

## **Growing up poor can affect brain development**

Pitt study among those to find poverty impacts function

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By Mark Roth, Pittsburgh Post-Gazette



Peter Gianaros of the University of Pittsburgh is researching the effect of poverty on the developing brain using brain imaging.

A classic public service ad showed a man holding an egg and saying, "This is your brain," and then dropping its contents into a sizzling frying pan and saying, "This is your brain on drugs."

Today, it may be time to come up with an image for an even more damaging social time bomb: "This is your brain on poverty."

Studies emerging from around the nation are showing that growing up in a low-income household can have a direct impact on the organization and function of the brain. Living in a poor home has been linked to people having trouble forming memories, difficulty focusing attention, hypersensitivity to stress, problems with delaying gratification and even being stifled in overall intelligence.

In the midst of these gloomy reports, however, is a silver lining: It appears that if parents can provide warm, consistent nurturing, they can counteract many of the effects of too little money, too little food and too little safety -- the ingredients that often make up an impoverished childhood.

But doing that is a challenge.

"It's not that a [low-income] parent can't parent well," said Enrico Mezzacappa, a psychiatrist at Children's Hospital Boston who does research on these issues. "It's just that it's harder. I mean, I don't know if I would be resilient under those circumstances."

One of the leaders of the new focus on poverty and the brain is Martha Farah, director of the Center for Neuroscience and Society at the University of Pennsylvania in Philadelphia and a former professor at Carnegie Mellon University.

"I believe cognitive neuroscience can provide a framework for understanding and even solving" such issues as "the persistence of poverty across generations," she wrote in a 2006 research article.

"It's a rapidly developing area," she said in a recent interview. "We're going from knowing absolutely nothing a few years ago to having a handful of studies now."

In one research project, Dr. Farah and her colleagues found that kindergartners from low-income families showed poorer function than their middle-class peers in the parts of their brains used for reading and language and for "executive control."

Executive control includes such skills as working memory (remembering a phone number long enough to dial it correctly) and quashing impulsive behavior (holding your tongue instead of lashing out with an angry response).

To avoid the racial issues that sometimes bedevil such research, Dr. Farah's group looked only at African-American children in poor and middle-class households.

Some of the deficits poor children have, such as difficulty focusing their attention, may be an adaptation to their environments, she said.

"If you live in a neighborhood where, when you're walking down the street, you need to be really tuned in not to what your friend is saying but to who is giving you a funny stare from across the street, that may give you a tendency to keep your attention widely distributed."

In the long run, though, the inability to block out distractions can cause fundamental problems, she said.

"On the one hand, you have to fight against your own middle class-centrism, and see that in a dangerous and unpredictable world like the inner city, highly focused attention may not be as useful as broad alertness," Dr. Farah said.

"But on the other hand, if you value physical and mental health, educational and occupational opportunity, right now those things are located in the middle-class world, and so people need the attention and language abilities to function in that world."

### Childhood poverty can have long-lasting effects on the brain.

In a study done here, University of Pittsburgh researcher Peter Gianaros and his colleagues found that college freshmen and sophomores who ranked their families lower on the socioeconomic scale had stronger emotional reactions to photos of threatening faces than students who ranked themselves higher.

The students were asked to look at three photos at a time and find the two that matched, so they weren't aware of what the researchers were measuring. They performed the task while lying in a functional magnetic resonance imaging scanner, which can measure what parts of the brain are active at a given moment.

The students with lower socioeconomic rankings showed more activity in the amygdala, a part of the brain that processes negative emotions and stress. In another study, Dr. Gianaros' team found that students from lower socioeconomic backgrounds also had less brain tissue in the anterior cingulate cortex, a frontal region that controls emotional impulses.

Why would these students react that way to the angry faces?

He doesn't know for sure, but speculated that there not only may have been more physical punishment in their households, but more arguments over such issues as money.

"Fights over bills can sensitize the development of these brain systems that are responsive to stress and uncertainty and unpredictability," he said.

The cumulative insults of poverty -- not enough food, poor sleep patterns, lead paint exposure, stress and conflict, lack of mental stimulation -- even seem to have a major impact on children's general IQ, one researcher has found.

Eric Turkheimer, a psychology professor at the University of Virginia, concluded in a 2003 study that environment exerts a much bigger influence on IQ in poor children than in middle-class children.

He did that by analyzing the differences between identical and fraternal twins from a range of economic backgrounds.

Because identical twins share the same genes but fraternal twins do not, scientists can measure the influence of genes on any characteristic by seeing how alike the pairs of twins are in each group.

On height, for instance, studies have shown that identical twins are 90 percent similar, while fraternal twins are only 50-60 percent similar, Dr. Turkheimer said. The gap shows that genes have a strong influence on that trait.

By analyzing each pair of twins in his study based on family incomes, his group discovered that genes accounted for 60 percent of the variation in IQ among higher-income families, but the twins' shared environments had almost no effect. In poor households, it was almost exactly the reverse -- the environment accounted for 60 percent of the variation, but genes made almost no difference. The study did not list specific scores.

He uses a gardening analogy to explain why.

"Suppose you have a bunch of plant seeds that have some genetic variability for how big the plant gets, and you plant them in good enriched soil. You will then see the variability in those plants when they grow.

"But if you take a similar handful of seeds and plant them in sand and don't water them, under those conditions, all the plants might turn out short because the deprived environment doesn't allow the genes to express themselves."

There are rays of hope in this grim picture, though.

Even in very poor families, some children are much more resilient than others, according to a study by Boston Children's Dr. Mezzacappa and psychologist John Buckner. They do better in school, they get along better with their peers and they're far less likely to get into trouble.

The critical factor that separates these children from their peers, he believes, may be how nurturing and stimulating their parents were.

He also believes those parenting skills can be taught.

One of the simplest things parents can do is simply talk a lot with their children. In one classic study, researchers found that 3-year-olds whose parents were professionals had vocabularies that were more than twice as large as children in families on welfare.

"Kids are hungry for interaction with other humans," he said, "and it leads to structural changes in their brains when they interact."

One other thing that makes resilient children stand out, his studies have shown, is their self-regulating "executive control" abilities.

In one study, he asked resilient and non-resilient children how they would respond to different problems, such as their mothers not wanting them to see a certain friend.

The resilient children gave such answers as "tell mom that she is my best friend and we have a lot in common and do the same things together," and "maybe talk to my guidance counselor in school about the situation."

The non-resilient children gave answers like "I would run away to one of my friend's houses to tell them what happened" and "I would let her forget and not say anything, and then see my friend anyway."

While good parenting can blunt some of the worst effects of poverty, the burden shouldn't be entirely on families, these researchers believe.

The strict laws against the use of lead paint offer a parallel for society to intervene early to lessen poverty, Dr. Farah said. Research is beginning to show that "early life stress and limited cognitive stimulation have negative effects on neurological development" that are just as real as lead damage, she said.

Dr. Mezzacappa recalled that there was once a study titled, "Can poverty get under your skin?" "I would say, not only does it get under your skin, but it gets deep into your brain," he said, and as a society we're not doing enough to remedy that.

"There's no question that I think we've been remiss as a society in addressing these social issues," he said. "There's a great deal of suffering that could be alleviated.

"Why isn't this part of the social fabric, this notion that it takes a village to raise a child? How did we lose sight of that?"