

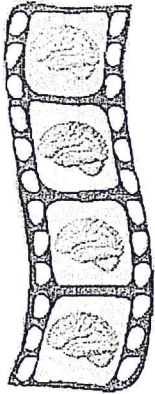
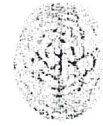
Brain Plasticity: What Is It?

Learning and Memory



Brain Plasticity--An Overview

What is *brain plasticity*? Does it mean that our brains are made of plastic? Of course not. Plasticity, or neuroplasticity, is the lifelong ability of the brain to reorganize neural pathways based on new experiences. As we learn, we acquire new knowledge and skills through instruction or experience. In order to learn or memorize a fact or skill, there must be persistent functional changes in the brain that represent the new knowledge. The ability of the brain to change with learning is what is known as *neuroplasticity*.



To illustrate the concept of plasticity, imagine the film of a camera. Pretend that the film represents your brain. Now imagine using the camera to take a picture of a tree. When a picture is taken, the film is exposed to new information -- that of the image of a tree. In order for the image to be retained, the film must react to the light and ?change? to record the image of the tree. Similarly, in order for new knowledge to be retained in memory, changes in the brain representing the new knowledge must occur.

To illustrate plasticity in another way, imagine making an impression of a coin in a lump of clay. In order for the impression of the coin to appear in the clay, changes must occur in the clay -- the shape of the clay changes as the coin is pressed into the clay. Similarly, the neural circuitry in the brain must reorganize in response to experience or sensory stimulation.

Facts About Neuroplasticity

FACT 1: *Neuroplasticity includes several different processes that take place throughout a lifetime.*

Neuroplasticity does not consist of a single type of morphological change, but rather includes several different processes that occur throughout an individual's lifetime. Many types of brain cells are involved in neuroplasticity, including neurons, glia, and vascular cells.



FACT 2: *Neuroplasticity has a clear age-dependent determinant.*

Although plasticity occurs over an individual's lifetime, different types of plasticity dominate during certain periods of one's life and are less prevalent during other periods.



FACT 3: *Neuroplasticity occurs in the brain under two primary conditions:*

1. During normal brain development when the immature brain first begins to process sensory information through adulthood (developmental plasticity and plasticity of learning and memory).
2. As an adaptive mechanism to compensate for lost function and/or to maximize remaining functions in the event of brain injury.



FACT 4: *The environment plays a key role in influencing plasticity.*

In addition to genetic factors, the brain is shaped by the characteristics of a person's environment and by the actions of that same person.

What is Brain Plasticity?

Brain plasticity is a term which is used to refer the brain's unique ability to constantly change, grow, and remap itself over the course of a lifetime. The "plastic" in this sense refers to "moldable," rather than to the family of products derived from petrochemicals. This distinctive trait makes the brain a very valuable organ, as it can constantly adapt itself to deal with new input and information. All animals possess brain plasticity, to some extent, although most studies have focused specifically on the workings of the human brain.

There are three different types of brain plasticity. The first occurs when infants are born and start developing into children. Studies have shown that the immature brain grows and creates neural networks at an unprecedented rate, as the brain is flooded with new sensory input from the outside world. The second type occurs over the course of a lifetime, as the brain changes with age to reflect new experiences and events. Additionally, the brain demonstrates tremendous plasticity in the wake of injury.

Without plasticity, the brain would remain static, frozen at a particular point in time. Brain plasticity allows the brain to do everything from learn how to speak to refining physical movements such as those associated with playing a musical instrument. Every time the brain encounters information, it reworks itself to accommodate it, and creates a map of the information it contains so that it can readily retrieve information when it is needed. People always need to be able to store and interpret new information, making brain plasticity critical to function at all ages.

In addition to reworking itself to store information and organize it effectively, the brain can also repair itself, to some extent. When an area of the brain is damaged, the activities associated with that region will sometimes move to another area of the brain, allowing the person to recover functionality. This type of brain plasticity is critical for people recovering from brain injuries and neurological disorders, as the damage may be permanent, but it can be possible to mitigate the effects.

Numerous studies have been conducted on brain plasticity to explore the changes in cellular structure which occur in the brain over time. A number of factors appear to contribute, from hormones generated inside the body to environmental cues, and people appear to be able to enhance the flexibility of the brain by "exercising" it, much like function of the musculoskeletal system can be improved or modified with exercise.