Brain cells work differently than previously thought

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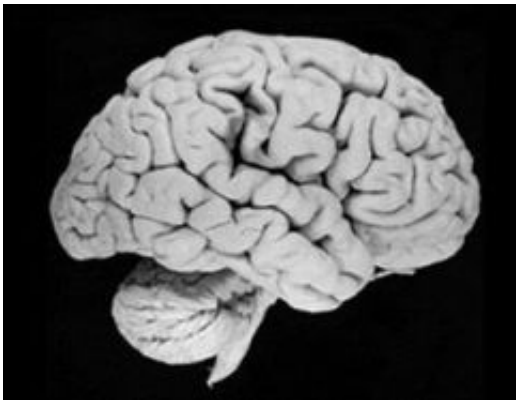

Modern human brain. Credit: Univ. of Wisconsin-Madison Brain Collection.

Scientists know that information travels between brain cells along hairlike extensions called axons. For the first time, researchers have found that axons don't just transmit information – they can turn the signal up or down with the right stimulation.

This finding may help scientists develop treatments for psychiatric disorders such as depression and schizophrenia in which it is thought that different parts of the brain do not communicate correctly with each other.

"Until now, scientists have thought that in the brain's cortex -- where most cognitive processes occur -- information was only processed in the

cell body," said Raju Metherate, author of the study, associate professor of neurobiology and behavior, and director of the Center for Hearing Research at UC Irvine. "The result of our study suggests that we must consider the axons as sites of information processing – and of potential problems when things go wrong."

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Increasingly, studies are beginning to show that complex information processing, and perhaps consciousness itself, may result from coordinated activity among many parts of the brain connected by bundles of long axons. Cognitive problems may occur when these areas don't communicate properly with each other.

Cognitive function occurs when millions of brain cells communicate with each other at the same time. A brain cell has a network of branches called dendrites through which it receives and processes information from other cells. The body of the cell then relays the processed information along an axon to a terminal that links to another cell's dendrites. At the terminal, chemicals called neurotransmitters are released, allowing the information to enter the receiving cell. Until now, scientists believed axons were just the wires between point A and point B.

"Axons, we thought, were like wires in a radio conveying signals, but we found that if you stimulate the axon, the signal can be altered, like turning the volume knob on the radio," Metherate said.

Originally, Metherate and his colleagues had hoped to confirm the idea that the drug nicotine alters information that is processed in the cell body or terminal. Puzzled by several negative tests, they developed an experiment in which they could study the intervening axon.

In their experiment, they examined a section of mouse brain associated with hearing that contained a brain cell with an axon connecting to the cortex. Using nicotine, they stimulated the axon to determine how it would affect a signal the brain cell sent to the cortex. Without applying nicotine, about 35 percent of the messages sent by the brain cell reached the cortex. But when nicotine was applied to the axon, the success rate nearly doubled to about 70 percent.

“We looked for more conventional reasons why the response was enhanced, but the evidence just kept pointing to the axon. Nicotine activated the proteins that we think are on the axon,” Metherate said. “This is a completely new idea about how the brain works.”

Source: University of California - Irvine