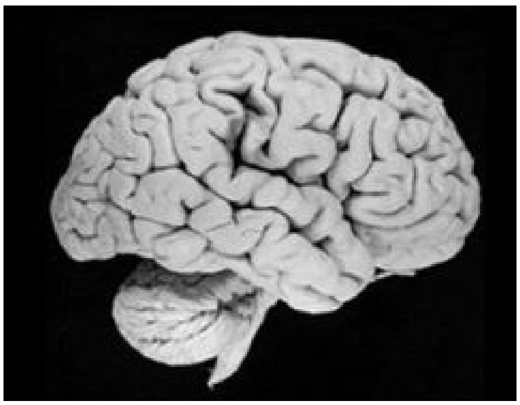
Brain mechanisms for behavioral flexibility

April 15 2009



Modern human brain. Credit: Univ. of Wisconsin-Madison Brain Collection.

New research provides insight into how the brain can execute different actions in response to the same stimulus. The study, published by Cell Press in the April 16 issue of the journal *Neuron*, suggests that information from single brain cells cannot be interpreted differently within a short time period, a finding that is important for understanding both normal cognition and psychiatric disorders.

Humans exhibit incredible flexibility when it comes to adjusting to the demands of a particular task. For example, when the word "blue" is written in red ink, separate responses to the color or the meaning of the word can be elicited. "Although the roles played by the frontal cortex in this kind of switching behavior have been well documented, little is known about how neural pathways governing sensory and motor associations accomplish such a switch," explains senior study author, Dr.

Takanori Uka from the Juntendo University School of Medicine in Tokyo.

Dr. Uka and coauthor Dr. Ryo Sasaki investigated where and how identical sensory signals are converted into distinct motor signals. The researchers examined the responses of middle temporal (MT) neurons and the associations between MT neurons and downstream functions in monkeys as they switched between direction and depth discrimination tasks. Previous work has shown that the MT area is critical for both direction and depth discrimination.

The monkeys were trained to view dots on a screen and to indicate whether dots moved up or down when they saw the color magenta or whether the dots were nearer or father away when they saw the color cyan. "We found that neuronal sensitivities were nearly identical during both the direction and depth discrimination tasks; that is, neural activity depended on the visual stimulus and not the task itself," says Dr. Uka. This finding suggests that inputs to the MT area were not directly responsible for task switching.

Importantly, the researchers went on to show that signals from different MT populations were read out to perform different tasks. "We suggest that task switching is accomplished via the communication of distinct populations of MT neurons into a downstream decision system," explains Dr. Uka. "We hypothesize that single neurons probably cannot switch outputs in a short period of time, so the brain realizes behavioral flexibility by preparing separate pathways for each task through learning, and then chooses the appropriate pathways, rather than switching outputs, in a given trial."

Source: Cell Press (news : web)