

brain

BRIEFINGS

JUNE 2007

FOR MORE THAN A CENTURY, MEDICAL SCIENCE FIRMLY BELIEVED THAT OUR BRAIN COULD NOT REPAIR ITSELF AND THAT WE WERE BORN WITH ALL THE BRAIN CELLS WE WOULD EVER HAVE. THAT BELIEF HAS CHANGED. OVER THE LAST 20 YEARS, RESEARCH HAS SHOWN THAT NEUROGENESIS, THE CREATION OF NEW BRAIN CELLS, ACTUALLY OCCURS IN THE ADULT HUMAN. CURRENTLY, WORK IS SHIFTING TO FIND OUT WHERE NEUROGENESIS HAPPENS, HOW IT HAPPENS, WHY IT HAPPENS, AND, MORE IMPORTANTLY, HOW IT MIGHT HELP THE BRAIN HEAL ITSELF.

ADULT NEUROGENESIS

We've been taught for generations that the adult brain doesn't create new brain cells. The cells you have at birth are about all you'll ever have, and a neuron lost is lost forever. Now, medical science has learned a different lesson.

Research over the last decade has produced growing evidence that the adult human brain creates new neurons, a process known as neurogenesis. Recent findings show that many of these new neurons survive and integrate themselves into the working brain, suggesting the potential for a self-healing brain. If researchers can harness and enhance neurogenesis, it could lead to improved treatments for many disorders, diseases, or damage—from Alzheimer's and epilepsy to stroke and traumatic brain injury—and it can help keep our minds and memories sharp.

Already research has:

- Identified areas of the brain where neurogenesis is evident.
- Discovered the processes that may promote or inhibit neurogenesis.
- Offered a glimpse of how new neurons may assimilate into the working brain.

What began with the song of a small bird has changed an entire paradigm in neuroscience.

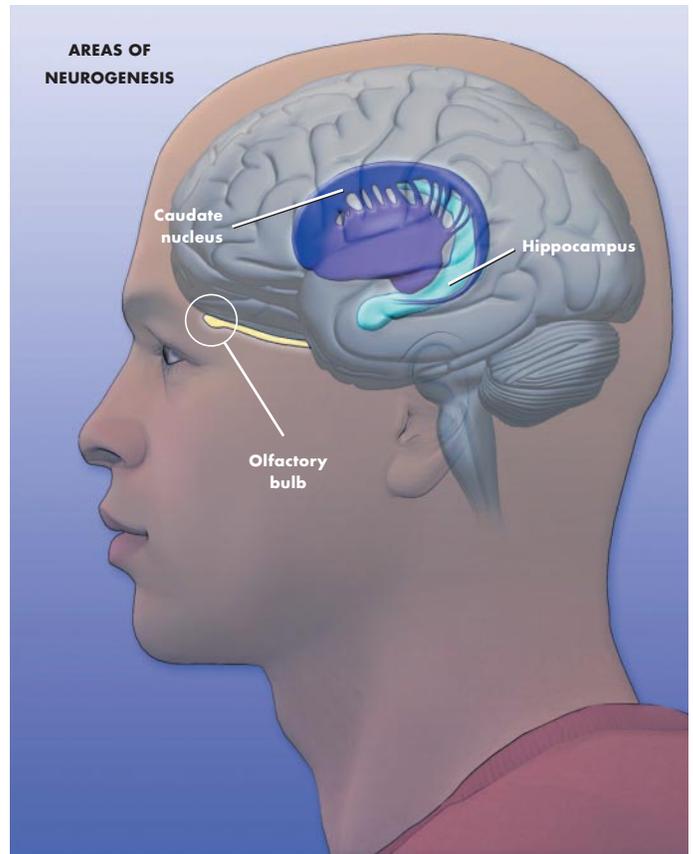


ILLUSTRATION BY ETHAN TYLER

▲ **ALTHOUGH SCIENTISTS STILL DEBATE THE EXTENT AND PURPOSE OF NEUROGENESIS IN THE ADULT BRAIN, RESEARCH HAS IDENTIFIED CERTAIN AREAS OF THE BRAIN WHERE IT IS MOST EVIDENT. THESE AREAS INCLUDE THE HIPPOCAMPUS, CAUDATE NUCLEUS, AND OLFACTORY BULB.**

About 20 years ago, research on the ability of adult songbirds to learn new songs showed that their brains created new cells and that these neurons helped them form memories of the new songs. This opened up debate on whether the same process occurred in humans. Subsequent research confirmed human neurogenesis, and now questions revolve around the extent

that neurogenesis occurs, where it occurs, and the function new neurons perform in the working brain.

In order to understand neurogenesis better, it helps to understand that not all new neurons live very long after birth. In fact, more die than survive, which may be one reason it took so long for researchers to recognize neurogenesis in the adult brain.

DAVID VAN ESSEN, PHD

President
Washington University
School of Medicine

EVE E. MARDER, PHD

President-Elect
Brandeis University

STEPHEN F. HEINEMANN, PHD

Past President
The Salk Institute

FOR MORE INFORMATION

Please contact the public
information department
at publicinfo@sfn.org or
(202) 962-4000

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To live and become part of the working brain, a new neuron needs not only support from neighboring glial cells and nutrients from blood, but also, and more important, connections with other neurons. Without these connections, neurons wither and die.

Research to date suggests that the most active area of neurogenesis is the hippocampus, a region deep within the brain involved in learning and memory. Research has shown that thousands of new cells are produced in the hippocampus each day, although many die within weeks of their birth.

Recent animal studies have shown a correlation between learning and new neurons surviving in the hippocampus. After teaching rodents a variety of tasks that engaged a range of brain areas, scientists found that, generally, the more the animal learned, the more neurons survived in the hippocampus. Cells that were born before the learning experience were

more likely to survive to become neurons, but only if the animals actually learned. The increase in survival occurred with tasks that depended on the hippocampus as well as those that required significant effort to learn.

Everybody knows that exercise is good for your heart, but in recent years, compelling evidence has shown that exercise is also good for your brain.

Experiments have found that mice that used a running wheel had about twice as many new hippocampal neurons as mice that didn't exercise. Learning may still be necessary to preserve them, however.

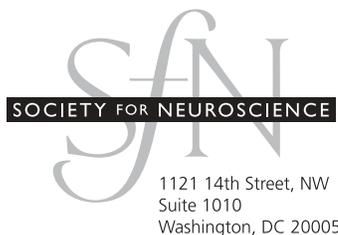
Other research has found that beta-endorphin, a mood-elevating chemical produced by the hypothalamus and the pituitary gland, may play a role in the effects of exercise on the brain. Mice producing beta-endorphin and exercising showed an increase in the hippocampus in both the number of newborn cells and the rate

at which those cells survived. However, mice that could not produce beta-endorphin but were still allowed to exercise showed no change in neurogenesis.

Recent experiments using antidepressant therapy found that it stimulates neurogenesis in adult animals. On the other hand, stress seems to work against the production of new cells.

A key question for researchers now is what do these new neurons do once they survive and become part of the working brain. Do they merely replace old neurons, or do they form entirely new circuits? Are they responsible for new memories? Some very recent studies suggest that the strength of a memory can relate to how many new neurons remain in the brain after learning. These new insights are opening up many exciting avenues of research for scientists as they increase their understanding of how our brains work.

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