CECAD Excellence Cluster, University of Cologne

Press Release

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

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

Cologne/Munich/Mainz, February 5, 2015. The hippocampus is an anatomical area of the brain classically involved in memory formation and modulation of emotional behavior. This 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 incorporate into the hippocampus increases. Now, Dr. Matteo Bergami from CECAD Cologne together with scientists from the LMU Munich and the University Medical Center of the Johannes Gutenberg University in Mainz have joined their efforts 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 deepen our understanding of how the brain responds to experience, and how external stimuli are translated into stable changes of neuronal connectivity.

Their results will not only help deciphering 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 mean to develop new effective therapeutic strategies.

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