

**Public release date: 6-Jun-2008**

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## **Serotonin may affect our sense of fairness, scientists report**

The neurotransmitter serotonin, which acts as a chemical messenger between nerve cells, plays a critical role in regulating emotions such as aggression during social decision-making, new research by scientists at England's University of Cambridge and UCLA suggests. Their findings appear June 6 in the peer-reviewed journal *Science*.

Serotonin has long been associated with social behavior, and low levels of serotonin are associated with depression and anxiety, but its precise involvement in impulsive aggression has been controversial. Though many scientists have hypothesized a link between serotonin and impulsivity, this is one of the first studies to show a causal link between the two.

The findings highlight why some of us may become combative or aggressive when we have not eaten. The essential amino acid necessary for the body to create serotonin can only be obtained through diet; our serotonin levels naturally decline when we don't eat.

The research also provides insight into clinical disorders characterized by low serotonin levels, such as depression and obsessive-compulsive disorder, and may help explain some of the social difficulties associated with these disorders.

UCLA scientists reported in April that the human brain responds to being treated fairly the same way it responds to winning money and eating chocolate; being treated fairly turns on the brain's reward circuitry. In the new *Science* study, they and their Cambridge colleagues report that people with low serotonin levels were found to be more sensitive to being treated unfairly.

The *Science* study involved 20 subjects, 14 of them female, with an average age of 25. As in the April study, published in the journal *Psychological Science*, participants were presented with fair and insulting offers for dividing sums of money. If they declined, neither they nor the person making the offer would receive anything. Some of the offers were fair, such as receiving 5

Brisith pounds out of 10 or out of 12, while others were unfair, such as receiving 5 pounds out of 23.

In this study, however, after initially responding to the offers, participants were given a drink that significantly reduced their serotonin levels. They were then presented with the offers again.

When their serotonin levels were reduced, they rejected 82 percent of the unfair offers; when their serotonin levels were normal, they rejected only 67 percent of the unfair offers. Thus, people with low serotonin levels were more likely to reject unfair offers.

"The same person may experience the same thing as fair and unfair on different days based on how the neurochemistry of the brain is functioning," said study co-author Matthew D. Lieberman, UCLA associate professor of psychology and a founder of social cognitive neuroscience. "When we feel something is unfair, that may have to do with how our brain causes us to experience the world. Our subjects are not aware their serotonin levels are affecting the way they experience the world. This suggests we should be more forgiving of other people's perspectives."

"A sense of fair play is not a purely rational process," he added. "It seems not to be the case that, like a math formula, if something is fair, it's fair for all time, in all situations."

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The study's lead author is Molly Crockett, a former UCLA psychology undergraduate who is conducting graduate work at Cambridge. Golnaz Tabibnia, a postdoctoral scholar at the Semel Institute for Neuroscience and Human Behavior at UCLA, is a co-author. Most of the subjects were Cambridge graduate students. (This was not a brain-mapping study.)

The study was supported by the Wellcome Trust in England, which funds neuroscience research.

UCLA is California's largest university, with an enrollment of nearly 37,000 undergraduate and graduate students. The UCLA College of Letters and Science and the university's 11 professional schools feature renowned faculty and offer more than 300 degree programs and majors. UCLA is a national and international leader in the breadth and quality of its academic, research, health care, cultural, continuing education and athletic programs. Four alumni and five faculty have been awarded the Nobel Prize.

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