Picower research finds unexpected activity in visual cortex

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For years, neural activity in the brain's visual cortex was thought to have only one job: to create visual perceptions. A new study by researchers at MIT's Picower Institute for Learning and Memory shows that visual cortical activity can serve another purpose--connecting visual experience with non-visual events.

The study, slated to appear in the March 17 issue of *Science*, implies that sensory parts of the brain may be able to accomplish more complex tasks than previously imagined, according to co-authors Marshall G. Shuler, MIT research affiliate, and Mark F. Bear, professor of brain and cognitive sciences. The findings have implications for understanding how our brains imbue sensory experience with behavioral meaning.

Electrodes were implanted in the visual cortex of adult rats. Initially, as expected, their neurons responded only to light. However, as the animal repeatedly experienced a light stimulus with the delivery of a drop of water, the neuronal activity changed. And in many cases, the neuron continued to be active after the light was extinguished until the water reward was delivered.

The neuron's activity, the researchers said, was related to the anticipation of the reward. What's more, neurons continued to predict reward times associated with the light cues even in different situations. "This is a strong indication that learning was actually occurring in the visual cortex," Shuler said.

Brain activity corresponding to "reward timing has been observed in higher-order brain regions, but never in the primary visual cortex," Bear said. "No one would have expected to see it there because the visual cortex is thought to be a detector of the physical features of the environment, with responses limited to those features to ensure that sensory processing is reliable and reproducible."

"These neurons were not acting in response to what the stimuli were, but what they had come to mean," Shuler said.

The researchers are not sure whether the animal perceives this brain activity, but they plan to explore how it may guide appropriate behaviors.

"We are pretty optimistic we can uncover the mechanism" underlying this finding, Bear said. "There is a lot going on in the brain that we have been unaware of, studying anesthetized animals all these years."

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Source: MIT