Neuroprosthetics

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A major breakthrough was made recently by researchers at the National Institute of Neurological Disorders and Stroke (NINDS), a component of the National Institutes of Health (NIH). For the first time, researchers have demonstrated that a direct artificial connection from the brain to muscles can restore voluntary movement in monkeys whose arms have been temporarily anesthetized (Gough). These results are very promising to the 250,000 Americans afflicted with spinal cord injuries and thousands of others with paralyzing neurological diseases.

"This research was conducted by Eberhard E. Fetz, Ph.D., professor of physiology and biophysics at the University of Washington in Seattle and an NINDS Javits awardee; Chet T. Moritz, Ph.D., a post-doctoral fellow funded by NINDS; and Steve I. Perlmutter, Ph.D., research associate professor. The results appear in the online Oct. 15 issue of *Nature*. The study was performed at the Washington National Primate Research Center, which is funded by NIH's National Center for Research Resources (Gough)".

Neuroprosthetics is the study and development of artificial devices used to replace or improve the function of an impaired nervous system (Bo). Thus far, researchers have been successful controlling a robotic limb using brain-computer interfaces (BCI) to record signals from neurons. They've also been able to use artificial signals to stimulate muscles and cause arm movement in a paralyzed arm. But until now, nobody has put these pieces together. This study is the first to combine a brain-computer interface (BCI) with real-time control of a paralyzed limb (Scientist).

In the experiment, Dr. Fetz and his associates trained monkeys to control their nerve cells in the motor cortex, an area of the brain that controls voluntary movements. Neuronal activity was detected using a type of brain-computer interface. In this case, electrodes implanted in the motor cortex were connected via external circuitry to a computer. The monkeys played a target practice game where they learned to control their neural activity to produce movements of a cursor on the screen. "After each monkey mastered control of the cursor, the researchers temporarily paralyzed the monkey's wrist muscles using a local anesthetic to block nerve conduction. Next, the researchers converted the activity in the monkey's brain to electrical stimulation delivered to the paralyzed wrist muscles. The monkeys continued to play the target practice game, however, now cursor movements were driven by actual wrist movements. This demonstrated that they had regained control of their otherwise paralyzed wrist through artificial means" (Gough).

While Dr. Fetz and his group were attempting to restore movement to a paralyzed limb, they made a very significant discovery. They discovered that any motor cortex cell, regardless of whether it had been previously associated with wrist movement, was capable of stimulating muscle activity. "Until now, brain-computer interfaces were designed to decode the activity of neurons known to be associated with movement of specific body parts. This finding greatly expands the potential number of neurons that could control signals for brain-computer interfaces and also illustrates the flexibility of the motor cortex" (Gough). "The cells don't have to have a preordained role in the movement. We can create a direct link between the cell and the motor output that the user can learn to control and optimize over time," says Dr. Fetz.

Dr. Fetz and his group made some significant discoveries and are very encouraged by their results. However, Dr. Fetz says "Clinical applications are still probably at least a decade away. Better methods for recording cortical neurons and for controlling multiple muscles must be developed, along with implantable circuitry that could be used reliably and safely" (Gough). Although we won't see the results of this research for years to come, it will have a huge impact on lives of so many people.

Works Cited

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