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Study analyzes monkey brain signals

Goal to narrow thought and execution

By Kimm Groshong , Staff Writer

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PASADENA -- Even though they cannot physically move, most paralyzed people can think about moving. In a new study, a group of Caltech scientists has taken an important step toward the creation of a technology capable of bridging that divide between thought and execution for such patients.

In the current issue of the journal Science, Sam Musallam, a postdoctoral fellow in biology at Caltech, his adviser, Richard Andersen, and their colleagues describe a method they have used to read monkeys' brain signals to accurately determine the animals' movement goals and preferences.

"We're moving closer to being able to implant patients who can't move, to give them mobility or to communicate,' Musallam, the lead author of the study, said.

Although other teams have worked on this problem, the previous focus has always been on signals from a portion of the brain that initiates movement, known as the motor cortex.

"We're the first to read out the goal of the movement,' Andersen said. His group monitors higher-level signals, or cognitive signals, from an area in the monkeys' brains involved in the planning of movements rather than the movement itself. The brain region in monkeys is known as the parietal reach region and is located just above the ears.

The researchers also report in the new study that they could tell how strongly the monkeys wanted a reward it would be given for successfully completing a task.

During the experiment, the researchers placed the monkeys in front of a computer screen. The monkeys had 96 tiny electrodes implanted into their brains, monitoring the activity of their brain cells.

To start, the computer studied the way the monkeys' brain cells behaved while the animals waited for a cue signaling them to reach toward an icon on the screen. From that information, the computer could then predict where the monkeys intended to reach, before they moved. Eventually, the monkeys received a reward if the computer correctly lit up where the monkey was planning to reach as long as the monkey did not move.

Later, the researchers ran a variation of the experiment where they changed the size of the cue, relating to the amount, probability or kind of reward the monkey would receive if the trial was successful. The monkeys like orange juice more than water so the researchers were able to experiment by varying delivery of the juice.

They identified the animals' higher order preferences, mood and desires along with their intention to reach out to a particular goal in that way, Musallam said.

That aspect of the new study is particularly important and useful, according to Ted Berger, the director of the Center for Neural Engineering at USC, who is not involved with the study.

"Ultimately, we want systems that can function like you and I do,' focusing on the goals rather than the physical movements required to reach them, he said.

Berger said previous work in the field has worked toward the creation of a "library' of

movement codes. "But it doesn't tell you if a person actually wants to use them,' he said.

Andersen's team has demonstrated a way for those movements to be informed by whether a person actually wants to execute them and with what level of motivation, he explained.

"It's a big contribution,' Berger said.

In addition to being able to help patients move, the new study suggests that cognitive signals might help patients who can't speak to communicate more easily than they currently can with letter boards or spelling devices. Musallam said human trials for the technology could begin within the next few years.

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