

Prosthetics Operated By Brain Activity Move A Step Closer to Reality

By Sharon Begley, The Wall Street Journal, 830 words
Jul 9, 2004

Document Text

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YOU WOULDN'T exactly call Chewy, Oscar and Simon garrulous -- they are, after all, rhesus monkeys -- but to neuroscientists at the California Institute of Technology, Pasadena, the animals communicate as volubly as any chatty teen. You just have to know how to read their minds.

The scientists do. Since the 1990s, researchers have been devising ways to detect the brain signals that accompany hand and arm movements and to translate those signals -- thoughts, really -- into electronic blips that will move a computer cursor or mechanical arm. Implanted electrodes would detect activity in the brain's motor cortex that corresponds to such thoughts as "move cursor left" in order to spell out words, or "move arm forward" to grab something. The goal is to devise a "neural prosthetic" that will let paralyzed patients move with their thoughts what they cannot move with their bodies.

In a significant advance for mind-reading machines, Caltech's Richard Andersen and his colleagues have bypassed the motor cortex and its detailed step-by-step instructions, and eavesdropped instead on higher-level thoughts. They placed scores of tiny electrodes into a region of Chewy's, Oscar's and Simon's brains that generates signals more along the lines of, "Hey, look what's over there; I think I'll reach for it." It's the difference between thinking about a goal, such as reaching a book lying on a table or a target on a computer screen, and figuring out the precise pathway to it.

READING THE THOUGHTS from the monkeys' "parietal reach region," whose human counterpart sits just above the ear, required ingenious training. The Caltech scientists taught Chewy, Oscar and Simon to watch a video screen and wait for a green spot to appear. When it did, the monkeys were trained to reach for it. If they did, they earned a sip of orange juice.

Then, rather than let the monkeys reach for the target immediately -- this is the clever part -- the scientists trained them to wait a moment. Since rhesus monkeys might as well carry signs saying "will work for juice," they quickly learned that if these crazy scientists wanted them to wait before reaching, they'd wait before reaching.

While waiting, the reach-planning region of the monkeys' brains was blasting signals that translate into, "I'm going to reach for that spot in a sec." It was these abstract signals of intended reaching, not actual reaching, that the electrodes picked up.

For the 2.2 million people in the U.S. who are partially or completely paralyzed, a thought such as "grab the newspaper from the table and open it" comes more naturally than step-by-step instructions needed to guide a mechanical arm. As Chewy, Oscar and Simon have shown, it should be possible to detect what a quadriplegic is trying to accomplish and quickly compute the detailed trajectory necessary to achieve it, translating high-level thoughts into precise movement commands.

"Sampling from multiple areas of the brain is more likely to be reliable and accurate, and to restore the motor function of paralyzed patients" by enabling them to move mechanical devices with their thoughts, says neuroscientist Miguel Nicolelis of Duke University, Durham, N.C., who has done pioneering work in this field.

ELECTRODES MIGHT even be able to reach brains that have more on their mind than simply moving a robot arm. When the Caltech monkeys were promised more juice for their labors, signals from the reach-planning regions became sharper and more accurate.

"This suggests that, in principle, we could monitor not only patients' goals, what they want to reach for, but also

their mood and motivation," says Prof. Andersen.

Electrodes might be able to read other kinds of thoughts, too. Today, the only way completely paralyzed, "locked-in" patients can communicate is by blinking ("The Diving Bell and the Butterfly," by Jean-Dominique Bauby, is a poignant account by and about one locked-in patient). A tiny handful, in experiments, have been fitted with scalp electrodes that monitor brainwaves called EEGs, allowing them to laboriously spell out words via a thought-controlled cursor.

But by decoding signals from the brain's language regions, neural prostheses might be able to translate thoughts into speech in a much less cumbersome way, suggests Caltech's Sam Musallam. As the scientists write in today's issue of the journal *Science*, "All kinds of cognitive signals can be decoded from patients."

In what may become the next milestone in neural prosthetics, Cyberkinetics Inc., a closely held company in Foxborough, Mass., recently received approval from the Food and Drug Administration for a clinical trial of a device called BrainGate. Based on research led by neuroscientist and company co-founder John Donoghue of Brown University, Providence, R.I., it uses implanted electrodes to translate signals from patients' premotor cortexes into movements of a wireless pen on a digital keypad.

Dr. Donoghue expects the results, from five quadriplegics, within a year. If it works, it will be one more step toward what was once relegated to the pages of science fiction: reading minds.

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