Stanford team seeks detours to fix brain damage

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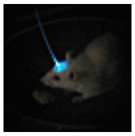

Stanford researchers are leading an international team of scientists to study how brain cells communicate with each other and how bioengineers may one day rewrite the signals cells send, with the ultimate goal of repairing devastating brain damage.

The research recently won almost $15 million in federal funding, and includes scientists from Brown University and Stanford, who are co-directing the studies, along with UCSF and University College London.

Their results could someday help doctors install pacemaker-like devices in the brain that would create detours around cells damaged by head trauma, stroke or diseases like Alzheimer's. Scientists also hope to find a way to send coded instructions to neurons that will help the brain heal itself.

"We might be able to encourage the brain to route around the injury, like, 'Hey, that bridge is no longer there, why don't you reroute and take that other path,' " said Krishna Shenoy, an associate professor of electrical engineering and bioengineering at Stanford, who is leading the research there.

The federal funding will cover two years of research with an option to extend the study four additional years with $28.8 million in funding. The money comes from the Defense Advanced Research Projects Agency, run by the U.S. Department of Defense. Thousands of U.S. troops have suffered traumatic brain injuries while fighting overseas.

Research will focus on relatively new areas of study on how the different parts of the brain communicate and work together, and how bioengineers might be able to send instructions to healthy cells and help them avoid or even repair damaged areas.

Stanford researchers are focused on a technique called optogenetics, in which quick bursts of colored lights are used to set off certain actions in brain cells. Specific cells are first genetically engineered to be responsive to light, and then a cable embedded in the brain directs lights at the cells.

Optogenetics allows researchers to test actual brain function and cell behavior in a living animal. Stanford scientists have been able to control the movement of a mouse - getting it to run around in circles - using optogenetics, although the therapy is still years away from possible use in humans.

Testing brain function

At UCSF, scientists are studying how to use electrical impulses to send messages to the brain. While optogenetics allows scientists to send messages to very specific cells in the brain, electrical impulses tend to be broader and affect larger areas of the brain. But researchers say both techniques show promise.

"Electrical techniques are in some ways old-fashioned. We're going to compare electrical stimulation and the optical technique," said Dr. Philip Sabes, a neuroscientist at Keck Center for Integrative Neuroscience at UCSF. "The goal here is to learn how to write information into the brain, and learn how the brain reacts when we write information."

Researchers hope the technologies ultimately will help doctors fix injured parts of the brain in much the same way bypass surgery can correct damaged blood vessels and a pacemaker can help the heart function normally.

Current treatment for brain damage - whether it's caused by physical injury, a stroke or diseases that affect the brain - typically is limited to drugs and behavioral therapy.

But drugs almost always have multiple side effects, and it's impossible for them to reach only very specific parts of the body. Behavioral therapy - helping a stroke victim learn to walk and talk again, for example - is limited because the brain already has developed a structure for communicating that can be difficult to overrule.

Signals through a maze

Sabes likens the new research possibilities to one of those puzzles with a small metal ball in a maze - you can try to move the ball from one side of the maze to the other by tilting the puzzle and avoiding dead ends, or you could just pick up the ball and move it to the right place.

Bioengineers want to help the brain shift damaged communications so the signals don't get lost in a maze. They're hoping instructions sent straight to healthy neurons will give the brain the nudge it needs to heal itself.

"We want to be able to take advantage of what nature has given us, which is an incredibly adaptive, plastic brain, that in many cases is able to fix itself just fine," Sabes said. "We're going to give the brain a new source of sensory information, and hope the brain is able to incorporate that information and make it seem natural."

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