

NIDA Study Offers New Clues About Connection Between Cocaine Abuse, Thinking, and Decision-making

December 8, 2004

New research, funded in part by the National Institute on Drug Abuse (NIDA), National Institutes of Health, shows that chronic cocaine abuse is directly related to dysfunction in areas of the brain involved in higher thought and decision-making. The scientists who performed the study suggest that the resulting cognitive deficits may help explain why abusers persist in using the drug or return to it after a period of abstinence. The study, published in the December 8, 2004 issue of the *Journal of Neuroscience*, was conducted by Dr. Robert Hester of Trinity College in Dublin, Ireland, and Dr. Hugh Garavan of Trinity College and the Medical College of Wisconsin in Milwaukee.

"Addictive substances such as cocaine can damage the dopamine system in the brain, and there is a high concentration of dopamine receptors in brain regions involved in higher-order decision-making processes," says NIDA Director Dr. Nora D. Volkow. "By employing functional neuroimaging to examine the neural changes that often result from chronic cocaine abuse, these scientists have identified another aspect of cocaine's effect on the brain that may help explain why individuals persist in these behaviors despite the negative consequences."

In the study, the scientists enlisted 15 active cocaine abusers and 15 healthy individuals who have never used the drug. Each participant completed a task in which they viewed memory lists of letters for 6 seconds and "rehearsed" each list for 8 seconds. The participant then pressed a button when they were presented with a letter that was not part of the preceding "memorized" list. During the task, the participants' brains were analyzed via functional magnetic resonance imaging (fMRI), a noninvasive imaging technique that illustrates nerve cell activity during the performance of a specific task.

Results showed that the cocaine abusers were significantly less proficient than the controls at accurately completing the task. The scientists found that the demands of working memory required increased activation of two brain regions, the anterior cingulate cortex (ACC) and the prefrontal cortex. These areas, which have been consistently associated with memory and higher brain function, are richly interconnected and have bidirectional communication with other regions associated with cognition.

"Previous research that examined cognitive function in cocaine abusers identified decreased activity in the ACC," says Dr. Garavan. "But our study is the first to show that the difficulty cocaine users have with inhibiting their actions, particularly when high levels of reasoning and decision-making are required, relate directly to this reduced capacity for controlling activity in the ACC and prefrontal regions of the brain."