Risk takers, drug abusers driven by decreased ability to process dopamine

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For risk-takers and impulsive people, New Year's resolutions often include being more careful, spending more frugally and cutting back on dangerous behavior, such as drug use. But new research from Vanderbilt finds that these individuals--labeled as novelty seekers by psychologists--face an uphill battle in keeping their New Year's resolutions due to the way their brains process dopamine. The research reveals that novelty seekers have less of a particular type of dopamine receptor, which may lead them to seek out novel and exciting experiences--such as spending lavishly, taking risks and partying like there's no tomorrow.

The research was published Dec. 31, 2008, in the *Journal of Neuroscience*.

The neurotransmitter dopamine is produced by a select group of cells in the brain. These dopamine-producing cells have receptors called autoreceptors that help limit dopamine release when these cells are stimulated.

"We've found that the density of these dopamine autoreceptors is inversely related to an individual's interest in and desire for novel experiences," David Zald, associate professor of psychology and lead author of the study, said. "The fewer available dopamine autoreceptors an individual has, the less they are able to regulate how much dopamine is released when these cells are engaged. Because of this, novelty and other potentially rewarding experiences that normally induce dopamine release will produce greater dopamine release in these individuals."

Dopamine has long been known to play an important role in how we experience rewards from a variety of natural sources, including food and sex, as well as from drugs such as cocaine and amphetamine. Previous research has shown that individuals differ in both their number of dopamine receptors and the amount of dopamine they produce, and that these differences may play a critical role in addiction. Zald and his colleagues set out to explore the connection between dopamine receptors and the novelty-seeking personality trait.

"Novelty-seeking personality traits are a major risk factor for the development of drug abuse and other unsafe behaviors," Zald and his colleagues wrote.

"Our research suggests that in high novelty-seeking individuals, the brain is less able to regulate dopamine, and this may lead these individuals to be particularly responsive to novel and rewarding situations that normally induce dopamine release," Zald said.

Previous research in rodents showed that some respond differently to novel environments. Those who explore novel environments more are also more likely to self-administer cocaine when given the chance. Dopamine neurons fire at a higher rate in these novelty-responsive rodents, and the animals also have weak autoreceptor control of their dopamine neurons. Zald and colleagues speculated that the same relationships would be seen in humans.

The researchers used positron emission topography to view the levels of dopamine receptors in 34 healthy humans who had taken a questionnaire that measured the novelty-seeking personality trait. The questionnaire measured things such as an individual's preference for and response to novelty, decision-making speed, a person's readiness to freely spend money, and the extent to which a person is spontaneous and unconstrained by rules and regulations. The higher the score, the more likely the person was to be a novelty seeker.

The researchers found that those that scored higher on the novelty-seeking scale had decreased

dopamine autoreceptor availability compared to the subjects that scored lower.

Source: Vanderbilt University