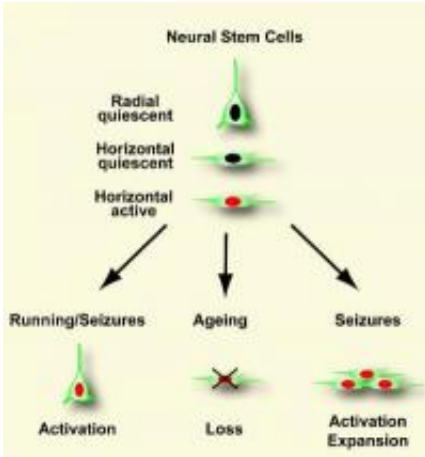


New nerve cells -- even in old age

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This illustration shows different types of stem cells in the brains of mature mice. Credit: Verdon Taylor, Max Planck Institute of Immunobiology

After birth the brain loses many nerve cells and this continues throughout life - most neurons are formed before birth, after which many excess neurons degenerate. However, there are some cells that are still capable of division in old age - in the brains of mice, at least.

According to scientists from the Max Planck Institute of Immunobiology in Freiburg, different types of neuronal stem cells exist that can create new [neurons](#). While they divide continuously and create new neurons in young animals, a large proportion of the cells in older animals persist in a state of dormancy. However, the production of new cells can be reactivated, for example, through physical activity or epileptic seizures. What happens in mice could also be applicable to humans as neurons

that are capable of dividing also occur in the human brain into adulthood. (*Cell Stem Cell*, May 7th 2010)

You can't teach an old dog new tricks. The corresponding view that the brain loses learning and [memory capacity](#) with advancing age prevailed for a long time. However, neuronal stem cells exist in the [hippocampus](#) - a region of the brain that plays a central role in learning and memory functions - that can produce new [nerve cells](#) throughout life. It is known from tests on mice that the newly formed cells are integrated into the existing networks and play an important role in the learning capacity of animals. Nonetheless, the formation of new cells declines with age and the reasons for this were unknown up to now.

Together with colleagues from Dresden and Munich, the Freiburg researchers have now succeeded in explaining for the first time why fewer new neurons are formed in the adult mouse brain. They managed to identify different populations of neuronal stem cells, thereby demonstrating that the hippocampus has active and dormant or inactive neuronal stem cells. "In young mice, the stem cells divide four times more frequently than in older animals. However, the number of cells in older animals is only slightly lower. Therefore, neuronal stem cells do not disappear with age but are kept in reserve," explains Verdon Taylor from the Max Planck Institute of Immunobiology.

The precise factors that influence the reactivation of dormant stem cells are not yet clear. The cells can, however, be stimulated to divide again. The scientists observed more newborn hippocampal neurons in physically active mice than in their inactive counterparts. "Consequently, running promotes the formation of new neurons," says Verdon Taylor. Pathological brain activity, for example that which occurs during epileptic seizures, also triggers the division of the neuronal stem cells.

Horizontal and radial stem cells

The different stem cell populations are easy to distinguish under the microscope. The first group comprises cells which lie perpendicular to the surface of the hippocampus. Most of these radial stem cells are dormant. As opposed to this, over 80% of the cells in the group of horizontal stem cells - cells whose orientation runs parallel to the hippocampus surface - continuously form new cells; the remaining 20% are dormant but sporadically become activated. The activity of genes such as Notch, RBP-J and Sox2 is common to all of the cells.

Radial and horizontal stem cells differ not only in their arrangement, apparently they also react to different stimuli. When the animals are physically active, some radial stem cells abandon their dormant state and begin to divide, while this has little influence on the horizontal stem cells. The result is that more radial stem cells divide in active mice. The horizontal stem cells, in contrast, are also influenced by [epileptic seizures](#).

It would appear that neuronal stem cells are not only found in the brains of mice. The presence of neurons that are formed over the course of life has also been demonstrated in the human hippocampus. Therefore, scientists suspect that different types of active and inactive stem cells also arise in the human brain. It is possible that inactive stem cells in humans can also be activated in a similar way to inactive stem cells in mice. "There are indicators that the excessive formation of new neurons plays a role in epilepsy. The use of neuronal brain [stem cells](#) in the treatment of [brain](#) injuries or degenerative diseases like Alzheimers may also be possible one day," hopes Verdon Taylor.

More information: Quiescent and active hippocampal neural stem cells with distinct morphologies respond selectively to physiological and pathological stimuli and ageing. Sebastian Lugert, Onur Basak, Philip Knuckles, Ute Haussler, Klaus Fabel, Magdalena Götz, Carola A. Haas, Gerd Kempermann, Verdon Taylor, Claudio Giachino, *Cell Stem Cell*,

May 7th 2010

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