Research explains how the brain finds Waldo

May 27 2005

Professor Robert Desimone, director of the McGovern Institute for Brain Research at MIT, and colleagues show that neurons synchronize their signals to command attention, like a chorus rising above the din of noisy chatter in a crowded room, or like the striped shirt of the storybook character Waldo.

At any given moment, the world bombards the senses with more information than the brain can process, and for more than a century scientists and psychologists have debated how the brain filters out distractions and focuses attention on the things that matter.

Using the visual system as a model, Professor Robert Desimone, director of the McGovern Institute for Brain Research at MIT, and his former colleagues at the National Institutes of Health show that neurons synchronize their signals to command attention, like a chorus rising above the din of noisy chatter in a crowded room.

"We think that synchronizing signals could be a general way the brain focuses on what's important," says Desimone, who also holds an appointment through MIT's Department of Brain and Cognitive Sciences. "Attention is a general problem for the brain, and maybe it has a general solution."

This new study, published in a recent issue of Science, addresses a central question that anyone who has tackled a "Where's Waldo?" book can appreciate. When looking for Waldo on the crowded page, does the brain scan the page spatially (serial processing), like a mental spotlight moving across an otherwise dark page? Or does the brain take in the whole page at once and gradually zoom in on relevant features such as color and shape (parallel processing).

In the first model, the spotlight of attention would track across the page, checking each detail against a mental image of Waldo's red stocking cap and striped shirt. In the second model, the color red and stocking-cap shapes would gradually come to the foreground and other shapes and colors would recede.

For decades, scientists divided into two camps regarding these models, but recent evidence made some scientists suspect that the brain conducts a combination of the two. "What's cool about this paper is that it shows both processes are going on in the same chunk of the brain and in the same neurons," says Jeremy Wolfe, professor of Ophthalmology at Harvard Medical School, who wrote an accompanying review article in Science.

To explore visual attention, researchers study macaque monkeys, recording the activity of specific neurons, along with the eye movements, while the monkeys scan a complex array in an experimental equivalent of looking for Waldo. The neurons belong to the V4 area, a midregion of the visual cortex known to be important to attention.

Neurons specialize as to what they detect best. A "red" neuron gives off a stronger signal when red appears in the field of view, and the signal is even stronger if the monkey is actively searching for red. Moreover, if the monkey is searching for a red object, red neurons turn up their activity before the eyes even move toward the red item, as if the louder signal were calling: Look over here! "We think the yelling neurons are commanding the eyes to move toward a feature that matches something in the mental image," Desimone says.

Even so, the ability of a neuron to raise its lone voice does not explain how it gets heard over the cacophony of all the other neurons. "We think it's not just a question of the individual neuron," he says. "It's how it cooperates with other neurons to make their voices heard. We showed that to increase the signal, the neurons synchronize their activity."

Desimone uses the analogy of a room full of people talking. If random individuals raise their voices, the room just gets louder. If a group of people starts chanting in unison, their voices rise above the background noise.

Synchronization of the signals helps explain how the brain uses parallel processing to concentrate on relevant features in a complex scene. Then the brain switches to serial processing, scrutinizing relevant objects sequentially to find the object of desire.

Source: MIT

Citation: Research explains how the brain finds Waldo (2005, May 27) retrieved 27 April 2024 from https://phys.org/news/2005-05-brain-waldo.html