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Scientists control monkey behavior with light for the first time

By Jon Bardin
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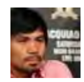
For the first time, scientists have changed a monkey's behavior with a simple flash of blue light. Well, that and a fancy cellular technique called "optogenetics." The new research clears an important hurdle on the path toward using the light-based approach to treat human neurological and psychiatric diseases, such as Parkinson's disease and depression.

Optogenetics takes advantage of a class of proteins called channelrhodopsins. The proteins naturally reside in the outer walls of some algae, and have a peculiar property: They are activated by light. The field's breakthrough came in 2005 when a group of scientists at Stanford demonstrated that they could get the protein into mammalian brain cells, allowing the researchers to make the cells fire when they turned on lights they had implanted in the animal's brain. What's more, they could get the protein into whatever specific types of brain cells they wanted, allowing them to focus on particular areas or functions.

The discovery paved the way for a small revolution in neuroscience: For the first time, scientists could activate specific cell types with astounding specificity. They could even activate some cells



Researchers used pulses of light and a cutting-edge cellular technique called optogenetics to change a monkey's behavior. (Sajjad Hussain / AFP/Getty Images)

while deactivating others by using versions of the protein that respond differently to various wavelengths of light. In theory, the technique allows scientists to carefully modulate any brain system in almost any way they like, an ability that was not previously available to scientists: While blue light might make a group of cells fire, for example, yellow light could be used to turn a different group of cells off.

This has led to important discoveries in lab rats and has been used to study topics as wide-ranging as how therapeutic deep brain stimulation works to treat Parkinson’s to which brain systems are important for arousing a creature from sleep (in those studies, the researchers demonstrated that they could wake a mouse up just by activating a few cells with light in an area called the locus coeruleus). Scientists have also shown that symptoms of depression can be reduced by stimulating particular brain systems, and that animals that don’t like to socialize suddenly become friendly when the scientists stimulate other areas.

The power and specificity of the technique has led many to propose that optogenetics might eventually be a good way to treat brain disorders. But because almost all optogenetic research has been conducted in rodents, it has remained unclear whether the technique would work as well in humans, since we have larger, more complex brains.

While researchers had previously shown they could successfully perform optogenetic experiments in monkeys, they had yet to show that the technique worked well enough to change a monkey’s behavior. In the new study, published Thursday in the journal Current Biology, researchers at Harvard and MIT attempted a modest experiment: To change the dynamics of a monkey’s eye movements by inserting and activating the light-sensitive protein in cells in a part of the brain known to be involved with eye movements.

During the experiments, monkeys were required to make

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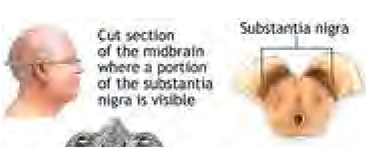

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quick eye movements, called “saccades,” to a target that appeared on a computer screen. The researchers found that when the blue light was turned on, thus activating the neurons that had channelrhodopsin added, the monkey’s eyes moved to the target significantly faster than when the light was not turned on.

The researchers also wanted to know how much of the brain they were activating. By using functional brain imaging while stimulating the cells with blue light, they were able to show that it wasn’t just the areas being flashed with light that were activated: The areas they are connected to also became active, suggesting that even in the large brains of primates, optogenetics can activate whole networks in the brain.

This first simple demonstration that optogenetics can work in non-human primates is likely to lead to more optogenetics studies in monkeys as researchers begin the long path to transition the technology from research to therapy.

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