Brain differences in college-aged occasional drug users

March 25 2014

Researchers at the University of California, San Diego School of Medicine have discovered impaired neuronal activity in the parts of the brain associated with anticipatory functioning among occasional 18- to 24-year-old users of stimulant drugs, such as cocaine, amphetamines and prescription drugs such as Adderall.

The brain differences, detected using functional magnetic resonance imaging (fMRI), are believed to represent an internal hard wiring that may make some people more prone to drug addiction later in life.

Among the study's main implications is the possibility of being able to use brain activity patterns as a means of identifying at-risk youth long

before they have any obvious outward signs of addictive behaviors.

The study is published in the March 26 issue of the *Journal of Neuroscience*.

"If you show me 100 college students and tell me which ones have taken stimulants a dozen times, I can tell you those students' brains are different," said Martin Paulus, MD, professor of psychiatry and a co-senior author with Angela Yu, PhD, professor of cognitive science at UC San Diego. "Our study is telling us, it's not 'this is your brain on drugs,' it's 'this is the brain that does drugs.'"

In the study, 18- to 24-year-old college students were shown either an X or an O on a screen and instructed to press, as quickly as possible, a left button if an X appeared or a right button if an O appeared. If a tone was heard, they were instructed not to press a button. Each participant's reaction times and errors were measured for 288 trials, while their brain activity was recorded via fMRI.

Occasional users were characterized as having taken stimulants an average of 12 to 15 times. The "stimulant naïve" control group included students who had never taken stimulants. Both groups were screened for factors, such as alcohol dependency and mental health disorders, that might have confounded the study's results.

The outcomes from the trials showed that occasional users have slightly faster reaction times, suggesting a tendency toward impulsivity. The most striking difference, however, occurred during the "stop" trials. Here, the occasional users made more mistakes, and their performance worsened, relative to the control group, as the task became harder (i.e., when the tone occurred later in the trial).

The brain images of the occasional users showed consistent patterns of

diminished neuronal activity in the parts of the brain associated with anticipatory functioning and updating anticipation based on past trials.

"We used to think that drug addicts just did not hold themselves back but this work suggests that the root of this is an impaired ability to anticipate a situation and to detect trends in when they need to stop," said Katia Harlé, PhD, a postdoctoral researcher in the Paulus laboratory and the study's lead author.

The next step will be to examine the degree to which these brain activity patterns are permanent or can be re-calibrated. The researchers said it may be possible to "exercise" weak areas of the brain, where attenuated neuronal activity is associated with higher tendency to addiction.

"Right now there are no treatments for stimulant addiction and the relapse rate is upward of 50 percent," Paulus said. "Early intervention is our best option."

Provided by University of California - San Diego