National Academy of Sciences, Vol. 106 No. 13, March 30, 2009.