Ready to learn? Brain scans can tell you

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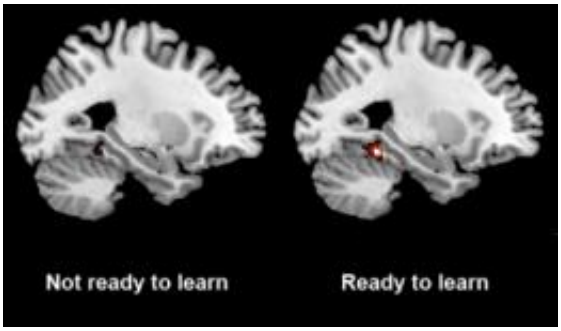

MIT neuroscientists showed that activity in a part of the brain called the parahippocampal cortex correlates with the brain's preparedness to learn new information. Image: Julie Yoo

Our memories work better when our brains are prepared to absorb new information, according to a new study by MIT researchers. A team led by Professor John Gabrieli has shown that activity in a specific part of the brain, known as the parahippocampal cortex (PHC), predicts how well people will remember a visual scene.

The new study, published in the journal *NeuroImage*, found that when the PHC was very active before people were shown an image, they were less likely to remember it later. "When that area is busy, for some reason or another, it's less ready to learn something new," says Gabrieli, the Grover Hermann Professor of Health Sciences and Technology and Cognitive Neuroscience and a principal investigator at the McGovern Institute for Brain Research at MIT.

The PHC, which has previously been linked to recollection of visual scenes, wraps around the hippocampus, a part of the brain critical for memory formation. However, this study is the first to investigate how PHC activity before a scene was presented would affect how well the scene was remembered. Lead author of the paper is Julie Yoo, a postdoc at the McGovern Institute.

Subjects were shown 250 color photographs of indoor and outdoor scenes as they lay in a functional magnetic resonance imaging (fMRI) scanner. They were later shown 500 scenes - including the 250 they had already seen - as a test of their recollection of the first batch of images. The fMRI scans revealed that images were remembered better when there was lower activity in the PHC before the scenes were presented.

The precise area of activation was slightly different in each person studied, but was always located in the PHC.

In a second experiment, the researchers used real-time fMRI, which can monitor subjects' brain states from moment to moment, to determine when the brain was "ready" or "not ready" to recall images. Those states were used as triggers to present new visual scenes. As expected, images presented while the brain was in a "ready" state were better remembered.

The finding adds a new element to the longstanding question of why we remember certain things better than others, says Nicholas Turk-Browne, assistant professor of psychology at Princeton University, who was not involved in this study. Traditionally, scientists have believed that memory is based on the inherent memorability of specific events, with strongly emotional events likeliest to be remembered. More recently, cognitive neuroscientists have found that the brain's ability to consolidate, store and retrieve information is also important.

"The significance of this study is that it suggests that beyond the inherent memorability of things, and how well the memory systems are working, there's a huge role to be played by how well prepared you are to process what's coming in," Turk-Browne says.

In theory, this method could be used to determine when a student is best prepared to learn new material, or to monitor workers who need to stay alert. "That's what we would like to think - that we are able to measure states of receptivity for learning, or preparedness for learning," Gabrieli says. "In terms of how that would be translated to real life, there are still a few steps to go."

The main hurdle is that fMRI scanners are very large, and at this point, they cannot be made into small, portable devices. A possible alternative is using electroencephalography (EEG), a more easily miniaturized technology that measures electrical activity along the scalp. The researchers are now working on ways to use EEG to measure activity in the PHC.

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