Noninvasive Brain Control Possible with New Light-Sensitive Protein

CAMBRIDGE, Mass., June 30, 2014 — A new molecule, along with optogenetics, has put brain control in the hands of scientists.

Researchers from MIT developed the protein, which is sensitive to red light and enables neurons to be manipulated noninvasively, as the controlling light source is outside the body. In addition, the new protein opsin allows a larger volume of tissue to be influenced simultaneously.

In their experiments, the researchers were able to essentially shut down neural activity in the brains of mice using a light source outside the skull. This suppression of activity penetrated as deeply as 3 mm into the brain.

The new light-sensitive protein enables more powerful optogenetics. Courtesy of Jose-Luis Olivares/MIT.

The new technique was found to be as effective as existing neural silencers, which use other colors of light and rely on invasive methods, such as implanted optical fibers.

The researchers have been searching for a noninvasive alternative to study neurons, first looking into naturally occurring microbes and other organisms that already use opsins to detect light. They identified two light-sensitive chloride ion opsins as a possibility because they respond to red light, which has been shown to penetrate deeper into living tissue than blue or green light.

However, the researchers found that these did not produce enough photocurrent to control neuron activity.

To overcome this challenge, Amy Chuong, a graduate student at MIT and one of the researchers on this study, engineered a relative of chloride ion. Called Jaws, the new protein retains the same red light sensitivity, but also features a stronger photocurrent.

"This exemplifies how the genomic diversity of the natural world can yield powerful reagents that can be of use in biology and neuroscience," said Dr. Edward Boyden, an associate professor of biological engineering and brain and cognitive sciences at MIT and leader of this study.

The MIT team furthered its study beyond the basic neural control, in

collaboration with researchers at the Friedrich Miescher Institute for Biomedical Research in Switzerland, next testing Jaws' ability to restore the light sensitivity of retinal cone cells.

They examined mice suffering from retinitis pigmentosa, in which such cells weaken to eventual blindness. The Friedrich Miescher researchers, who had previously demonstrated that some vision can be restored by engineering cone cells to express light-sensitive proteins, found that Jaws offers a greater range of light sensitivity because it more closely resembles the eye's natural opsins.

Although additional testing is needed, the researchers said the new noninvasive approach could potentially lead to better, more effective treatment of retinitis pigmentosa, as well as epilepsy and other neurological disorders.

The work was funded by Jerry and Marge Burnett, DARPA, the Human Frontiers Science Program, the Institution of Engineering and Technology A.F. Harvey Prize, the Janet and Sheldon Razin '59 Fellowship of the MIT McGovern Institute, the New York Stem Cell Foundation/Robertson Investigator Award, the National Institutes of Health, the National Science Foundation and the Wallace H. Coulter Foundation.

The research was published in Nature Neuroscience (doi: 10.1038/nn.3752).

For more information, visit www.mit.edu.

Astounding news! What do the letters JAWS proteing spell out the acronym "JAWS" please. Thank you, Sherry Fuzesy microscopist MMP
- SHERRY FUZESY 7/3/2014 4:13:40 PM

reply

Jaws isn't an acronym, it's a nickname. Dr Boyden writes: "It's named Jaws because it's from the H. salinarum "shark" strain -- and the most famous shark of course is..."
- James Lowe [photonics.com staff] 7/14/2014 8:52:12 AM

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