Serotonin levels affect the brain's response to anger

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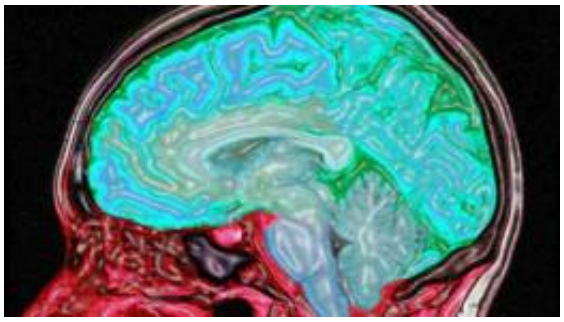

Research provides new insight into why some individuals may be more aggressive than others.

Fluctuations of serotonin levels in the brain, which often occur when someone hasn't eaten or is stressed, affects brain regions that enable people to regulate anger, new research from the University of Cambridge has shown.

Although reduced serotonin levels have previously been implicated in aggression, this is the first study which has shown how this chemical helps regulate behaviour in the brain as well as why some individuals may be more prone to aggression. The research findings were published today, 15 September, in the journal *Biological Psychiatry*.

For the study, healthy volunteers' serotonin levels were altered by manipulating their diet. On the serotonin depletion day, they were given a mixture of amino acids that lacked tryptophan, the building block for serotonin. On the placebo day, they were given the same mixture but with a normal amount of tryptophan.

The researchers then scanned the volunteers' brains using functional magnetic resonance imaging (fMRI) as they viewed faces with angry, sad, and neutral expressions. Using the fMRI, they were able to measure how different brain regions reacted and communicated with one another when the volunteers viewed angry faces, as opposed to sad or neutral faces.

The research revealed that low brain serotonin made communications between specific brain regions of the emotional limbic system of the brain (a structure called the amygdala) and the frontal lobes weaker compared to those present under normal levels of serotonin. The findings suggest that when serotonin levels are low, it may be more difficult for the prefrontal cortex to control emotional responses to anger that are generated within the amygdala.

Using a personality questionnaire, they also determined which individuals have a natural tendency to behave aggressively. In these individuals, the communications between the amygdala and the prefrontal cortex was even weaker following serotonin depletion. 'Weak' communications means that it is more difficult for the prefrontal cortex to control the feelings of anger that are generated within the amygdala when the levels of serotonin are low. As a result, those individuals who might be predisposed to aggression were the most sensitive to changes in serotonin depletion.

Dr Molly Crockett, co-first author who worked on the research while a PhD student at Cambridge's Behavioural and Clinical Neuroscience Institute (and currently based at the University of Zurich) said: "We've known for decades that serotonin plays a key role in aggression, but it's only very recently that we've had the technology to look into the brain and examine just how serotonin helps us regulate our emotional impulses. By combining a long tradition in behavioral research with new technology, we were finally able to uncover a mechanism for how serotonin might influence aggression."

Dr Luca Passamonti, co-first author who worked on the research while a visiting scientist at the Medical Research Council Cognition and Brain Sciences Unit in Cambridge (and currently based at the Consiglio Nazionale delle Ricerche (CNR), Unità di Ricerca Neuroimmagini, Catanzaro), said: "Although these results came from healthy volunteers, they are also relevant for a broad range of psychiatric disorders in which violence is a common problem. For example, these results may help to explain the brain mechanisms of a psychiatric disorder known as intermittent explosive disorder (IED). Individuals with IED typically show intense, extreme and uncontrollable outbursts of violence which may be triggered by cues of provocation such as a facial expression of anger.

"We are hopeful that our research will lead to improved diagnostics as well as better treatments for this and other conditions."

Provided by University of Cambridge