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July 2014

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Brain computer interface holds potential to improve daily lives of people with prosthetic limbs

February 7, 2017

The use of brain computer interface has the potential to improve the daily lives of people with prosthetic limbs, according to research presented this week at the Association of Academic Physiatrists Annual Meeting in Las Vegas.

A brain-computer interface, also known as a brain-machine interface (BCI), is a system that allows a person to control a computer using only their thoughts. The person is trained to use a specific thought such as flexing a knee for control. The thought generates electrical activity in the nerve cells and also brainwaves. A chip can be implanted in the brain to pick up electrical activity or electrodes can be placed on the scalp to pick up brainwaves. In people with paralysis or amputation, BCI can be used to control the movement of muscles, limbs and prosthetics.

"In general, using a prosthesis is an unnatural act that requires training, extra effort and can have a certain amount of awkwardness to it," explains Douglas P. Murphy, MD; from Hunter Holmes McGuire VA Medical Center who is also an associate professor of PM&R at Virginia Commonwealth University and lead investigator (along with Ou Bai PhD from Florida International University) in a recent study that sought to establish the feasibility of manipulating a prosthetic knee with BCI. Also, use of a prosthesis can be difficult or cause problems under certain circumstances (i.e., stairs, ramps etc.). The goal of all prosthetic research is to bring the patient back to the same ease, comfort and ability as with a natural leg. Controlling a prosthesis with thought is a big step in that direction, which is why our research team initiated this study.

In the study, Dr. Murphy's team worked with a person whose leg has been amputated above the knee (transfemoral amputee). Using surface scalp electrodes to transmit brainwave data to a computer software program, the participant was taught how to activate a knee-unlocking switch through mental imaging.

"In our first attempt at using BCI with a lower extremity prosthesis, we wanted

to test a simple system before moving on to more complicated ones to test the feasibility of the concept," says Dr. Murphy. "Thus, we chose control of the simplest prosthetic knee, which is the manual locking knee. When locked, the knee is rigid and straight, and when unlocked the knee swings freely. Someone with an above knee amputation would have to physically/manually unlock the knee to sit and could lock or unlock in standing or walking depending on his/her needs. We were interested to see if our participant could literally 'think' his way to unlocking his prosthetic."

The participant learned to activate the knee-unlocking switch on his prosthesis that turned on a motor and unlocked his prosthetic knee. He then proceeded to walk up and down parallel bars while demonstrating his ability to unlock the knee to swing his leg and to sit down. Throughout the study, the participant was able to successfully unlock his knee anywhere from 50 to 100 percent of the time, and he noted (through a questionnaire) his reactions to using BCI with his prosthesis.

"The ultimate goal of this research is to provide the individual with a prosthesis that more easily and more successfully meets his or her needs for movement and walking," Dr. Murphy notes of the study. "The system should be comfortable, easy to use and serve useful purposes. The patient's subjective experience should reflect these goals. Our subject gave a very good example of how this system could help him. He likes to hike with his children. Sometimes he is carrying his daughter and coming down a hill. With BCI control he could adjust his prosthesis for descending the hill very easily. This is the type of daily life activity we believe can be improved with BCI."

Based on this study, Dr. Murphy's BCI controlled prosthesis would provide patients with a prosthesis that gives them a hands-free system of control as well as a prosthesis that is responsive to a greater variety of their needs and a prosthesis that takes less energy to use in complex environments. This system is in the early stages of development, but research promises to provide rapid growth in the development of applications that can be used for people with prosthesis."

Source:

http://www.physiatry.org/