New information about how neurons act could lead to brain disorder advancements

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Schulz' study was conducted using clusters of neurons found in Jonah crabs.
Credit: David Schulz

Neurons are electrically charged cells, located in the nervous system, that interpret and transmit information using electrical and chemical signals. Now, researchers at the University of Missouri have determined that individual neurons can react differently to electrical signals at the molecular level and in different ways—even among neurons of the same type. This variability may be important in discovering underlying problems associated with brain disorders and neural diseases such as epilepsy.

"Genetic mutations found in neurological disorders create imbalances in the inward and outward flow of electrical current through cells," said David Schulz, associate professor in the Division of Biological Sciences in the College of Arts and Science and a researcher in the Interdisciplinary Neuroscience Program at MU. "Often, neurons react to electrical signals, or voltage, and compensate by altering their own electrical outputs. The variability in these imbalances, even among multiple cells of the same kind within the brain, is one of the major problems scientists face when trying to design therapeutics for disorders like epilepsy. Seizures in individuals can be caused by different imbalances—therefore getting to the root of how neurons act individually makes our studies important."

Schulz and his team previously proved that two identical neurons can reach the same electrical activity in different ways. In his new study, Schulz hypothesized that neurons might use the cell's genetic code, or its messenger RNA (mRNA), to "fine tune" the production of proteins, helping individual cells react accordingly.

Using clusters of neurons obtained from Jonah crabs, Schulz and his team experimentally altered electrical input and output in the neurons and measured the messenger RNA (mRNA) levels found within the cells. Invertebrates like crabs are useful in neuroscience research because their neurons are simple enough to observe and study, but advanced enough that they can be "scaled up" to apply to higher organisms, Schulz said.

They found that when normal patterns of stimulation were maintained, cells engaged the correct ratios of mRNA to produce the proteins needed to help keep electrical impulses in order; however, when normal patterns of activity were not maintained, this fundamentally changed the cells at the molecular level.

"We were the first to show that the correct ratios of mRNAs are actively maintained by the actual activity or voltage of the cell, and not chemical feedback," Schulz said. "These results represent a novel aspect of regulation that might be useful for developing therapeutics for neuronal disorders later."

Schulz' study, "Activity-dependent feedback regulates correlated ion channel mRNA levels in single identified motor neurons," was published in the August 18th edition of *Current Biology*.

More information: www.sciencedirect.com/science/ … ii/S0960982214007842

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