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Exposure To Environmental Toxins Last For Generations

Researchers at The University of Texas at Austin and Washington State University have seen an increased reaction to stress in animals whose ancestors were exposed to an environmental compound generations earlier.

The findings, published in the latest Proceedings of the National Academy of Sciences, put a new twist on the notions of nature and nurture, with broad implications for how certain behavioral tendencies might be inherited.

The researchers—David Crews at Texas , Michael Skinner at Washington State and colleagues—exposed gestating female rats to vinclozolin, a popular fruit and vegetable fungicide known to disrupt hormones and have effects across generations of animals. The researchers then put the rats' third generation of offspring through a variety of behavioral tests and found they were more anxious, more sensitive to stress, and had greater activity in stress-related regions of the brain than descendants of unexposed rats.

Michael Skinner

Credit: Washington State University

"We are now in the third human generation since the start of the chemical revolution, since humans have been exposed to these kinds of toxins," says Crews. "This is the animal model of that."

"The ancestral exposure of your great grandmother alters your brain development to then respond to stress differently," says Skinner. "We did not know a stress response could be programmed by your ancestors' environmental exposures."

The researchers had already shown exposure to vinclozolin can effect subsequent generations by affecting how genes are turned on and off, a process called epigenetics. In that case, the epigenetic transgenerational inheritance altered how rats choose mates.

The new research deepens their study of the epigenetics of the brain and behavior, dealing for the first time with real-life challenges like stress. It also takes a rare systems biology approach, looking at the brain from the molecular level to the physiological level to behavior.

"We did not know a stress response could be reprogrammed by your ancestors' environmental exposures," says Skinner, who focused on the epigenetic transgenerational inheritance and genomics aspects of the paper. "So how well you socialize or how your anxiety levels respond to stress may be as much your ancestral epigenetic inheritance as your individual early-life events."

This could explain why some individuals have issues with post-traumatic stress syndrome while others do not, he says.

Crews says that increases in other mental disorders may be attributable to the kind of "two-hit" exposure that the experiment is modeling.

"There is no doubt that we have been seeing real increases in mental disorders like autism and bipolar disorder," says Crews, who focused on the neuroscience, behavior and stress aspects of the paper. "It's more than just a change in diagnostics. The question is why? Is it because we are living in a more frantic world, or because we are living in a more frantic world and are responding to that in a different way because we have been exposed? I favor the latter."

The researchers also saw intriguing differences in weight gain, opening the door to further research on obesity.

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