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Sons of cocaine-using fathers may resist addiction to drug, study suggests

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A father's cocaine use may make his sons less sensitive to the drug and thereby more likely to resist addictive behaviors, suggests new findings from an animal study presented by Penn Medicine researchers at Neuroscience 2013, the annual meeting of the Society for Neuroscience.

The study, led by Mathieu Wimmer, PhD, a post-doctoral researcher in the laboratory of R. Christopher Pierce, PhD, associate professor of Neuroscience in Psychiatry at the Perelman School of Medicine at the University of Pennsylvania, found that sons, but not females, of male rats on cocaine were not only less likely to want the drug, but also resistant to effects of it. This suggests cocaine causes epigenetic changes—that is alterations to DNA that do not involve changing the sequence—in sperm in which reprogrammed information is transmitted down to the next generation of men.

Last year, Dr. Pierce and colleagues found that cocaine abuse in a male rat rendered the next generation of animals resistant to the rewarding properties of the drug—those offspring were less likely to take cocaine. They found changes in the brain-derived neurotrophic factor (BDNF), which is a molecule known to be important for the rewarding efficacy of cocaine, but only by looking at molecular signaling pathways in progeny that had never experienced cocaine.

In the current study, the authors focused on the physiology of neurons before and after taking cocaine in the offspring of cocaine-experienced

fathers, and found that they were less sensitive to the drug and less likely to succumb to addictive behaviors.

In short, not only are rat offspring of cocaine-abusing fathers less likely to take the drug on their own volition, they are less likely to become addicted to it if they are administered it.

In male rats whose fathers used cocaine, the neurons in the nucleus accumbens were less sensitive to cocaine. That is, repeated cocaine use in the sons of cocaine-experienced fathers did not cause remodeling of excitatory AMPA receptors, which is thought to be critical for the development of addiction and cocaine craving.

"This adds to the growing body of evidence that cocaine abuse in a father rat can affect how his sons may respond to the drug—and point to potential mechanisms that contribute to this phenomenon," said Wimmer. "Further research is needed to better understand how these behavior changes are passed down from one animal generation to the next, and eventually if the same holds true for humans."

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