First empirical study demonstrating that populations of nerve cells adapt to changing images

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Neuroscientists studying the mind's ability to process images have completed the first empirical study to demonstrate, using animal models, how populations of nerve cells in visual cortex adapt to changing images. Their findings could lead to sight-improving therapies for people following trauma or stroke. The study at The University of Texas Health Science Center at Houston appears in the March 13 issue of the journal *Nature*.

"Our perception of the environment relies on the capacity of neural networks to adapt rapidly to changes in incoming stimuli," wrote senior author Valentin Dragoi, Ph.D., assistant professor of neurobiology and anatomy at The University of Texas Medical School at Houston. "It is increasingly being realized that the neural code is adaptive, that is, sensory neurons change their responses and selectivity in a dynamic manner to match the changes in input stimuli." The neural code is the set of rules that transforms electrical impulses in the brain into thoughts, memories and decisions.

In the study, Dragoi and co-author Diego Gutnisky, a graduate research assistant at The University of Texas Graduate School of Biomedical Sciences at Houston, measured the effects of visual stimulation on the responses of multiple neurons whose electrical activity was measured simultaneously in animals. They carefully examined the responses of a population of cells in visual cortex to dynamic stimuli, which consisted

of movie sequences displayed on a video monitor.

“We provide empirical evidence that brief exposure, or adaptation, to a fixed stimulus causes pronounced changes in the degree of cooperation between individual neurons and an improvement in the efficiency with which the population of cells encodes information,” Dragoi and Gutnisky report. “These results are consistent with the ‘efficient coding hypothesis’ - that is, sensory neurons are adapted to the statistical properties of the stimuli that they are exposed to and with changes in human discrimination performance after adaptation.”

This information may be helpful in the fight against brain illness. “Right now, we don’t know the causes of brain illnesses such as Alzheimer’s disease or disorders caused by trauma,” Dragoi said. “However, it is our belief that understanding not only how individual neurons work, but how they cooperate with their neighbors to impact the functions of the brain involved in diseases may help develop better diagnostic tools and therapies to improve visual function following trauma, stroke or disease, or even prevent brain disorder.”

While their study focused on how neuronal populations adapt to visual stimulation, the same could hold true for other senses - hearing, smell, taste and touch, Dragoi said. “We’re trying to understand how a network of sensory neurons changes its encoding properties to properly represent the environment,” he said. “Our results may have general implications for sensory and motor coding in a variety of brain areas.”

The brain is the control center of the central nervous system and is responsible for behavior. It contains more than 100 billion neurons or nerve cells, each linked to as many as 10,000 other neurons or nerve cells. “One dream of neuroscientists is to crack the neural code and through our study we have made steps in understanding how populations of neurons encode information,” Dragoi said.

Source: University of Texas

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