



Affects Mice Brains Like An MIB Neuralyzer

By **Dann Albright** / October 15, 2014 15-10-2014 / 4 minutes



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557 articles

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Remember when Will Smith and Tommy Lee Jones used the neuralyzer to erase people's memories with blue light in *Men in Black*? Well, we can't do that yet, but some scientists have done something remarkably similar. On October 9th, UC Davis announced that researchers there have "erased specific memories" within mice using light.

The secret to the technology lies in a fascinating field called optogenetics, and it's already started to change [how we think about the brain](#).

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What Is Optogenetics?

Optogenetics is a very recent field by scientific standards, having only been around since 2002. If

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light, opto, and genetics — but how this works is surprising (and really cool). First, a quick lesson in neuroanatomy.

The brain is made up of trillions of neurons, each of which is connected to many other neurons, the same structure reflected in **artificial neural networks and neuromorphic chips**. When a neuron is activated, or “fires,” it communicates with other neurons and creates a cascade of neural activity — this is what causes thought and action (for more details on how the brain works, check out the **HowStuffWorks explanation**).

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So what does light have to do with that? Usually, nothing. However, with a bit of genetic modification, scientists have been able to breed mice whose brains contain neurons that are responsive to light, meaning that when a certain set of neurons are exposed to a very specific wavelength of blue light, they can be turned on or off.



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been used to get a mouse to run with the flick of a switch (the link goes to a video of the experiment; it's pretty cool, but I decided not to embed in case you'd rather not see animal testing in action—that said, it's not too bad).

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When it comes to the brain, however, things like motor activation and neural circuit mapping aren't as complex as modifying memories. Scientists have been studying memories and cognition for a long time, and there's still disagreement over how it works and what the relationship is between a neuron or a group of neurons and particular cognitive functions.

“A Standard-Issue Neuralyzer”



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Really understand what was going on in that research, I'll walk you through the experiment.

Long before the experiment, mice were genetically modified so that their neurons could be affected by blue light. A tiny light was implanted in the brain of the mouse to provide the necessary optical stimulation, and then the experiment began. In this particular experiment, the mice were placed in a cage that gave them a small electric shock. Once they had learned the association between the cage and the shock, they would freeze immediately upon being put into that cage; this is called a fear response.

After the mice had learned this response, the researchers triggered the blue light, which was aimed at specific neuronal clusters. The mice, when reintroduced to the shock cage, no longer showed the fear response—they had “forgotten” what they were afraid of.



Of course, saying that the researchers had erased the memories of the mice is a bit of an oversimplification; this was a very simple conditioned memory and response, and it was suppressed by the application of the blue light.

With that said, it's definitely a step forward in how we understand the brain (if you're interested in the neuroanatomy of the experiment, it showed that the



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It also showed that specific parts of the hippocampus are activated during memory retrieval).

Future Considerations

While you don't have to start worrying about someone zapping your brain with blue light and erasing your memories any time soon, this does provoke some very serious questions about the future of optogenetic research. No research has been conducted with humans yet, but recent studies have used primates, so it seems likely that humans are on the schedule. Because of the genetic component, it could be quite a while before this happens (if you want to see it for yourself, you might want to consider **putting your brain on ice** and checking back in after few decades).

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It's not hard to imagine that someone out there is trying to figure out how to find a wavelength of light that would work without the genetic component. Whether or not this is possible is certainly outside the scope of this article, but it does make for an interesting thought experiment. If scientists figure out how to manipulate neurons without previous genetic manipulation, we could someday see a world straight out of *Dollhouse* (and if you haven't seen *Dollhouse*, I recommend it).

What do you think of this research? Think we could be headed toward pocket-sized neuralyzers? Share your thoughts below!



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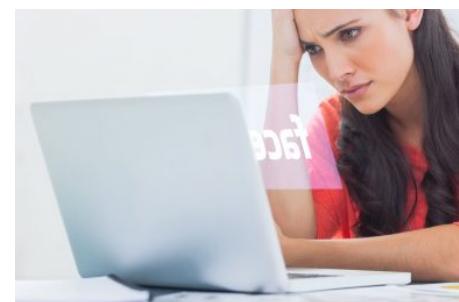
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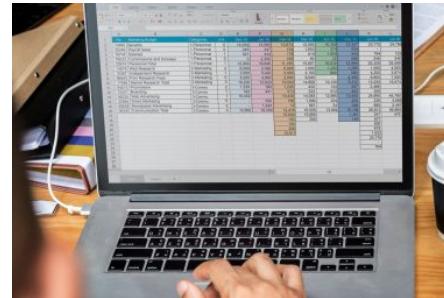


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By **Akshata Shanbhag** / February 1, 2020 01-02-2020 / 0 minutes



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The cheat sheet includes shortcuts for navigation, window and tab management, and search. For those of you who use Edge as an eBook and PDF reader, we've added shortcuts for navigating pages, switching layouts, and for toggling various toolbars. Plus, there's a dedicated section covering shortcuts for Developer Tools.

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Microsoft Edge Keyboard Shortcuts for Windows

Shortcut Action

Search

Ctrl + L	Jump to the address bar
OR	
F4 OR	
Alt + D	

Akshata trained in manual testing, animation, and UX design before focusing on technology and writing. This brought together two of her favorite activities — making sense of systems and simplifying jargon. At MakeUseOf, Akshata writes about making the best of your Apple devices.

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Ctrl + F Find on page
OR
F3

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Navigation

Alt + Home Open home page

Backspace OR Alt + Arrow Left Go back

\$0

\$0

Alt + Arrow Right Go forward

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Page Up Scroll page up
OR
Shift + SpacePage Down Scroll page down
OR
Space

Ctrl + Home Scroll to top of page

Ctrl + End Scroll to bottom of page

Ctrl + Tab Switch to the next tab

Ctrl + Shift + Tab Switch to previous tab

Ctrl + 1,2,3,...,8 Switch to a specific tab number

Ctrl + 9 Switch to last tab

Ctrl + I Open Favorites pane

Ctrl + M Open Reading List pane

Ctrl + H Open History pane

Ctrl + J Open Downloads pane

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Windows and Tabs

Ctrl + N	Open new window
Ctrl + Shift + P	Open new InPrivate browsing window
Ctrl + T	Open new tab
Ctrl + K	Replicate tab and switch to newly created tab
Ctrl + Shift + K	Replicate tab and keep current tab active
Ctrl + click	Open link in new tab
Ctrl + Shift + click	Open link in new tab and switch to the tab
Alt + Shift + click	Open link in new window
Ctrl + Shift + N	Move current tab to new window
³ Ctrl + W	Close current tab
Ctrl + Shift + T	Open a previously closed tab
Alt + Spacebar + M	Move Edge window with arrow keys/mouse/touchpad
Alt + Spacebar + S	Resize window with arrow keys/mouse/touchpad

Bookmarks

Ctrl + D Add current site to Favorites or Reading List



View/Print

Esc Stop loading the page OR
Close sidebar (if open; e.g.: Bookmarks)

Ctrl + R Refresh page
OR
F5

Ctrl +
Shift + R Toggle reading view

Ctrl +
Plus Zoom in (25%)

Ctrl +
Minus Zoom out (25%)

Ctrl + 0 Reset zoom level

Ctrl + P Print current page

General Shortcuts

³Alt + F4 Quit application

Alt + X Open More pane

F12 OR
Ctrl +
Shift + I Open Developer Tools pane

F1 Help

Using Edge as an eBook Reader

Alt + T Toggle table of contents

Ctrl + B Toggle list of bookmarks

Ctrl +
Shift + D Add or remove bookmark

Ctrl +
Shift + O Toggle Options

Ctrl +
Shift + Y Toggle reading bar

Ctrl +
Shift + U Open Books in the Hub

Ctrl +
Shift + G Start read aloud

F11 Enter or exit full-screen reading



Arrow
OR
Up Arrow
OR
Page Up

Right Arrow Go to previous page

OR

Down Arrow

OR

Page Down

Home Go to beginning of book

End Go to end of book

Ctrl + F Search book

Ctrl + Shift + S Save book locally (for books not purchased in the Microsoft Store)

Ctrl + G Go to page (when the book supports page lists)

Alt + A Open Notes panel

Reading Fixed Layout Books

Ctrl + Shift + A Toggle between "fit to width" and "fit to page" layout

F8 Toggle between one-page and two-page layouts

Reading PDF Documents

Ctrl + G Go to specific page number

Alt + T Toggle table of contents

Ctrl + F Search document

Ctrl + Plus (+) Zoom in/zoom out
OR
Ctrl + Minus (-)

Ctrl + Shift + A Toggle between "fit to width" and "fit to page" layout

F8 Toggle between one-page and two-page layouts

F9 Rotate PDF



Ctrl + Shift + G Start Read Aloud

Ctrl + Shift + M Add notes to PDF books

Ctrl + Shift + S Save a copy of the PDF document

*Developer Tools

Ctrl + B Select element (on DOM Explorer tab)

Ctrl + K Color picker (on DOM Explorer tab)

Ctrl + J Debug just my code (on Debugger tab)

Ctrl + E Start/stop profiling to begin a performance session (on Performance, Network, and Memory tabs)

Ctrl + S Export as HAR (on Network tab)

Ctrl + O Import profiling session (on Performance and Memory tabs)

Ctrl + S Export profiling session (on Performance and Memory tabs)

Ctrl + L Clear errors, warnings, information (on Performance tab)

F5 or F8 Continue (on Debugger tab)

Hold F5/F8 Fast Continue (on Debugger tab)

F11 Step into (on Debugger tab)

F12 Step over (on Debugger tab)

Shift + F11 Step out (on Debugger tab)

Ctrl + Shift + F5 Continue and refresh (on Debugger tab)

Ctrl + Shift + I DOM element highlighting (on DOM Explorer tab)

Ctrl + Shift + W Break on new worker (on Debugger tab)

Ctrl + Shift + E Change exception behavior (on Debugger tab)



Ctrl + Shift + T Reset Emulation settings (On Emulation tab)

¹Middle Mouse Button

²Middle Mouse Wheel

³Closing last remaining tab quits application.

⁴Associated shortcuts work only in tabs of Developer Tools.

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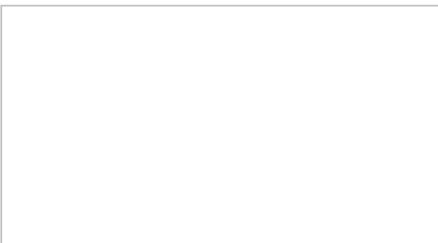
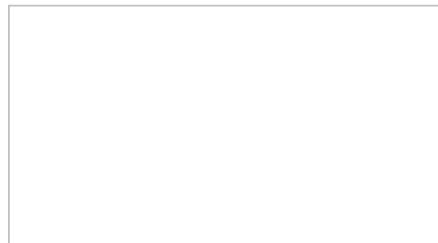
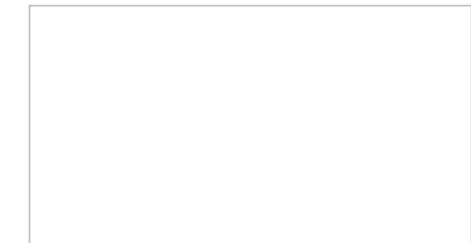
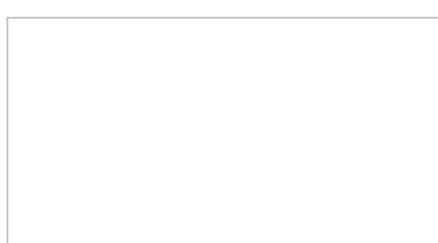
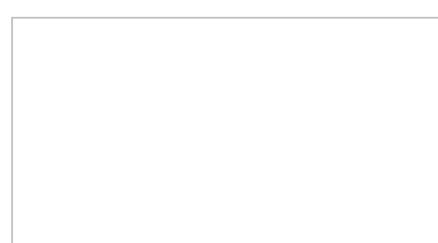
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