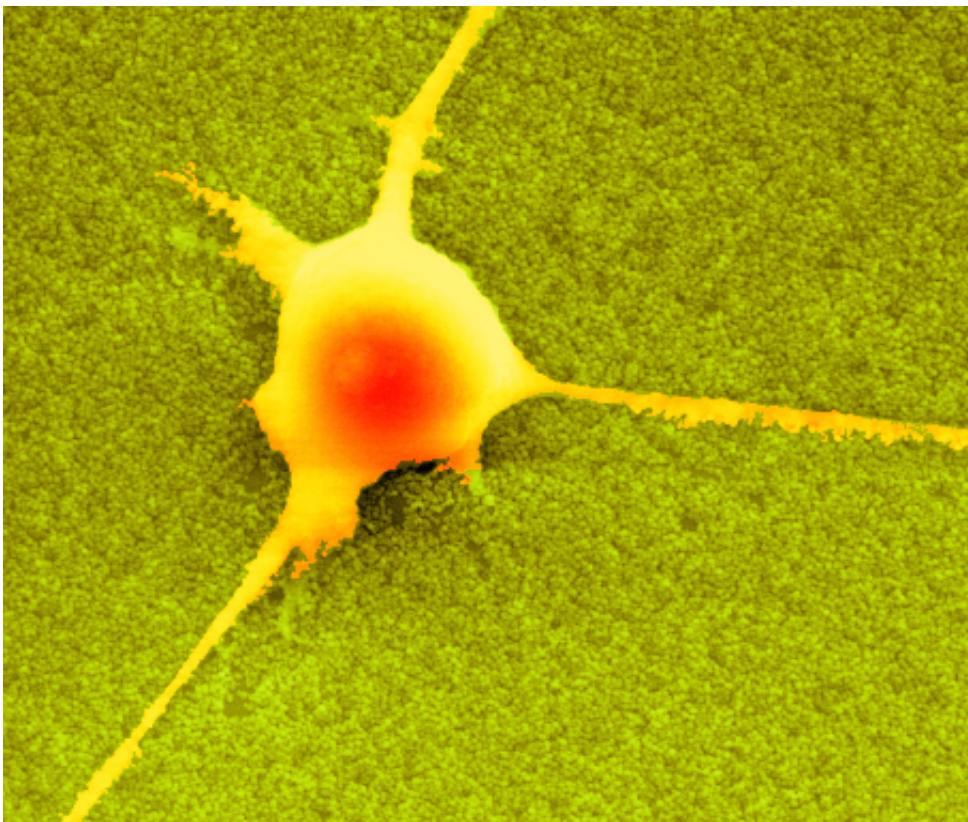


Researchers decipher the role of nanostructures around brain cells in central nervous system function

October 30 2014



Scanning electron micrograph showing a neuron on a nanorough surface making intimate contact with the surface. Surfaces has been given a false color for visualization. Credit: Nils Blumenthal and Prasad Shastri

An accumulation of a protein called amyloid-beta into large insoluble

deposits called plaques is known to cause Alzheimer's disease. One aspect of this illness that has not received much attention is which role the structure of the brain environment plays. How do macromolecules and macromolecular assemblies, such as polysaccharides, influence cell interaction in the brain?

In a paper published in the journal *Proceedings of the National Academy of Sciences*, Prof. Prasad Shastri and graduate student Nils Blumenthal, in collaboration with Prof. Bernd Heimrich and Prof. Ola Hermanson, have discovered that macromolecules or support cells like [astrocytes](#) provide well-defined physical cues in the form of random roughness or ruffles that have a crucial role in promoting and maintaining healthy interactions between cells in the hippocampus. This [brain](#) area is regarded as the brain's GPS system: It processes and stores spatial information. In Alzheimer's disease, this area degenerates. Shastri says, "It has been long thought that only biological signals have a role in health and function of brain cells, but here we show that the structure of the molecules that surround these cells may be equally important."

The researchers found that there is a restricted regime of roughness at the nanoscale that is beneficial to [neurons](#). If the magnitude of roughness exceeds or is below this regime, neurons experience detrimental changes to their function. By analyzing human brain tissue from patients who suffered from Alzheimer's disease, Shastri's team has found a crucial link between regions in the brain that have amyloid-beta plaque accumulation - which are responsible for neuron death - and unfavorable changes to the nanotopography in the tissue surrounding these neurons, that is the features of its surface..

Shastri and his co-workers have found that astrocytes provide a nanoscale physical environment that neurons need to function well. "Our discovery shows for the first time that stretch-activated ion channels may have a role in central nervous system function and disease. Hence, our

findings offer new pharmacological targets", says Blumenthal. Using synthetic substrates of precise roughness, they found out that stretch-sensitive molecules, including the so-called Piezo-1 ion channel in murine brain [cells](#), direct the interaction between nanotopography, astrocytes and neurons. Former research has shown that the expression of MIB-1, a human analog of Piezo-1, is altered in human Alzheimer's patients.

More information: Nils Blumenthal, Ola Hermanson, Bernd Heimrich and V. Prasad Shastri (2014).. "Stochastic Nanoroughness Modulates Neuron-Astrocyte Interactions and Function via Mechanosensing Cation Channels," *Proc. Natl. Acad. Sci.*.. [DOI: 10.1073/pnas.1412740111](https://doi.org/10.1073/pnas.1412740111)

Provided by Albert Ludwigs University of Freiburg

Citation: Researchers decipher the role of nanostructures around brain cells in central nervous system function (2014, October 30) retrieved 19 April 2024 from <https://medicalxpress.com/news/2014-10-decipher-role-nanostructures-brain-cells.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--