Medical Xpress

Researcher discovers brain cells have 'memory'

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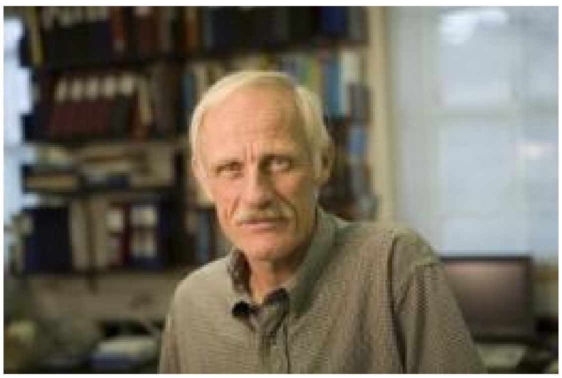

Rudiger von der Heydt, a professor in Johns Hopkins University's Zanvyl Krieger Mind-Brain Institute. Credit: Will Kirk

As we look at the world around us, images flicker into our brains like so many disparate pixels on a computer screen that change every time our eyes move, which is several times a second. Yet we don't perceive the world as a constantly flashing computer display. Why not?

Neuroscientists at The Johns Hopkins University think that part of the answer lies in a special region of the brain's visual cortex which is in charge of distinguishing between background and foreground images. Writing in a recent issue of the journal Neuron, the team demonstrates that nerve cells in this region (called V2) are able to "grab onto" figure-ground information from visual images for several seconds, even after the images themselves are removed from our sight.

"Recent studies have hotly debated whether the visual system uses a buffer to store image information and if so, the duration of that storage," said Rudiger von der Heydt, a professor in Johns Hopkins' Zanvyl Krieger Mind-Brain Institute, and co-author on the paper. "We found that the answer is 'yes,' the brain in fact stores the last image seen for up to two seconds."

The image that the brain grabs and holds onto momentarily is not detailed; it's more like a rough sketch of the layout of objects in the scene, von der Heydt explains. This may elucidate, at least in part, how the brain creates for us a stable visual world when the information coming in through our eyes changes at a rapid-fire pace: up to four times in a single second.

The study was based on recordings of activity in nerve cells in the V2 region of the brains of macaques, whose visual systems closely resemble that of humans. Located at the very back of the brain, V2 is roughly the size of a wristwatch strap.

The macaques were rewarded for watching a screen onto which various images were presented as the researchers recorded the animals' brain nerve cells' response. Previous experiments have shown that the nerve cells in V2 code for elementary features such as pieces of contour and patches of color. What is characteristic of V2, though, is that it codes these features with reference to objects. A vertical line, for instance, is coded either as the contour of an object on the left or as a contour of an object on the right. In this study, the researchers presented sequences of images consisting of a briefly-flashed square followed by a vertical line. They then compared the nerve cells' responses to the line when it was preceded by a square on the left and when it was preceded by a square on the right. The recordings revealed that the V2 cells remember the side on which the square had been presented, meaning that the flashing square set up a representation in the brain that persisted even after the image of the square was extinguished.

Von der Heydt said that discovering memory in this region was quite a surprise because the usual understanding is that neurons in the visual cortex simply respond to visual stimulation, but do not have a memory of their own.

Though this research is only a small piece of the "how people see and process images" puzzle, it's important, according to von der Heydt.

"We are trying to understand how the brain represents the changing visual scene and knows what is where at any given moment," von der Heydt said. "How does it delineate the contours of objects and how does it remember which contours belong to each object in a stream of multiple images? These are important and interesting questions whose answer may someday have very practical implications. For instance, how we function under conditions that strain our ability to process all relevant information - whether it be driving in city traffic, surveying a large crowd to find someone, or something else, may depend in large part on what kind of short-term memory our visual system has."

Understanding how this brain function works is more than just interesting. Because this study shows how the strength and duration of the memory trace can be directly measured, it may eventually be possible to understand its mechanism and to identify factors that can enhance or reduce this important function. This could assist researchers in unraveling the causes of - and perhaps even identifying treatment for - disorders such as attention deficit disorder and dyslexia.

Source: Johns Hopkins University (news : web)