Neuroscientists Uncover Brain Region Involved in Voluntary Behavior

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Scientists at the California Institute of Technology have deciphered the activity of an area of the brain that could one day prove vital in the development of neural prostheses--within-the-brain implants that would translate thought into movement in paralyzed patients. The results of this study were published as the featured article in the November 8 issue of *Neuron*.

Richard A. Andersen, the James G. Boswell Professor of Neuroscience at Caltech, and his postdoctoral fellow, He Cui, looked in particular at the posterior parietal cortex (PPC), a higher brain region where sensory stimuli are transformed into movement.

To tease out the functions of two subregions of the PPC, the parietal reach region (PRR) and the lateral intraparietal area (LIP), Cui and Andersen designed an experiment in which rhesus monkeys were allowed to freely chose one of two actions, an eye movement or an arm movement, to acquire a visual target.

Prior to the monkeys' selection, a computer program "guessed" which of those two actions would be performed by the monkeys, and picked the opposite movement as the choice to be rewarded. (The monkeys were essentially playing a matching game.) The computer's choices were biased by the previous choices made by the monkeys, which gave the monkeys an incentive to mix up their choices. Without it, they would invariably opt for the eye movement, which is the less energetically taxing of the two.

When the monkeys chose the arm movement, the PRR showed the most activity; when the monkeys opted for the eye movement, the LIP was most active.

The experiment shows that it is "the monkey's own choice that activates these areas," says Cui, and not the sensory stimuli provided by the visual target it sees on the computer screen. This finding is significant, Andersen says, because "this is the earliest stage in the brain found so far that is actively related to movement plans."

The research in Andersen's laboratory is focused on understanding the neurobiological underpinnings of brain processes, including the senses of sight, hearing, balance, and touch, and the neural mechanisms of action.

The lab is working toward the development of implanted neural prosthetic devices that would serve as an interface between severely paralyzed individuals' brain signals and their artificial limbs--allowing thoughts to control movement. To assist in designing a more optimal prosthetic, they are now examining whether the decision to make a reaching motion is first made in PRR, or is made in another area of the brain and then transferred to PRR to form the movement plan.

"These areas are prime targets for neural prosthetics. The better we understand these areas, the better we can design prosthetics to decide the subjects' intent," Andersen says.

Source: Caltech