Independent brain pathways generate positive or negative reappraisals of emotional events

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Scientists now have a better understanding of how the human brain orchestrates the sophisticated pathways involved in the regulation of emotions. The research, published by Cell Press in the September 25th issue of the journal *Neuron*, identifies brain pathways that underlie reinterpretation of aversive images in ways that reduce or enhance their negative emotional intensity.

"If our emotions are a duet played between the self and the environment, then our ability to regulate them keeps us in harmony with the outside world," says senior study author Dr. Tor D. Wager from the Department of Psychology at Columbia University. "Although the failure to successfully regulate emotions is thought to contribute to several psychiatric disorders, we do not fully understand how the brain regions involved interact with one another to orchestrate an emotional response and what makes attempts at regulation less successful in some individuals."

Recently developed brain-based models of emotion regulation identify the prefrontal cortex (PFC) as a key player in the cognitive regulation of emotion. Specifically, brain imaging studies have demonstrated increased activity in the ventrolateral, dorsolateral, and dorsomedial prefrontal cortices (vlPFC, dlPFC, and dmPFC) when individuals are asked to make use of cognitive strategies, such as reappraisal, to alter the emotional impact of a stimulus.

Scientists think that these brain regions are involved in bringing feelings into line with what the situation demands—for example, avoiding feeling or expressing anger during a conflict with a boss. However, there is relatively scant evidence on how the PFC interacts with nuclei deep in the brain that are critical for generating the visceral emotional responses that sometimes cause us to get carried away.

To examine this potential interaction, Dr. Wager and colleagues developed a novel mechanism that enabled them to identify multiple brain regions that serve as mediators of successful reappraisal and to examine how they are organized into functional networks. "We looked for evidence on how PFC activity leads to successful reappraisal, and whether it does so by affecting evolutionarily older subcortical systems critical for emotional experience and emotional learning," explains Dr. Wager.

The researchers correlated activity in the right vlPFC with reduced negative emotional experience during cognitive reappraisal of aversive images. They went on to use their new mapping strategy to identify two separate pathways that linked activity of the vlPFC with regulation of negative emotion during reappraisal. One pathway, which involved the nucleus accumbens, predicted greater reductions in negative emotion during reappraisal while the other pathway, linked with the amygdala, predicted reduced reappraisal success and, therefore, an increase in negative emotion.

"These results provide evidence that vlPFC is involved in both the generation and regulation of emotion through different subcortical pathways and indicate that the prefrontal cortex is involved in both creating and mitigating negative emotion, depending on the contents of thought," concludes Dr. Wager. "Our findings also suggest that the existence of multiple prefrontal-subcortical pathways should be considered when examining how emotion is dysregulated in psychiatric disorders."

Source: Cell Press