'Sensational' barrels in the brain

November 18 2013

A new study from scientists at the Tata Institute of Fundamental Research (TIFR), Mumbai, gives an insight into how the circuitry for high resolution signal processing is wired in the brain.

Our sensory system has the ability to discriminate signals coming in from various sensory modalities such as visual, auditory, or somatosensory (touch) pathways at a very high resolution. This ability is directly linked to two parameters: One, the amount of cerebral cortex that processes the incoming information- e.g. an image recorded by a camera with a higher number of pixels will be of a higher resolution. . The second parameter is the circuitry that enables discrimination i.e. nerves carrying sensation from two adjacent points on the body must connect to distinct portions of the cerebral cortex in order for the brain to perceive the two points as physically distinct.

In a study that will appear in the *Proceedings of the National Academy of Sciences* (*PNAS*) next week, a group led by Dr. Shubha Tole, a scientist at TIFR, reports that a gene named Lhx2 regulates the formation of high-resolution neurocircuitry for touch in mice. In rodents, the whiskers on the snout serve as the 'fingers' in terms of sensing the environment. Nerves carrying sensation from each whisker traverse a pathway from the snout to the brain, ending in a small cluster of nerve fibers that connects with a ring of neurons in the cerebral cortex. This ring-and-cluster, called "barrel-and-core", is a signature of the fine microcircuitry that allows the mouse to assess its environment by rapid whisking. There are as many barrels as whiskers, which is necessary for the animal to be able to distinguish which whisker is being stimulated. The fundamental

molecular mechanisms that govern the formation of this intertwined circuitry in the mouse model would be broadly applicable to other organisms such as humans and to other sensory modalities such as vision and hearing as well.

Ashwin Shetty, a PhD student in Dr. Tole's laboratory, showed that when the Lhx2 gene is knocked out in cortical neurons, none of the barrels form. Even more surprising, the barrel cores are also lost. In this scenario, even though the nerves bringing signals from the whiskers do make connections with the sensory cortex, the circuitry that brings about resolution and discrimination is profoundly defective. The discovery of Lhx2 as a central regulator of circuit formation in the brain will open the door to further studies that unravel exactly how this process is executed. These leads will also provide a mechanistic insight to studies from other groups that explore how defective circuit formation underlies neurological disorders such as autism, schizophrenia, and other disorders of brain function.

More information: Lhx2 regulates a cortex-specific mechanism for barrel formation, www.pnas.org/cgi/doi/10.1073/pnas.1311158110

Provided by Tata Institute of Fundamental Research