

Psychopaths' brains wired to seek rewards, no matter the consequences

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Abnormalities in how the nucleus accumbens, highlighted here, processes dopamine have been found in individuals with psychopathic traits and may be linked to violent, criminal behavior. Credit: Gregory R.Samanez-Larkin and Joshua W. Buckholtz

The brains of psychopaths appear to be wired to keep seeking a reward at any cost, new research from Vanderbilt University finds. The research uncovers the role of the brain's reward system in psychopathy and opens a new area of study for understanding what drives these individuals.

"This study underscores the importance of neurological research as it

relates to behavior," Dr. Francis S. Collins, director of the National Institutes of Health, said. "The findings may help us find new ways to intervene before a personality trait becomes [antisocial behavior](#)."

The results were published March 14, 2010, in [Nature Neuroscience](#).

"Psychopaths are often thought of as cold-blooded criminals who take what they want without thinking about consequences," Joshua Buckholtz, a graduate student in the Department of Psychology and lead author of the new study, said. "We found that a hyper-reactive [dopamine](#) reward system may be the foundation for some of the most problematic behaviors associated with psychopathy, such as [violent crime](#), recidivism and substance abuse."

Previous research on psychopathy has focused on what these individuals lack—fear, empathy and interpersonal skills. The new research, however, examines what they have in abundance—impulsivity, heightened attraction to rewards and risk taking. Importantly, it is these latter traits that are most closely linked with the violent and criminal aspects of psychopathy.

"There has been a long tradition of research on psychopathy that has focused on the lack of sensitivity to punishment and a lack of fear, but those traits are not particularly good predictors of violence or [criminal behavior](#)," David Zald, associate professor of psychology and of psychiatry and co-author of the study, said. "Our data is suggesting that something might be happening on the other side of things. These individuals appear to have such a strong draw to reward—to the carrot—that it overwhelms the sense of risk or concern about the stick."

To examine the relationship between dopamine and psychopathy, the researchers used positron emission tomography, or PET, imaging of the brain to measure dopamine release, in concert with a functional

magnetic imaging, or fMRI, probe of the brain's [reward system](#).

"The really striking thing is with these two very different techniques we saw a very similar pattern—both were heightened in individuals with psychopathic traits," Zald said.

Study volunteers were given a personality test to determine their level of psychopathic traits. These traits exist on a spectrum, with violent criminals falling at the extreme end of the spectrum. However, a normally functioning person can also have the traits, which include manipulativeness, egocentricity, aggression and risk taking.

In the first portion of the experiment, the researchers gave the volunteers a dose of amphetamine, or speed, and then scanned their brains using PET to view dopamine release in response to the stimulant. Substance abuse has been shown in the past to be associated with alterations in dopamine responses. [Psychopathy](#) is strongly associated with substance abuse.

"Our hypothesis was that psychopathic traits are also linked to dysfunction in dopamine reward circuitry," Buckholtz said. "Consistent with what we thought, we found people with high levels of psychopathic traits had almost four times the amount of dopamine released in response to amphetamine."

In the second portion of the experiment, the research subjects were told they would receive a monetary reward for completing a simple task. Their brains were scanned with fMRI while they were performing the task. The researchers found in those individuals with elevated psychopathic traits the dopamine reward area of the brain, the nucleus accumbens, was much more active while they were anticipating the monetary reward than in the other volunteers.

"It may be that because of these exaggerated dopamine responses, once they focus on the chance to get a reward, psychopaths are unable to alter their attention until they get what they're after," Buckholtz said. Added Zald, "It's not just that they don't appreciate the potential threat, but that the anticipation or motivation for reward overwhelms those concerns."

Provided by Vanderbilt University

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