Scientists 'reading minds' to discern what's real

By Byron Spice
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What you are doing and what you think you are doing aren't always the same thing, and a University of Pittsburgh neurobiologist has identified what he believes are the areas of the brain where this mismatch between reality and perception plays out.

The experiments, reported in Friday's issue of the journal Science, make use of techniques that come close to "reading minds," enabling Andrew Schwartz and his fellow researchers not only to see that parts of the brain are active, but to actually discern what is being thought by monitoring the electrical activity of brain cells.

The same monitoring technique might eventually be used to control artificial limbs, enabling users to move a prosthetic arm or leg just by thinking about it.

In this new study, however, Schwartz and his colleagues focused on studying perception. They created an illusion that made the subjects, including humans and macaque monkeys, think they were tracing ellipses with their hands, though they actually were moving their hands in a circular motion.

By monitoring groups of nerve cells in the monkeys, the researchers were able to see that the area of the brain's motor cortex that controls hand motion was indeed directing the hand to make circles, while trajectory

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Differentiating perception, reality

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signals from cells in a neighboring area, called the ventral premotor cortex, were generating elliptical shapes.

"Now we have a way of identifying perception and differentiating that from reality" in separate brain structures, Schwartz said. The findings thus advance the understanding of how the mind builds an internal map of the world and adjusts its sensory inputs to eliminate distortions.

For instance, when someone first dons a pair of bifocal eyeglasses, images initially can seem distorted. Over time, however, the brain adjusts this new input so that vision once again appears normal. The ventral premotor cortex is thought to play a key role in that adjustment, Schwartz said.

The idea that the ventral premotor cortex influences perception is a provocative one, said Jacqueline Gottlieb, a neurobiologist at Columbia University who wrote an accompanying editorial. That structure was long assumed to be involved in preparing commands that eventually would be transmitted to the motor cortex. It's possible that the area may be involved in both preparing commands and in perception, she suggested.

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>
> — **Andrew Schwartz**, University of Pittsburgh neurobiologist

More research is necessary to clarify the area's function, she maintained, noting there's always some uncertainty about exactly what's going on in the monkey's head.

"We're not sure what the monkey's seeing," she said.

But Schwartz maintained that the experiments reported in Friday's article would be impossible without the ability to see what the mind is seeing. His research group, which relocated to Pittsburgh in 2002 from Arizona State University and the Neurosciences Institute in San Diego, has devised ways of monitoring groups of brain cells that allow them to determine the trajectory of motor movements.

Previously, he said, "We could never look in the brain and see what's going on." Other researchers have been able to discern different brain responses to different shapes, such as circles and squares. But this new technique allows researchers to detect any kind or number of shapes; they might even be able to read a person's name, if the subject was envisioning how to sign his name.

Schwartz has found that monitoring as few as 40 or 50 neurons might be sufficient for such mind reading.

The method, reported two years ago in Science, was developed as part of Schwartz's efforts to use impulses from the brain to control artificial limbs. In other experiments, he is training monkeys to feed themselves with an artificial limb simply by thinking about moving their arms.

Schwartz is working with the University of Michigan to develop special neuron sensors that could be used for clinical trials involving humans. For now, neuron monitoring is being performed only on monkeys.

In the experiments involving perception, the human and monkey subjects were directed to use a hand-controlled cursor to trace an oval that was projected from a computer monitor so that it appeared to float shoulder-high in space. As they traced the oval, however, their view of their hands was blocked.

Each traced the oval five times. With each pass, the researchers adjusted the cursor controls to exaggerate horizontal movements until, by the fifth pass, the subjects needed only to move their hands in a circle to move the cursor around the oval shape they saw. Afterward, the human subjects consistently said they were moving their hands in an elliptical motion during the experiment, unaware that their hands actually were moving in circles.

Presumably, that's what the monkeys thought as well.

"The animals can't tell you what they're doing," said Schwartz, who co-authored Friday's report with Pitt's Dr. Anthony Reina and Daniel Moran of Washington University.

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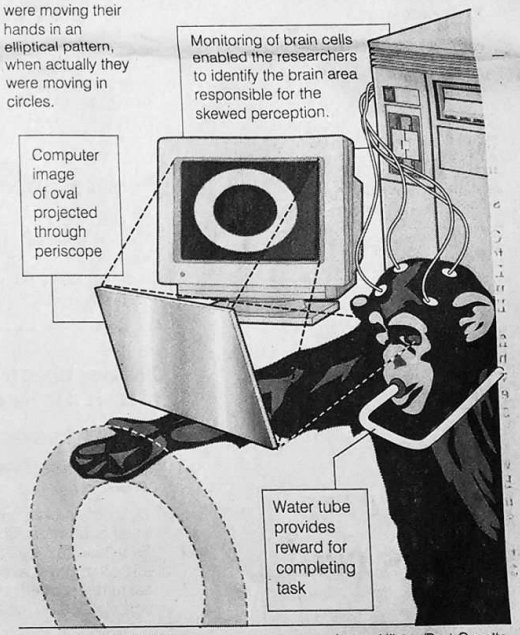
Monkey moves

In an experiment involving perception, University of Pittsburgh researchers had monkeys trace an oval shape, but blocked their view of their hands, forcing them to view a computer image instead. The researchers create an illusion that the monkeys thought they were moving their hands in an elliptical pattern, when actually they were moving in circles.



Source: Andrew Schwartz

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