MedicalXpress

Novel form of experience-dependent plasticity in the adult brain revealed

February 6 2015

Research by a team of scientists from Cologne, Munich and Mainz has shown an unprecedented degree of connectivity reorganization in newly-generated hippocampal neurons in response to experience, suggesting their direct contribution to the processing of complex information in the adult brain.

The hippocampus is an anatomical area of the brain classically involved in memory formation and modulation of emotional behavior. It is also one of the very few regions in the adult brain where resident neural stem cells generate new neurons life-long, thus providing the hippocampal circuitry with an almost unique renewal mechanism important for information processing and mood regulation. In response to experience and voluntary exercise, the amount of new neurons that are incorporated into the hippocampus increases. Dr. Matteo Bergami from CECAD Cologne (Cluster of Excellence in Cellular Stress Responses in Aging-Associated Diseases) has joined efforts with scientists from Ludwig Maximilians University Munich and the University Medical Center of Johannes Gutenberg University Mainz to investigate whether experience, rather than merely promoting neurogenesis, also modifies the connectivity of new neurons.

The scientists successfully showed that the pattern of connectivity of new neurons, namely the number and types of inputs received by each new neuron, is not prefigured in the adult brain but can be significantly altered in response to complex environmental conditions. In fact, following environmental enrichment (EE) the innervation by both local

hippocampal interneurons and long distance projection cortical neurons was substantially increased. However, while the inhibitory inputs were largely transient, cortical innervation remained elevated even after ending the exposure to EE. These findings reveal that exposure to complex environmental stimuli as well as their deprivation regulates the way new neurons become incorporated into the preexisting circuitry and thus, their engagement into hippocampal-dependent tasks.

These findings significantly contribute to deepening our understanding of how the brain responds to experience and how external stimuli are translated into stable changes of neuronal connectivity. The results will not only help to decipher how complex learning processes modify the brain's plasticity, but may also create an experimental basis for investigating the maladaptive changes in brain connectivity associated with neurological and neuropsychiatric disorders such as epilepsy, depression, anxiety, and posttraumatic stress.

The research group's results represent a crucial step towards realizing the broader vision of CECAD at the University of Cologne, namely to understand the molecular and cellular basis of aging-associated diseases as a means to developing new effective therapeutic strategies.

Provided by University of Cologne

Citation: Novel form of experience-dependent plasticity in the adult brain revealed (2015, February 6) retrieved 25 April 2024 from https://medicalxpress.com/news/2015-02-experience-dependent-plasticity-adult-brain-revealed.html