

THE BRAIN AND PLASTICITY

Learning and adapting the brain throughout the lifespan

WHAT IS BRAIN PLASTICITY AND WHY IS IT IMPORTANT AS WE AGE?

Brain plasticity, also known as neuroplasticity, is the biological, chemical, and physical capacity for the brain to reorganize its structure and function. Neuroplasticity occurs as a result of learning, experience and memory formation, or as a result of damage to the brain.

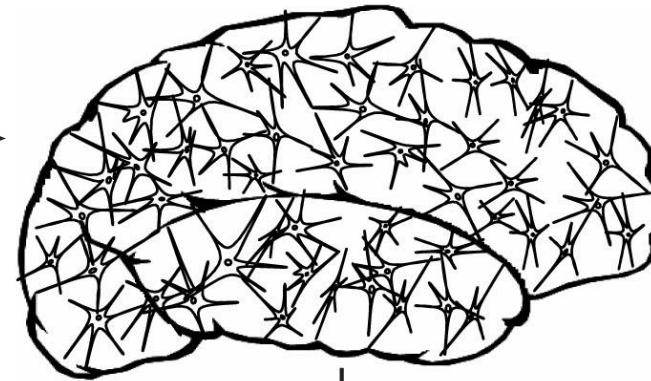
In view of the demographic evolution of society, characterized by a steadily increasing proportion of older adults, **the evidenced lifelong brain plasticity provides a critical foundation for a sustained role of older adults in society and for securing prolonged functional independence and quality of life.**

Positive Neuroplasticity

Examples for promoting positive neuroplasticity include:

- Mental stimulation
- Intellectual pursuits
- Social interaction
- Good emotional health
- Physical exercise
- Proper nutrition
- Proper sleep
- Cognitive remediation therapy

Increases cognitive reserve
Promotes neuronal connections



Denser neuronal connections

Better brain health results in better cognition

Better cognition translates into better everyday functioning

Cognitive Ability

Everyday Functioning

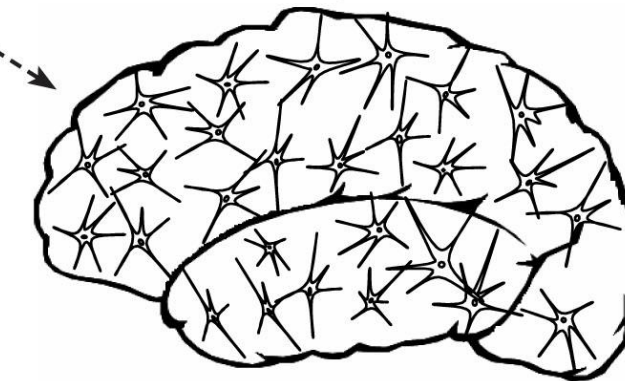
(e.g., activities of daily living, instrumental activities of daily living)

Negative Neuroplasticity

Examples for promoting negative neuroplasticity include:

- Nonstimulating activities
- Social isolation
- Poor emotional health
- Sedentary lifestyle
- Inadequate nutrition
- Inadequate sleep
- Substance abuse

Decreases cognitive reserve
Inhibits neuronal connections



Sparser neuronal connections

Poorer brain health results in poorer cognition

Figure. Methods of promoting positive and negative neuroplasticity.

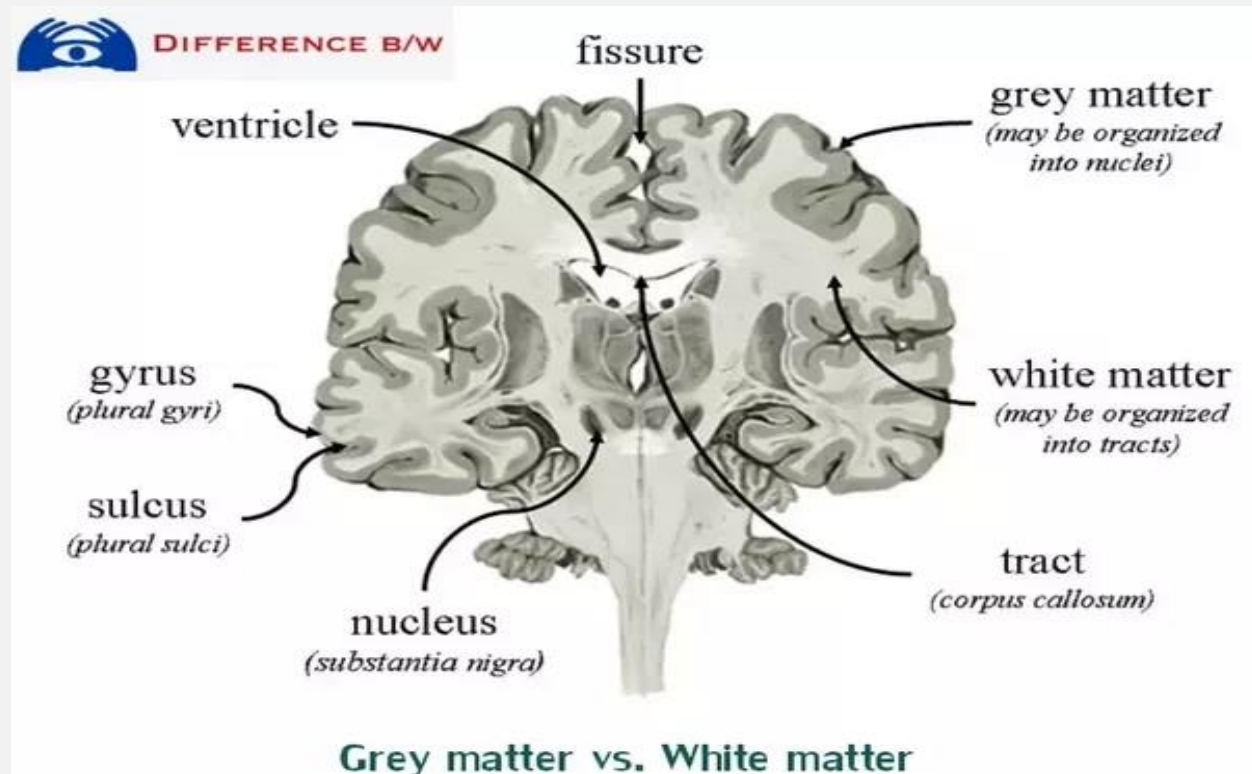
SHORT VIDEO ABOUT BRAIN PLASTICITY

- [Brain Plasticity and Aging - Bing video](#)

WHEN DOES BRAIN PLASTICITY BEGIN?

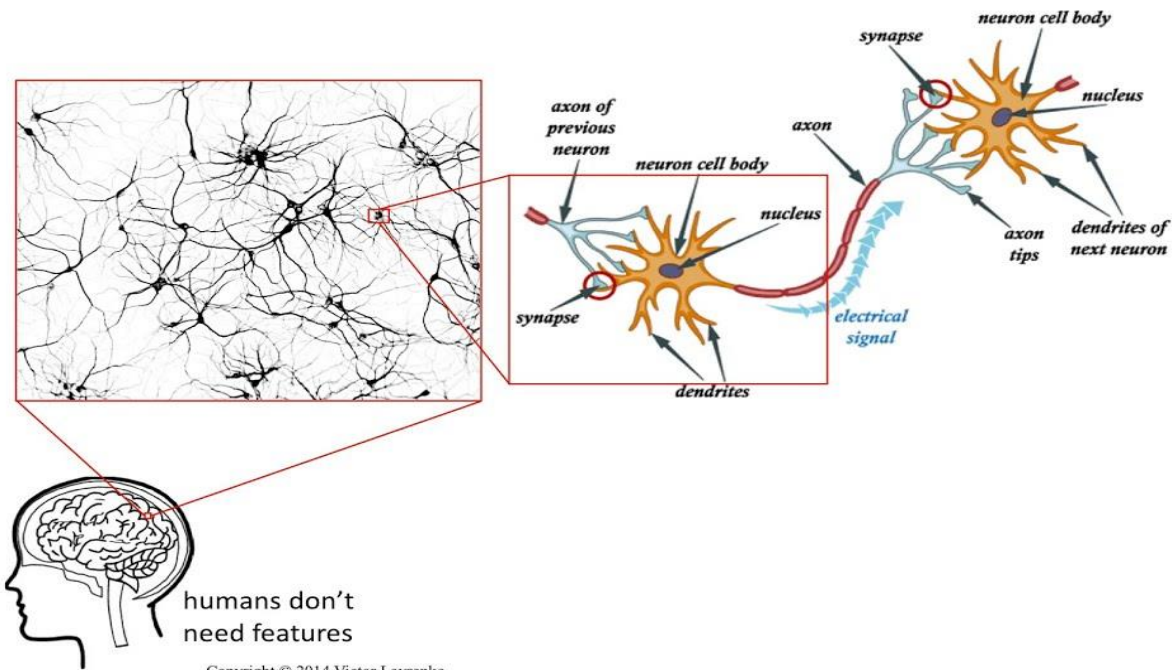
- The first few years of a child's life are a time of rapid brain growth. At birth, every neuron in the cerebral cortex has an estimated 2,500 [synapses](#) or small gaps between the neurons where nerve impulses are relayed. By the age of three, this number has grown to a whopping 15,000 synapses per neuron.³
- The average adult, however, only has about half that number of synapses. Why? Because as we gain new experiences, some connections are strengthened while others are eliminated. This process is known as synaptic pruning.
- Neurons that are used frequently develop stronger connections and those that are rarely or never used eventually die. By developing new connections and pruning away weak ones, the brain is able to adapt to the changing environment.

BRAIN CUT AWAY GRAY AND WHITE MATTER CELL BODIES AND AXONS



BRAIN AND NEURON

Neurons and the brain



TYPES OF BRAIN PLASTICITY

The 2 Types of Brain Plasticity

**What is Neuroplasticity
(aka Brain Plasticity)?**



**Brain's ability to
change and adapt**

verywell

Type 1: Structural Plasticity



**Experiences or memories
change a brain's physical
structure**

Type 2: Functional Plasticity



**Brain functions move from
damaged area to
undamaged area**

NEUROPLASTICITY(BRAIN PLASTICITY)

- The Brain has a 100 billion Neurons
- The creation of new neurons stopped just after birth
- The brain possesses a remarkable capacity to reorganize pathways, create new connections, and occasionally new neurons----which is the concept of brain plasticity. This is of two types!
- **Functional:** brains ability to move some functions from a damaged area to another area that is undamaged
- **Structural:** brains ability to change its structure as a result of learning. Meaning neural repairs and new connections actually change connections in the brain. Memory and experience does this within the brain.

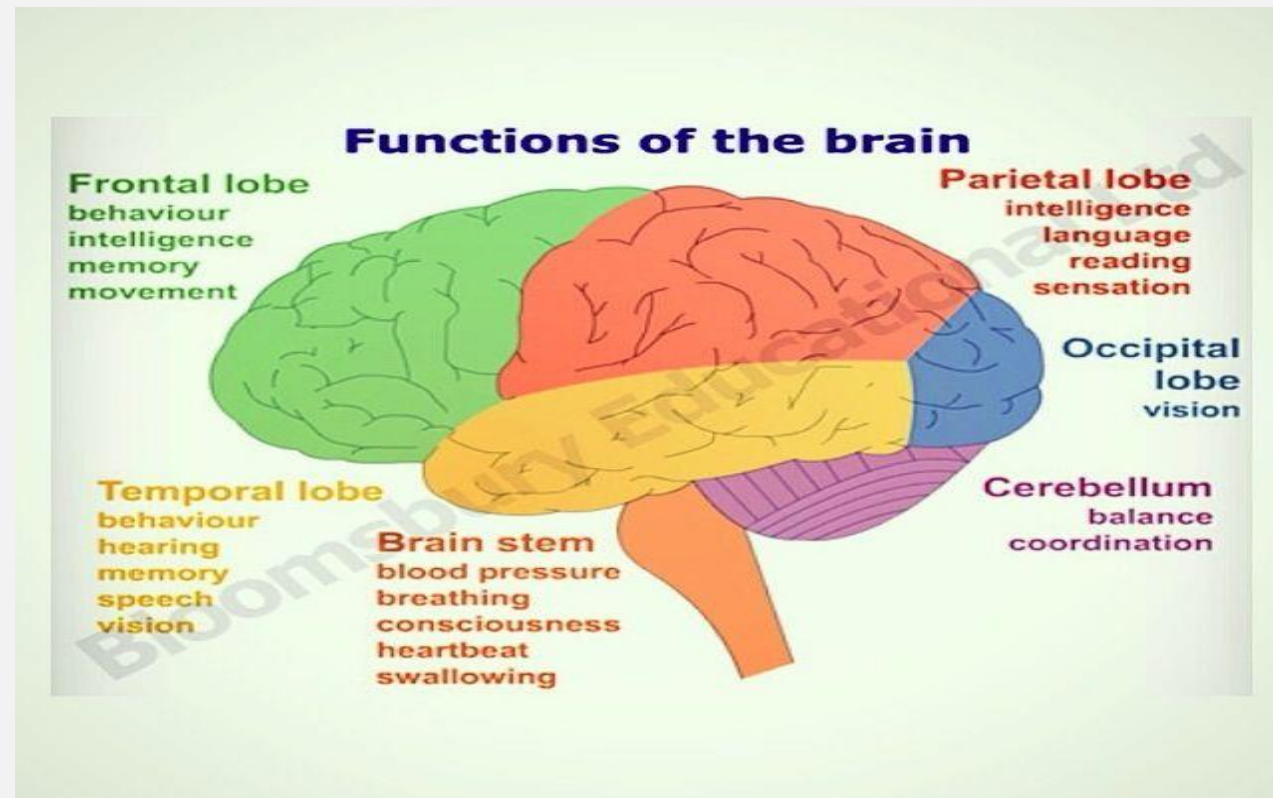
10 THINGS THAT CAN CHANGE YOUR BRAIN

- [\(3\) 10 Things that Change your Brain | OpenMind - YouTube](#)

BENEFITS OF THE BRAIN'S ABILITY TO ADAPT AND DEVELOP NEW CONNECTIONS

- The ability to learn new things (a new language)
- Advance existing cognitive function and reinforce it (keeping what you have)
- Recovery from traumatic injury or stroke (Brain and general health)
- Strengthen other areas if some are damaged (begin making new connections)
- Improvements that can actually boost brain activity (change in brain habits)
- Genetics and environment also play a role in neuro plasticity (less up to you)
- A benefit is that these positive mechanisms occur throughout the lifespan

THE BRAIN, LOBES, AND FUNCTIONS



SOME LIMITATIONS TO NEUROPLASTICITY

- Some brain injuries can be severe enough that recovery at least in full, is less likely (a major brain bleed or head injury)
- Younger brains tend to be able to recover from injury better than older adults because of adaptability and the creation of new connections are still being made, whereas in the adult that process slows down considerably, but does not stop. (This is because younger brains are still making thousands of new connections)
- The brain is not infinitely malleable in areas like speech and language development and some areas of motor capability. (Limited by space)
- Recovery from injury is less likely because of certain limitations in connections

OTHER MECHANISMS THAT LIMIT BRAIN PLASTICITY

- Genetics and genetic malformations
- Certain drugs can negatively impact brain plasticity (alcohol, thalidomide, meth)
- Certain brain diseases and insults can negatively impact brain resilience and plasticity (see below)
- Neurological disorders, cerebral palsy, epilepsy, and many other pediatric brain conditions can negatively impact brain development and plasticity.
- Knowing that brain connections and production of millions of neurons at and before birth set the stage for development and plasticity

WHAT NEUROSCIENCE TELLS US!

- Brain development does not end.....always under construction
- This development starts in utero and continues throughout the adult life provided certain environmental and social positives can be followed and enhanced:
 - Diet
 - Exercise
 - Rest
 - Challenging yourself with new activities

WHAT WE KNOW ABOUT THE BRAIN



WHAT WE KNOW ABOUT THE BRAIN CONTINUED

- Brain imaging shows that we use more than 10% of our brain!
- Brain damage isn't always permanent—time and severity play apart in recovery
- People are not entirely Right hand or Left hand brain controlled—R brain tend to be more creative and L brain tend to be more analytical. Not entirely true as brain lateralization is a proven phenomena, we still tend to use the entire brain.
- Theoretically we develop a certain amount of brain cells/neurons, and no more, but that notion may not be completely true. There are regions in the hippocampus of the brain that have shown neurogenesis and development.

WHAT WE KNOW ABOUT THE BRAIN

- Alcohol use....does it kill brain cells? Newest research finds that it can inhibit brain activity and new connections, as well as cellular growth in the brain.
- Newest research shows that the number of brain cells only reaches 85 billion, and not the 100 billion once put forth as the number we can attain throughout life.
- Learning style assessment instruments have been used to support learning capability and styles that support learning per the individual. New research does not bear out this finding.

CONCLUSIVE REMARKS

- The Human Brain is amazing! The development of the brain is still a mystery in many ways.
- Plasticity of the brain is essential to growth and development throughout the lifespan.
- We have some control over how this happens.
- Brain injury does not mean no recoverability
- We know what enhances the neuroplasticity of the brain and what inhibits development.