Systems Neuroscience  
Standard methods may lead to distorted results  

Brain neurons are sensitive. They only respond normally to natural signals. Therefore it might be time for neuroscientists to reconsider their knowledge.

Neuroscientists usually employ a standardized method when examining neurons: They stimulate the cells electrically by using artificial action potential patterns. This might very well be a mistake as Prof. Dr. Patrik Krieger and his team from the department of Systems Neuroscience of the Faculty of Medicine of the Ruhr University Bochum have discovered. Instead of artificial action potential patterns they used natural stimulation patterns. The results differed notably and have been published in the journal “Frontiers in Cellular Neuroscience”.

At the synapse – the link between two cells – is a narrow gap which is bridged by the cells by means of chemical signals. When neurons receive synaptic signals from other neurons, these signals are being integrated and transformed into a pattern of electrical action potentials. Those electrical impulses can in turn stimulate other cells: action potentials open up channels within the cell membrane through which calcium ions can enter. These calcium ions set a number of cellular processes in motion which can be measured by means of imaging techniques.

Whiskers leading to the breakthrough

Patrik Krieger and his colleagues have examined this process, using the example of two different cell types in the cerebral cortex of rats. Instead of going for the traditional method – stimulating every cell with the same artificial pattern of electrical signals –, they used signal patterns they had previously recorded in exactly the same cell types of living rats while stimulating their whiskers. The two cell types in the brains of those rats responded in different ways: While the first group of cells fired electrical signals with a high frequency, the second group produced less action potentials within the same time span.

The fine-tuning of calcium dynamics

In a second experiment the researchers stimulated every cell type once with natural frequencies and firing patterns and once with standardized artificial frequencies, measuring the influx of calcium into the cells at the same time. “The comparison has shown that the amount of calcium influx is the same in both cell types under natural conditions, while it differs, when using artificial signal patterns”, explains Patrik
Krieger. “This indicates that the calcium dynamics and the respective action potentials in the body are very precisely tuned. This is how the cell prevents saturation. Furthermore it can be noted that the properties of the different neurons are tuned according to their role in the brain.” In future the scientists intend to find out whether the examination of other cell types in the brain leads to the same results. “When examining neurons one should use natural frequencies and firing patterns to make sure that the results are as transferable as possible to the living organism,” Krieger concludes.

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**Reference:**
Patrik Krieger, Christiaan P. J. de Kock, Andreas Frick: Calcium dynamics in basal dendrites of layer 5A and 5B pyramidal neurons is tuned to the cell-type specific physiological action potential discharge, in: Frontiers in Cellular Neuroscience, 2017, DOI: 10.3389/fncel.2017.00194

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