

Neurogenesis or the state of continuing creation of ourselves

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ABSTRACT

Challenging times. As we can't go outside, we move inside. Inside us. Books are still the most reliable friends during these days. Authors look like some Lord of The Rings` characters: not coming from this world. And, honestly, if you start reading authors like Daniel J. Siegel you will, definitely, reach up the conclusion that he is some sort of alien coming from the planet called Genesis. Neurogenesis.

“The Developing Mind: How Relationships and the Brain Interact to Shape Who We Are” got me, till late during the nights “We are always in a perpetual state of being created and creating ourselves”- he said at point and that was the beginning of my journey.

NEUROGENESIS

Neurogenesis – a term that gives you chills. The art of creating new neurons, of making new connections, new bridges, no frontiers. The power to reinvent, recreate, reshape. It is defined as the formation of new neurons from neural stem and progenitor cells which occurs in various brain regions such as the sub-granular zone of dentate gyrus in the hippocampus and the sub-ventricular zone of lateral ventricles.

It is widely known that the mature brain has many specialized areas of function, and neurons that differ in structure and connections. The hippocampus, for example, which is a brain region that plays an important role in memory and spatial navigation, alone has at least 27 different types of neurons.

What is not widely known is that the incredible diversity of neurons in the brain results from regulated neurogenesis during embryonic development. During the process, neural stem cells differentiate that is, they become any one of a number of specialized cell types, at specific times and regions in the brain.

Stem cells can divide indefinitely to produce more stem cells, or differentiate to give rise to more specialized cells, such as neural progenitor cells. These progenitor cells themselves differentiate into specific types of neurons.

In 1928, Santiago Ramón y Cajal, the father of modern neuroscience, proclaimed that the brains of adult humans never make new neurons. “Once development was ended,” he wrote, “the founts of growth and regeneration ... dried up irrevocably. In the

adult centers the nerve paths are something fixed, ended and immutable. Everything must die, nothing may be regenerated.”

But from the 1980s onward, this dogma started to falter. Researchers showed that neurogenesis does occur in the brains of various adult animals, and eventually found signs of newly formed neurons in the adult human brain. Hundreds of these cells are supposedly added every day to the hippocampus—a comma-shaped structure involved in learning and memory. The concept of adult neurogenesis is now so widely accepted that you can find diets and exercise regimens that purportedly boost it.

NEUROPLASTICITY

Another related term, connected to neurogenesis, is neuroplasticity. Discourses of ‘neuroplasticity’ have become increasingly apparent in the neurosciences and wider society. These connect with broader narratives about the ‘changing brain’ throughout the life-course.

Over the last decade, the concept of neuro or brain ‘plasticity’ has become increasingly resonant in international neuroscience research. Whilst scientific discourse is divergent in its deployment of ‘plasticity’, this term can be broadly understood as the potential for “changes in the input of any neural system, or in the targets or demands of its efferent connections, to lead to system reorganization that might be demonstrable at the level of behavior, anatomy, and physiology and down to the cellular and molecular levels.

WHERE DOES NEUROGENESIS OCCUR IN THE BRAIN

The central point in neurogenesis is the neural stem cell. Neural Stem Cells are the self-renewing, multi-potent stem cells of the nervous system. NSCs can generate both new neurons and glial cells (the non-neuronal brain cells that provide support and protection for neurons, also known as neuroglia or simply glia).

A cell's ability to differentiate into other types of cells is called its potency. The more cell types it can differentiate into, the greater a cell's potency. Potency exists on a continuum, from most to least differentiation potential, of Totipotency → Pluripotency → Multipotency → Oligopotency → Unipotency.

NSCs reside in specific regions of the brain known as "neurogenic niches." These regions have molecular and cellular characteristics which create a microenvironment that allows neuronal development to occur. In adult mammals, there are two canonical neurogenic regions where NSCs reside:

- (1) the subventricular zone (SVZ) lining the lateral ventricles (the ventricles are fluid-filled cavities in the brain and
- (2) the subgranular zone (SGZ) of the dentate gyrus (DG) in the hippocampus.

Neurogenesis outside these two regions is generally considered to be very restricted in the adult mammalian brain. However, non-canonical sites of neurogenesis have been reported in different species (with regions vary between species), including the neocortex, striatum, amygdala,

hypothalamus, substantia nigra, cerebellum and brain stem.

Most research on adult neurogenesis has focused on the DG area of the hippocampus. Hippocampal adult neurogenesis has been observed in all mammalian species studied to date. In the adult human brain, neurogenesis appears to occur in the hippocampus, a brain area that is particularly important for cognitive functions such as learning and memory, and for emotions, mood, anxiety and stress response.

Another area where evidence of adult neurogenesis has been found in humans is the striatum. The striatum is mostly known for its role in motor coordination, but it also has important roles in the regulation of reward, aversion, motivation, and pleasure. The striatum is also recognized as a key structure in higher cognitive functions, particularly in "cognitive flexibility", the ability to adapt behavioral goals in response to changing contextual demands.

Neural stem cells give birth, if needed, to new cells that replace dead or dying ones in the dentate gyrus, where adult neurogenesis might support processes involved in storing and retrieving memories.

If the memory center of the human brain can grow new cells, it might help people recover from depression and post-traumatic stress disorder (PTSD), delay the onset of Alzheimer's, deepen our understanding of epilepsy and offer new insights into memory and learning. If not, well then, it's just one other way people are different from rodents and birds.

Can we grow new neurons by ourselves, by working out our own brains? Exercising our brain can lead new “neuron babies”

If new neurons are being formed every day in our brain, how can we hold onto these cells and not let them simply die away? The answer has been lurking around in the scientific literature since the 1970's when Michael Kaplan reported that an enriched environment enhances the number of new neurons. In animals, placing them in cages full of interesting toys or giving them learning tasks promotes the survival of these newborn cells. New neurons born in the hippocampus may participate in the formation of long-term memories as well as in spatial perception. London taxi drivers who have extensive knowledge of the London city streets have larger-than-normal hippocampi. Perhaps, much neurogenesis has occurred in their hippocampi.

Physical exercise also increases the number of newborn neurons. But some conditions, such as excessive stress and depression, hamper the growth of newborn nerve cells.

What future holds for us, for neurogenesis, neuroscience, neuroplasticity?

The brain is the most complicated organ in the universe. We have learned a lot about other human organs. We know how the heart pumps and how the kidney does what it does. To a certain degree, we have read the letters of the human genome. But the brain has 100 billion neurons. Each one of those has about 10,000 connections.

In the brain, you have connections between the neurons called synapses, and they can change. All your knowledge is stored in those synapses. You, dear human being, you are the power! You run your own brain and

those synapses! Keep yourself in the state of creating yourself! Be the change you desire to see!

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