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Laser-Controlled Humans Closer to Reality

By Lizzie Buchen April 29, 2009 | 12:01 pm | Categories: Animals, Biotech, Brain and Behavior, Engineering, Medical Devices, Neuroscience

Flashes of light may one day be used to control the human brain, and that day just got a lot closer.

Using lasers, researchers at the MIT Media Lab were able to activate a specific set of neurons in a monkey's brain. Though the technique has been used to control and explore neural circuits in fish, flies and rodents, this is the first time the much-hyped technology has ever been used in primates.

"It paves the way for new therapies that could target a number of psychiatric disorders," said MIT neuroscientist Ed Boyden, who led the research with postdoctoral fellow Xue Han. "This is very exciting from a translational standpoint."

The beauty of this optogenetic technique is its specificity. By using a combination of lasers and genetic engineering, scientists can control, to the millisecond, the firing of a specific class of neurons, allowing them to pinpoint problematic cells and circuits while leaving innocent bystanders alone, thus minimizing potential side effects.

Viruses are engineered to infect neurons with a special type of channel, originally discovered in algae, which is sensitive to blue light. Once a blue laser shines on the infected neurons, the channels snap open, ions rush into the cell, and the neuron fires.

Crucial to the technique is that the virus is only injected into a very small part of the brain, and only a certain class of neurons, once infected, actually turn the channel on. The sharp laser beam further zeros in on a small portion of the brain. This precise aim is in contrast to current techniques, such as drugs and electrodes, both of which have a much broader reach.

The optogenetic method was pioneered in 2005 by Boyden and Karl Deisseroth at Stanford University and has since been used to understand how circuits of neurons control various behaviors, such as learning in mice and predator escape in fish. But until now, scientists had never demonstrated the technique in primates — a move essential for developing therapeutic uses for the technology in humans.

Boyden's new research, published Wednesday in *Neuron*, demonstrates not only that the technology works in primates, but also that it is safe. The rhesus macaques received multiple rounds of injections and laser stimulations over the course of eight or nine months without damaging the neurons or activating the brain's immune system, an obvious concern when viruses are involved.

"Many disorders are associated with changes in specific cell types," said Boyden. "For therapeutic purposes, you want to affect certain cells, but you want to leave normal cells intact. The ability to use light to turn specific cells on and off with very precise timing could in principle allow new therapies."

Future applications could involve using light-emitting neural prosthetics to replace the electrodes used in deep brain stimulation, which currently activate or silence a broad range of neurons. Deep brain stimulation has shown promise in treatments of Parkinson's disease, epilepsy and depression, but it has a number of side effects, stemming in part from its lack of specificity.

"Our ability to remedy problems in the brain may ultimately be limited by how many side effects occur," said Boyden. "We could find ways to shut down seizures but the side effects might be intolerable. By pinpointing specific cell types, we could craft therapeutic neuromodulators and directly develop therapies, while preserving a high degree of well-being."

Proving the method works in primate brains paves the way not only for cleaner therapies, but also for understanding the relationship between specific neural circuits and behaviors, particularly higher cognitive functions.

Genetically, mice are ideal model organisms — but their behavioral repertoire isn't very sophisticated. If neuroscientists hope to understand and treat problems like ADHD, schizophrenia, depression and compulsive behaviors like addiction, they can run far-more-powerful experiments using primates.

"This is a very important and exciting step forward for all systems neuroscience," said a neuroscientist who preferred to remain anonymous due to recent attacks against primate researchers.

"There are many limitations with the current way we try to understand neural circuits, primarily the lack of specificity. The hope is that as this sort of research continues in labs around the world, it will become possible to specifically target many different classes of neurons. We can learn how each of them contributes to specific cognitive functions."

See Also:

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Citation: "Millisecond-Timescale Optical Control of Neural Dynamics in the Nonhuman Primate Brain," by Xue Han, Xiaofeng Qian, Jacob G. Bernstein, Hui-hui Zhou, Giovanni

Talei Franzesi, Patrick Stern, Roderick T. Bronson, Ann M. Graybiel, Robert Desimone and Edward S. Boyden. Neuron 62, 191–198, April 30, 2009.

Tags: Media Lab, MIT, monkey, neuroengineering, optogenetic, Stanford
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Posted by: merom92 | 04/29/09 | 2:11 pm

This will not happen in the near future I think…

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Posted by: Vexxarr | 04/29/09 | 2:52 pm

…I…FEEL…TAHT…THIS…IS…A…BENEFICIAL…ADVANCEMENT…FOR…ALL…MANKIND…I…SUPPORT…AND…TRUST…IT…ENTIRELY…ALL…HAIL…MING.

Posted by: superonion | 04/29/09 | 3:08 pm

Anyone here ever see the show Dollhouse??????????????????????????????????
