Monkey Think, Monkey Do

By Sheryl Ubelacker
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In a high-tech variation of "monkey see, monkey do," U.S. researchers have taught two macaques to feed themselves with a human-like robotic arm using only signals from their brains.

The scientists at the University of Pittsburgh School of Medicine implanted tiny probes in the area of the animals' brains where voluntary movement originates as electrical impulses. Specially designed computer software then transmits these impulses to the robotic arm, which carries out the actions the monkey intended to perform with its own limb.

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—Andrew Schwartz, professor of neurobiology, University of Pittsburgh

Using this "brain–machine interface," the monkeys are able to direct the robotic arm and open and close a two-finger gripper to feed themselves marshmallows and chunks of fruit while their own arms are gently restrained in tube-like devices.

The technological advance lays the groundwork for development of prosthetics for people with spinal-cord injuries and physically "locked-in" diseases such as Lou Gehrig's disease (amyotrophic lateral sclerosis), say the researchers, whose work was published online [May 28] in the journal Nature.

"Our immediate goal is to make a prosthetic device for people with total paralysis," said senior author Andrew Schwartz, a professor of neurobiology. "Ultimately, our goal is to better understand brain complexity."

"Now we are beginning to understand how the brain works using brain–machine interface technology," Schwartz said in a statement. "The more we understand about the brain, the better we'll be able to treat a wide range of brain disorders, everything from Parkinson's disease and paralysis to, eventually, Alzheimer's disease and perhaps even mental illness."

Schwartz's lab had previously focused on brain-machine interfaces for controlling cursor movements on a computer screen, a task the monkeys were trained to perform.

The macaques first learned to maneuver the robotic arm to deliver tasty treats into their mouths using a joystick, then moved on to hands-free control using brain signals alone.

"The monkey learns by first observing the movement, which activates his brain cells as if he were doing it," Schwartz said. "It's a lot like sports training, where trainers have athletes first imagine that they are performing the movements they desire."

While the robotic arm looks somewhat industrial and unwieldy, the interface with the monkey's brain is anything but. Probes inserted into the neuronal pathways in the animal's motor cortex are as fine as a human hair.

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—John Kalaska, professor of physiology, Université de Montréal

The Pittsburgh scientists' latest endeavor isn't the first to employ brain–machine interface technology, but it takes the notion of thought-provoked movement to a whole new level and "provides a heartening example of what, in due course, may be possible," John Kalaska, a professor of physiology at the Université de Montréal, said in an accompanying commentary.

"One encouraging finding was how readily the monkeys learned to control the robot. ... Learning could be even quicker in human subjects, facilitated by verbal instructions from a trainer," writes Kalaska.

However, he said there are still hurdles to overcome before "neuroprosthetic robots" are developed for humans and make their debut at rehabilitation clinics.