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Frontal Lobe of the Brain is Key to Automatic Responses to Various Stimuli, Say Scientists

Some people may excel at riding a bike, tying a tie, or playing the piano, but those same people may find it difficult to explain or teach those skills to someone else.

These motor skills are learned in one part of the brain, whereas classroom instruction and information read in a book are acquired in another area of the brain, explained F. Gregory Ashby, professor and chair of UC Santa Barbara's Department of Psychology. This second area of learning is the frontal cortex –– the area immediately behind the forehead –– where executive function is located.

A study of different categories of learning is reported by Ashby and his research team in the current issue of the Journal of Neuroscience. A group of 16 UCSB undergraduates took part in thousands of visual tests, so the psychologists could study their responses. A significant number of the trials took place in the university's brain imaging scanner using fMRI, which allowed the scientists to observe areas of the brain during testing.

The team found that tasks with explicit reasoning behind them were much simpler for test subjects. "When you can't explain the reasoning, it takes test subjects about 10 times as many trials to master," said Ashby.

These areas without explicit reasoning are grasped in a lower part of the brain, the basal ganglia. "It is similar to the fact that you can't explain what your fingers are doing when you are playing the piano," said Ashby.

However, he went on to explain that once a behavior becomes automatic, it becomes cortical. "Automatic behaviors are stored in similar ways, in the frontal cortex, regardless which system of the brain learned it first," he said.

Ashby cited the example of an excellent tennis player with Parkinson's disease. He said that scientists used to think that tennis skills were stored in the basal ganglia, where they were learned, and the area of the brain affected by Parkinson's disease. The player, however, was able to hit moving tennis balls with the same skill exhibited before he was diagnosed with Parkinson's. According to Ashby, it is because it was an automatic response for him, one that is entirely mediated in the cortical area.

This could explain why people can react quickly with an automatic response to an event that is first perceived in sensory areas, such as seeing an oncoming vehicle and slamming on the brakes. Again, these automatic behaviors are stored in similar ways regardless of which brain system learned the behavior first.

The other authors are first author and postdoctoral fellow Sebastien Helie, and graduate student Jessica L. Roeder. Both are with UCSB's Department of Psychology.

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