

Man with spinal cord injury uses brain computer interface to move prosthetic arm with his thoughts

October 13 2011

(Medical Xpress) -- Seven years after a motorcycle accident damaged his spinal cord and left him paralyzed, 30-year-old Tim Hemmes reached up to touch hands with his girlfriend in a painstaking and tender high-five.

Mr. Hemmes, of Evans City, Pa., is the first to participate in a new trial assessing whether the thoughts of a person with [spinal cord](#) injury can be used to control the movement of an external device, such as a computer cursor or a sophisticated [prosthetic arm](#). The project, one of two [brain-computer interface](#) (BCI) studies underway at the University of Pittsburgh School of Medicine and UPMC Rehabilitation Institute, used a grid of [electrodes](#) placed on the surface of the brain to control the arm.

It was a unique [robotic arm](#) and hand, designed by the Johns Hopkins University [Applied Physics](#) Laboratory, that Mr. Hemmes willed to extend first toward the palm of a researcher on the team and a few minutes later, to his girlfriend's hand.

“I put my heart and soul into everything they asked me to do,” he said immediately after his achievement. “I got to reach out and touch somebody for the first time in seven years.”

“Seeing Tim reach out with a mechanical arm to touch his girlfriend was an unexpected and poignant bonus for all of us who are involved with this exciting project,” said co-principal investigator Michael Boninger,

M.D., director of the UPMC Rehabilitation Institute.

“This first round of testing reinforces the great potential BCI technology holds for not only helping spinal cord-injured patients become more independent, but also enhancing their physical and emotional connections with their friends and family,” added Dr. Boninger, who also is professor and chair of the Department of Physical Medicine and Rehabilitation at Pitt’s School of Medicine. “It further motivates us to make this technology useful and available to those who need it.”

On Aug. 25, an electrocortigraphy (ECoG) grid, about the size of a large postage stamp, adapted from seizure-mapping brain electrode arrays, was placed on the surface of Mr. Hemmes’ brain during a two-hour operation performed by co-investigator and UPMC neurosurgeon Elizabeth Tyler-Kabara, M.D., Ph.D., assistant professor, Department of Neurological Surgery, Pitt School of Medicine.

“Before the procedure, we conducted several functional imaging tests to determine where his brain processed signals for moving his right arm,” she explained. “We removed a small piece of his skull and opened the thick layer of protective dura mater beneath it to place the grid over that area of motor cortex. We then put the dura and skull back with the wires on the outside of the skull but under the scalp.”

Dr. Tyler-Kabara tunneled the connecting wires under the neck skin to exit from the upper chest, where they could be periodically hooked up to computer cables. Six days per week for the next four weeks at home and on campus, Mr. Hemmes and the team tested the technology. The researchers used computer software they developed in earlier studies to interpret the neural signals sensed by the brain grid.

After watching a computer-generated figure move an arm, Mr. Hemmes began trying to guide a ball from the middle of a large television screen

either up, down, left or right to a target, within a time limit. With practice, he could do this two-dimensional task without any computer assistance or what the researchers call “100 percent brain control.” He then performed a similar task with the arm, reaching out to touch a target on a large, desk-mounted panel.

It wasn’t the simultaneous thought-and-move process that he knew before becoming paralyzed. Instead, he imagined flexing his thumb, which created a brain signal pattern that the computer then interpreted as “move left,” or bending his elbow to move the object right, explained co-principal investigator Wei Wang, M.D., Ph.D., assistant professor, Department of Physical Medicine and Rehabilitation, Pitt School of Medicine.

“He mentally associated specific motor imageries with desired movement direction,” he said. “It required concentration and patience, but this process seemed to get easier for him with practice, just like when someone learns to drive a car with a manual transmission. In future studies, we also will test other approaches, including the participant simply thinking up for up, down for down, and so on.”

After about eight sessions, Mr. Hemmes tackled more complicated tasks. While wearing special goggles to properly view a three-dimensional TV screen, he moved the ball in the previous directions, and also to the front or back. He also practiced moving the arm in all directions, culminating in the joyful moments after formal testing had been completed when he reached out to Dr. Wang and to his girlfriend. Dr. Tyler-Kabara removed the ECoG brain grid and wiring in a short operation the next day, Sept. 22.

The researchers are now analyzing the data, and are seeking at least five more adults with [spinal cord injuries](#) or brainstem strokes who have very little or no use of their hands and arms for additional studies.

They also are looking for participants for a year-long trial of another kind of brain-computer interface that is a 10-by-10 array of tiny electrode points that penetrate the brain tissue by less than 1/10th of an inch and pick up signals from 100 individual neurons. Two of these grids will be put in place, one in the brain region that controls hand movement, and one in the region that controls the arm, said co-principal investigator Andrew Schwartz, Ph.D., professor, Department of Neurobiology, Pitt School of Medicine.

“We anticipate that these penetrating grids can pick up very clear signals from the brain to reveal what motion is intended by the participant,” Dr. Schwartz said. “The second grid will allow us to see what might be possible in controlling the fine movement of the fingers and hand, which is far more complicated but also could offer more useful function for the participant.”

In his other experiments, a monkey implanted with the penetrating grid has been able to use an APL arm to reach out and hold a doorknob-like object, building on earlier work in which a monkey was able to grasp a marshmallow with a gripper device on a less sophisticated robotic arm and feed the treat to itself.

The team plans to make the technology wireless, and to include sensors in the prosthesis that can send signals back to the brain to simulate sensation.

It might be possible to connect brain-computer interfaces to existing devices that stimulate muscle fibers in the arm and hand, in effect bypassing the spinal cord injury to allow these individuals to use their own limbs again, the researchers said. That approach could be studied in future trials.

Provided by University of Pittsburgh School of Medicine

Citation: Man with spinal cord injury uses brain computer interface to move prosthetic arm with his thoughts (2011, October 13) retrieved 23 April 2024 from

<https://medicalxpress.com/news/2011-10-spinal-cord-injury-brain-interface.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.