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Belief, disbelief and uncertainty activate distinct brain regions

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The capacity of the human mind to believe or disbelieve a statement is a powerful force for controlling both behavior and emotion, but the basis of these states in the brain is not yet understood. A new study found that belief, disbelief and uncertainty activate distinct regions of the brain, with belief/disbelief affecting areas associated with the pleasantness/unpleasantness of tastes and odors. The study will publish online in the *Annals of Neurology*, the official journal of the American Neurological Association.

Led by Sam Harris of the University of California, Los Angeles, the study involved 14 adults who underwent functional MRI scans during which they were presented with short statements that they had to evaluate as true, false or undecided. Each participant underwent three scans while they evaluated statements from a broad variety of categories such as mathematical, geographical, autobiographical, religious and factual. The statements were designed to be clearly true, false or undecidable.

Contrasting belief and disbelief trials yielded increased signal in the ventromedial prefrontal cortex (VMPFC), which is involved in linking factual knowledge with emotion. “The involvement of the VMPFC in belief processing suggests an anatomical link between the purely cognitive aspects of belief and human emotion and reward,” the authors state. The fact that ethical belief showed a similar pattern of activation to mathematical belief suggests that the physiological difference between belief and disbelief is not related to content or emotional

associations, they note.

The contrasts between disbelief and belief showed increased signal in the anterior insula, a region involved in the sensation of taste, the perception of pain, and the feeling of disgust, indicating that “false propositions might actually disgust us,” the authors state. “Our results appear to make sense of the emotional tone of disbelief, placing it on a continuum with other modes of stimulus appraisal and rejection,” they add.

Uncertainty evoked a positive signal in the anterior cingulate cortext (ACC) and a decreased signal in the caudate, a region of the basal ganglia, which plays a role in motor action. Noting that both belief and disbelief showed an increased signal in the caudate compared to uncertainty, the authors suggest that the basal ganglia may play a role in mediating the cognitive and behavioral differences between decision and indecision.

The study raises the possibility that the differences between belief, disbelief and uncertainty may one day be reliably distinguished by neuroimaging techniques. They conclude: “This would have obvious implications for the detection of deception, for the control of the placebo effect during the process of drug design, and for the study of any higher-cognitive phenomenon in which the differences between belief, disbelief, and uncertainty might be a relevant variable.”

Source: Wiley-Blackwell