Difficult decisions involving perception increase activity in brain's insular cortex, study finds

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As the difficulty of making a decision based on sensory evidence increases, activity in the brain's insular cortex also increases, according

to researchers at Georgia State University.

The findings, reported in the journal *Neuroscience*, shed light on how the insular cortex is involved in processing sensory information to perceive the environment and drive behaviors, which has been a mystery. Researchers examined anterior insulae activity for four perceptual decision-making tasks of varying difficulty and found a strong positive correlation between perceptual difficulty and insular cortex activity.

"This study found the activity of the anterior insulae can predict how well the sensory information is perceived or what the difficulty level of the perceptual task is," said Mukesh Dhamala, associate professor in the Department of Physics and Astronomy at Georgia State. "This research is important because the anterior insulae, along with two nearby brain structures, make up the salience network, and when this network is impaired, it affects the ability to switch between tasks and make coherent thoughts. Impairment in this network could possibly be linked to psychiatric illnesses, such as schizophrenia, dementia and autism, so it's essential to learn more about how this brain area should be functioning."

Perceptual decision-making is the process in which sensory information is gathered and used to influence our behavior. For instance, if a person is driving and suddenly sees an object in front of the vehicle, he or she must decide what action to take, such as whether to slow down or bypass the object.

The study involved 33 humans with normal or corrected-to-normal vision and normal neurological history. They completed four tasks, in which the researchers manipulated the visual and audiovisual stimuli to create varying degrees of task difficulty.

Behavioral experiments were performed outside the MRI scanner and

corresponding functional magnetic resonance imaging (fMRI) was carried out inside the scanner. Outside the MRI scanner, participants were asked to indicate their decisions as quickly and accurately as possible with left and right mouse clicks for two given stimuli. Inside the MRI scanner, they were asked to perceive the presented stimuli, wait for a question mark to be displayed on the screen and then indicate their choice by pressing a response key on a button box.

The researchers also measured blood oxygen level dependent (BOLD) signals and examined the role of anterior insulae in easy and difficult perceptual decision-making.

In all four experimental tasks, researchers found that anterior insulae activity consistently increased with task difficulty. For perception of facial expressions, for example, the anterior insulae was activated significantly higher for blurred or "noisy" pictures compared to clear pictures. Researchers also found higher BOLD activity for difficult tasks compared to easy ones and that participants' behavioral performance changed with the ambiguity of sensory information.

In a second study recently published in the journal *NeuroImage*, the researchers examined sub-second timing of the right insular cortex activity and the influence of the right anterior insula on two other key brain areas, the left anterior insula and dorsal anterior cingulate cortex. Together these three brain structures make up the salience network, which plays a key role in perceptual decision-making.

"This study discovered that the anterior insulae play a major role in integrating scantly available sensory information very early on around 100 milliseconds," Dhamala said.

The study also found the brain structures in the salience network communicate with each other around a frequency of 20 Hertz.

Electroencephalography was used to record electrical activity of the brain in 26 neurologically healthy human volunteers.

Provided by Georgia State University