MedicalXpress

Nature or nurture -- Are you who your brain chemistry says you are?

August 12 2008

Researchers using positron emission tomography (PET) have validated a long-held theory that individual personality traits—particularly reward dependency—are connected to brain chemistry, a finding that has implications for better understanding and treating substance abuse and other addictive behaviors.

In a study to identify biochemical correlates of personality traits in healthy humans, researchers focused their investigation for the first time on the role of the brain's opioidergic (or endorphine) system—specifically, the connection between an individual's level of reward expectancy and the brain's ability to transmit naturally occurring opiates. The study included 23 males with no history of substance abuse who were administered Fluoro-ethyl-diprenorphine—a radiolabeled chemical that binds readily to the brain's naturally occurring opiate system— and then underwent a PET scan.

The scans were compared to the results of each participant's Cloninger temperament and character inventory, a questionnaire that assesses human personality based on four dimensions: novelty seeking, harm avoidance, reward dependence and persistence. The comparison revealed that the binding to opiate receptors in the ventral striatum—an area of the brain known to be a central part of the reward system—correlated narrowly to the individual degree of reward dependence. The participants who skewed toward a high need to feel rewarded by approval were also those with the highest uptake of opiates, or endorphins, in the reward system.

"Our main finding was that reward dependence is the only personality dimension correlated with opiate receptor binding, and that positive correlation was restricted to the ventral striatum, which is considered the key area of the human reward system and of the development of addictive behavior," said Peter Bartenstein, M.D., professor of nuclear medicine, Ludwig Maximilians-University, Munich, Germany. "This correlation means that people with high reward dependence have a high concentration of opiate receptors available in that area, while people with low dependence have fewer opiate receptors."

According to the researchers, the biological purpose of the human reward system is to initiate behavior essential for the maintenance of the individual—for example, food intake—or the species—for example, reproduction. Therefore, food or sexual stimuli lead to an opioid-modulated dopamine release in core structures of the reward system and subsequently induce the sensation of craving. Modern addiction research maintains that genetic or acquired abuses of the reward system are the central basis for the development of addictive behavior. This latest finding suggests that individuals suffering from a relative endorphine deficit in their reward system show increased reward dependence and are probably more at risk for developing addictions.

"This is a novel finding and will provide a deeper understanding of the functional relation between human personality, neurobiology and addictive behavior," said Mathias Schreckenberger, M.D., professor of nuclear medicine, Johannes Gutenberg-University, Mainz, Germany. "Understanding the central role of neurotransmission processes in certain brain structures for the expression of psychologically defined constructs such as personality will make a great difference in the future of medicine."

The researchers foresee PET becoming the preferred imaging method for individualized therapy in a range of disorders caused by addictive

behaviour—such as drug abuse or pathological gambling—because it is the only method able to show specific local changes in different neurotransmitter systems (opiate, dopamine and serotonine) involved in addiction. These changes are different in different people and different types of addiction.

The researchers further suggest that PET could be used to predict a favorable response to treatment with drugs that block agents such as morphine, heroin or alcohol from binding to opiate receptors and may one day aid in determining treatment of other psychiatric diseases, such as personality disorders. PET may also play a central role in the development and preclinical evaluation of new anti-craving drugs since it enables researchers to investigate noninvasively the in vivo pharmacological effects of these drugs on the reward system.

The group's next study will delve deeper into the description of the neurochemistry of human personality and expand study sample sizes, according to Gerhard Gründer, M.D., professor of psychiatry and psychotherapy, Aachen University, Aachen, Germany.

"One of the more interesting aspects of this study," he added, "is that it shows that PET technology is capable of detecting subtle biochemical differences in the brain in healthy persons, which may ultimately be responsible for what we consider the individual personality. This has far-reaching implications—not only for choosing the best individual treatments, but also in discussions of an individual's free will."

Source: Society of Nuclear Medicine