Subordinate monkeys more likely to choose cocaine over food

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Having a lower social standing increases the likelihood that a monkey faced with a stressful situation will choose cocaine over food, according to a study at Wake Forest University School of Medicine. More dominant monkeys undergoing the same stressful situation had fewer changes in brain activity in areas of the brain involved in stress and anxiety and were less likely to choose cocaine.

Robert Warren Gould, a graduate student in the laboratory of Michael A. Nader, Ph.D., presented the study results Sunday at Experimental Biology 2008 in San Diego. The presentation was part of the scientific program of the American Society for Pharmacology and Experimental Therapeutics (ASPET).

Male cynomolgus monkeys live in a complex social structure in which the social hierarchy is established by physical aggression and maintained by clear signals. A monkey that has established his dominance over another monkey can elicit a subordinate response with no more than a meaningful look.

The researchers exposed four dominant and four subordinate monkeys to a socially stressful situation in which an individual monkey was taken out of his home cage and placed in an unfamiliar cage surrounded by four unfamiliar animals. The monkey was physically safe, but he could see and hear the animals around him engaging in aggressive behavior.

The study was performed twice, in order to ask two different types of

questions. The first concerned brain activity caused by the stressful situation. Before being placed in the unfamiliar cage, each monkey had been injected with radioactively labeled glucose. After 40 minutes, each was given a PET brain imaging examination to see which parts of the brain were most active, as determined by which parts were using the most glucose. This type of brain imaging has been used frequently in humans to determine brain activity during various activities and situations.
The scan of the individual monkey's brain during the stressful situation was compared to earlier scans made when the animal had spent time simply sitting in his own familiar home cage without stress.

The brains of dominant monkeys and subordinate monkeys responded differently in both situations. In the normal situation of sitting in their home cage, subordinate monkeys displayed less activity than did the dominant monkeys in areas of the brain involved in stress and anxiety (the amygdala and hippocampus) and also in areas of the brain involved with emotional and social processing (anterior cingulate cortex).

Gould and Nader say these findings suggest monkeys that have to cope with constant, ongoing social stressors may have developed a lower level of brain activity even at rest. In the abnormal situation of being placed in an unfamiliar cage surrounded by unfamiliar and aggressively behaving monkeys, however, the subordinate monkeys showed pronounced decreased brain activity in areas of the brain involved with stress, anxiety, reward, and emotion, whereas the dominant monkeys showed increases in reward-related areas after the same situation.

In a separate part of the study, researchers looked at the effect of the stressful situation on the likelihood that monkeys would use cocaine. After the 40 minutes in the unfamiliar cage surrounded by other monkeys, each monkey could choose between pressing a lever that they knew delivered cocaine or one that they knew delivered a food reward.

The subordinate monkey was more likely to choose cocaine while the dominant monkey was less likely to choose cocaine after this encounter, compared to their respective typical choices during the days preceding this encounter.

These differences in both brain activity and the likelihood of using cocaine between animals of different social rank offer clues to the social context of drug use and addiction in humans, say the researchers. Nader said, “We believe this type of research can be used to identify better treatment strategies, including providing environmental enrichment, that may affect the likelihood of abusing drugs.”

It’s also important, he said, to understand distinct patters of neurobiological activity occurring after acute social stress that may increase the attraction to cocaine in vulnerable individuals. Understanding the brain changes associated with stress also is critical in developing treatment and prevention strategies for disorders such as anxiety and depression that can result from chronic stress.

Source: Wake Forest University