THE KAVLI PRIZE

THE KAVLI PRIZE IN NEUROSCIENCE 2016

The Norwegian Academy of Science and Letters has decided

to award the Kavli Prize in Neuroscience for 2016 to

EVE MARDER
Brandeis University, USA

MICHAEL MERZENICH
University of California San Francisco, USA

CARLA SHATZ
Stanford University, USA

"for the discovery of mechanisms that allow experience and neural activity to remodel brain function"

How does the brain change during learning and development, while remaining structurally stable and producing reliable behaviour? This fundamental question has been addressed by the three 2016 Kavli Prize laureates in Neuroscience. Their discoveries showed how neuronal activity, generated either by experience or by intrinsic brain function, actively sculpts structural and functional connections between nerve cells. At the same time, essential stability is provided by self-regulating mechanisms that drive nerve cells to produce consistent patterns of activity.

Michael Merzenich demonstrated that sensory circuits in the cerebral cortex can be reorganized by experience in adulthood. Different parts of the body are represented in a continuous map in the somatosensory cortex. After demonstrating reorganization of this map after injury, Merzenich showed that simply expanding or limiting the use of different fingers leads to a corresponding change in the representation of the hand in the brain. Similarly, he showed that the auditory cortex can change its map of sound frequencies after individuals are trained to detect fine differences in pitch. This discovery helps explain how humans can recover their perception of speech with electronic cochlear implants, which generate signals much simpler than normal auditory inputs. Merzenich showed that neuromodulators as well as cognitive factors including attention determine whether adult plasticity takes place. This work is being extended in humans to maximize learning and recovery from brain injury and disease.

Carla Shatz showed how patterns of activity in the developing brain instruct and refine the arrangement of synapses between neurons. She demonstrated that the formation of appropriate connections between the eye and the brain of mammals depends on neuronal activity before birth. She discovered that spontaneous waves of activity sweep across the retina early in development, and showed that these organized activity patterns select the final set of connections from a coarse, genetically-determined map. Her demonstration that "neurons that fire together, wire together" links the mechanisms of brain wiring during development to those underlying adult learning and memory.

The Norwegian Academy of Science and Letters
Drammensveien 78, 0271 Oslo, Norway
Phone +47 22 84 15 00

www.dnva.no

See also:

The Kavli Prize
www.kavliprize.org

The Kavli Foundation
www.kavlifoundation.org

Eve Marder used the simple circuits of crustaceans to elucidate the dynamic interplay between flexibility and stability in the nervous system. She showed that numerous neuromodulators reconfigure the output of adult neural circuits without altering their underlying anatomy. At the same time, she found that circuits can generate similar neuronal and network outputs from many different configurations of intrinsic neuronal excitability and synaptic strength. This apparent paradox was solved by her recognition that neurons have a self-regulating homeostatic programme that drives them to a stable target activity level. With the other two Kavli Prize laureates, Marder defined the mechanisms by which brains remain stable while allowing for change during development and learning.