UNIVERSITÉ DE GENÈVE

PRESS RELEASE

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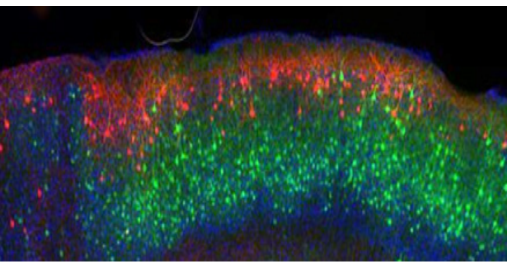
An activity-sensing thermostat in the brain

More inhibitory neurons are recruited, thereby preventing an electrical "overheating" of expanding circuits

Under the supervision of Professor Denis Jabaudon, a team of neuroscientists from the Faculty of Medicine of the University of Geneva (UNIGE) just demonstrated that brain activity can control the cellular composition of brain circuits. By studying the visual system of mice during their first week of life, the researchers discovered that the number of inhibitory neurons – the cells that balance brain activity – depends on the degree of visual activity. Therefore, it seems that the brain has an evolutionary "thermostat" mechanism through which neuronal activity can regulate itself when specific sensory circuits expand.

How do brain circuits adapt, during evolution, to a decrease or increase in the activity of specific sensory organs? What are the self-regulatory mechanisms that allow the brain to avoid a potentially pathological overstimulation? This is the kind of questions which Professor Jabaudon's group, specialists in brain development and plasticity, would like to answer.

By observing the visual system of newborn mice, the researchers of the Department of Fundamental Neurosciences of the Faculty of Medicine of UNIGE studied how retinal activity influences the construction of neuronal circuits to allow the brain to maintain balanced excitability.



Two types of visible neurons in the cerebral cortex. © Denis Jabaudon

Environmental influence

In an article published in *Neuron*, the researchers show that during the first week of life, visual activity controls the migration of inhibitory neurons, thereby determining the cellular composition of brain circuits. Inhibitory neurons are specialized cells whose role is to regulate excitation, preventing the brain from becoming over-active, as occurs during epilepsy, for example. When visual activity is reduced or impaired, less inhibitory neurons migrate in visual brain regions, compensating for the loss of information, and keep a constant signal.

Conversely, if visual activity increases, as has occurred during evolution, and particularly in primates, which have an elaborate visual system, inhibitory neurons are recruited, thereby preventing an electrical "overheating" of the system. Therefore, a "thermostat" mechanism exists through which neuronal activity can regulate itself, as circuits expand, through the capture of inhibitory cells.

This research indicates that cerebral circuits are more plastic than previously thought, and that activity itself acts to recruit new neuinhibitory neurons thereby **preventing an electrical “overheating”**

rons into circuits. Indeed, it is the onset of activity itself – here visual activity – that gives the recruitment signal of the inhibitory neurons, without which the system becomes hyperexcitable and therefore unstable. The researchers would now like to explore the possibilities of prolonging this period of hyperplasticity beyond the first week of life.

Variability in genetic identity

Moreover, Denis Jabaudon and his colleagues were awarded the 2014 Pfizer Research Prize a few weeks ago for demonstrating, in another study, that during this developmental period, specific neurons can be “transformed” genetically *in vivo*, thus acquiring a new identity allowing them to be integrated into other brain circuits. Generally speaking, this research aims at better understanding the mechanisms that control the assembly of brain circuits by studying the genetic and environmental mechanisms at play. A better understanding of these processes might contribute to protect or repair vulnerable circuits in neurodevelopmental and neurodegenerative diseases such as autism or Parkinson’s disease.

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