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NEWS

RSNA Press Release

Brain Remapping May Be Key to Recovery from Stroke

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At A Glance

- People with paralysis can learn to redirect motor commands through healthy parts of their brains to assist in recovery or control artificial limbs.
- Using fMRI and a special fiber-optic glove, researchers recorded which parts of the brain controlled individual hand movements.
- The findings are an important step in training strategies for brain-machine interfaces.

CHICAGO - People suffering from paralysis due to stroke or traumatic brain injury may be able to reprogram their brains to improve motor skills and to control artificial limbs, according to a study presented today at the annual meeting of the Radiological Society of North America (RSNA).

Using functional magnetic resonance imaging (fMRI) and a "cyberglove" to record brain changes during motor activities, researchers demonstrated that people can learn to remap, or redirect, motor commands. This is an important step in stroke recovery and in training strategies for brain-machine interfaces-conduits between the brain and artificial limbs.

"For stroke patients and others who have a brain deficit, coordinating what they see with body movement is very difficult," said the study's lead author Kristine Mosier, D.M.D., Ph.D., assistant professor of radiology at Indiana University in Indianapolis. "The brain must remap or relearn the process of matching visual input with sensory input. Our study demonstrated that individuals can learn to remap motor commands."

When neurons—the primary cells of the nervous system that make all thought, feeling and movement possible—are damaged by a stroke or brain injury, other neurons take over for them. But until now, scientists weren't sure which neurons compensated for damaged neurons, or how the brain cells learned their new jobs.

Dr. Mosier's study simulated a learning problem by having 17 healthy adults wear a synthetic glove with fiber-optic cables on their dominant hand. The glove translated hand movements into signals, which were sent to the computer and transformed into the two-dimensional position of a cursor on the computer screen. The subjects were then asked to align the cursor with 50 different targets while researchers used fMRI to observe which areas of the brain controlled the intricate movements of the hand. fMRI uses radio waves and a strong magnetic field to image the body. It can identify signs that neurons in a specific area of the brain are "firing," that is, processing information and giving commands to the body.

"Once we understand which part of the brain network does what, we will be able to tailor physical therapy approaches to an individual's brain deficit," Dr. Mosier explained. "Similarly, we'll be able to work with surgical patients ahead of time, laying the groundwork for re-learning before they undergo surgery on a particular part of the brain."

In addition to offering insight into the rehabilitation of stroke and brain injury patients, the study provides valuable information for the development of training strategies for brain-machine interfaces, which enable patients with brain injuries to operate external devices, such as artificial limbs, using only their brain signals. This new technology requires implanting electrodes in the brain to pick up movement-producing signals from neurons. A computer then translates those brain signals into commands instructing a robotic device to move.

"As we get a better understanding of what areas in the brain are involved in the remapping process, we'll be able to determine the optimal place in the brain to place the electrodes," Dr. Mosier said.

Co-authors are Yang Wang, M.D., Robert Scheidt, Ph.D., Santiago Acosta, M.S., and Ferdinando Mussa-Ivaldi, Ph.D.

Abstract:	• Radiology and the Cyborg: A Novel Functional Imaging Paradigm as a Testbed for Brain-Machine Interfaces

Images (.JPG format)

Figure 1	**Figure 2:** 2-D points on Computer screen must be "mapped" onto cortical neurons.	**Figure 3:** Imaging results support findings of behavioral data that there may be separate mechanisms for learning to control posture and movement.	**Figure 4:** Learning to control the cursor is primarily associated with activity in premotor cortex, parietal cortex and thalamus.

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