Neuroplasticity Studies Reveal Your Brain’s Amazing Malleability

By Dr. Mercola

As time goes by, science provides more and more evidence that your brain is malleable and continually changing in response to your lifestyle, physiology, and environment.

This concept is called neuroplasticity, or brain plasticity—meaning, you are literally reforming your brain with each passing day. It used to be thought that your brain was static, except during some critical developmental periods, but today, we know this isn’t true.

Your brain possesses the remarkable ability to reorganize pathways, create new connections and, in some cases, even create new neurons throughout your entire lifetime.

Our views of the nature of the brain have changed in a similar way as our views of DNA. It used to be thought that DNA did not change—in other words, you’re stuck with what you’re born with.

This, too, has been disproven by researchers like Bruce Lipton, who have introduced an entirely new branch of biological science called epigenetics. Your DNA changes continuously based on your experiences, emotions, and environment.

The point is, you have much more control over your body, mind, and brain than you might think. If you can mold and shape your brain, you are not entirely at the mercy of your genetics or the neural pathways you brought into this world or formed as a child—and this is great news!

New Study Shows How Quickly Your Brain Can Rewire Itself

A recent study discussed in Scientific American illuminates your brain’s remarkable ability to rewire itself in response to experience. Mice with amblyopia or “lazy eye” (partial blindness caused by visual deprivation early in life) improved faster if they were exposed to visual stimuli while running on a treadmill. Amblyopia can happen to someone born with a droopy eyelid, cataract, or other defect not corrected early in life. If the eye is opened in adulthood, recovery is usually slow and incomplete.

In this experiment, researchers induced amblyopia in mice by suturing one eye shut for several months. After the sutures were removed, the mice were shown a “noisy” visual pattern while running on a treadmill for four hours a day for three weeks.

The pattern was chosen to activate nearly all the cells in the animals’ primary visual cortex. After two weeks, the animals’ responses were comparable to those of normal
mice that had never been visually deprived. Neither running nor visual stimulation alone had this effect. The researchers believe the impressive response has something to do with built-in mechanisms that allow animals to keep track of environmental stimuli from a distance:

“It makes sense to put the visual system in a high-gain state when you're moving through the environment, because vision tells you about far away things, whereas touch only tells you about things that are close.”

The scientists do not know whether or not their findings apply to humans but are planning further studies. The current thinking is that “activity stimulates plasticity”—and this applies to your brain as well as other parts of your body. Plasticity is what allows tissues to heal.

**Neurons That Fire Together, Wire Together—And Neurons That Fire Apart, Wire Apart**

Neuroplasticity is, in simple terms, the ability of your brain to change and adapt in response to experience. You can think of those neurological changes as your brain’s way of tuning itself to meet your needs.

There are two types of brain plasticity—functional plasticity (your brain’s ability to move functions from a damaged area to undamaged areas) and structural plasticity (its ability to actually change its physical structure as a result of learning).

Think about what happens when you’re learning a new skill. The more you focus and practice something, the better you become, and this is a result of new neural pathways that form in response to your learning efforts. At the same time, your brain is undergoing “synaptic pruning”—elimination of the pathways you no longer need.

Until recently, it was believed that the human brain, which consists of approximately 100 billion neural cells, could not generate new ones. The old model assumed that you were born with a finite number of brain cells, and when a cell died, no new cell grew in its place.

This old model is no longer relevant, as it’s been proven that certain areas of your brain can generate new cells (neurogenesis), as well as creating new neural pathways.

Environment plays an essential role in the process, but genetics can also have an influence. These neural processes have been well documented in people recovering from stroke-related brain damage.

This phenomenon even applies to emotional states. For example, if you have a history of anxiety, your neural pathways become wired for anxiety. If you develop tools to feel calm and peaceful more of the time, those anxiety pathways are pruned away from lack of activity—“use it or lose it” really applies here.

According to “What is Neuroplasticity:”
“It was once believed that the human brain had a relatively small window to develop new pathways in our life span, then after that the pathways became immutable. This old theory thought our ability to generate new pathways dropped off sharply around the age of 20, and then became permanently fixed around the age of 40. New studies have shown through the use PET, and MRI brain scanning technology, that new neural cells are generated throughout life as well as new neural pathways. Even the elderly are capable of creating measurable changes in brain organization. These changes are not always easy but can happen through concerted focus on a defect area.”

How the Science of Neuroplasticity Changes the Game

Your brain’s plasticity is also controlled by your diet and lifestyle choices, including exercise. Despite what the media tells you, your brain is not "programmed" to shrink and fail as you age. The foods you eat, exercise, emotional states, sleep patterns, and your level of stress—all of these factors influence your brain from one moment to the next.

Any given gene is not in a static "on" or "off" position. You may be a carrier of a gene that never gets expressed, simply because you never supply the required environment to turn it on. As neurologist David Perlmutter explains: "We interact with our genome every moment of our lives, and we can do so very, very positively. Keeping your blood sugar low is very positive in terms of allowing the genes to express reduced inflammation, which increase the production of life-giving antioxidants. So that's rule number one: You can change your genetic destiny. Rule number two: you can change your genetic destiny to grow new brain cells, specifically in the hippocampus...

Your brain’s memory center regenerates. You are constantly growing new brain cells into your 50s, 60s, 80s, and 90s – throughout your lifetime – through a process called neurogenesis. That said, these two ideas come together because you can turn on your genes through lifestyle choices that enhance neurogenesis and that enhance regrowth of cells and expansion of your brain’s memory center. This was proven by researchers recently. They demonstrated that there are factors under our control that can make that happen."

The blind mice study is just one more piece of evidence for how important exercise is for your brain. Recent science has shown that physical exercise is as important as mental exercise when it comes to keeping your mind fit. A number of studies show that exercise can promote growth of new brain cells, enlarge your memory center, improve IQ scores, and help prevent brain deterioration as you age.

One study found that one 20-minute weight training session improved memory. In a year-long study, individuals who exercised were actually growing and expanding their brain’s memory center one to two percent per year, whereas typically that center would have continued to decline in size. Strength training, especially high-intensity interval training (HIIT), is especially beneficial for boosting long-term memory and reducing your risk for dementia.
Exercise prompts nerve cells to release one growth factor in particular, called brain-derived neurotrophic factor (BDNF). BDNF triggers numerous other chemicals that promote neural health and directly benefit cognitive functions, including learning. Fasting also triggers BDNF, and exercising while fasting can go a long way toward keeping your brain and muscles biologically young. According to brain plasticity expert Dr. Michael Merzenich (interviewed in the video above), engaging in challenging new activities throughout your life, staying socially active, and practicing “mindfulness” are other ways to boost your brain function. He also stresses the importance of having a genuine interest in your chosen activities. Just going through the motions is not enough to build these neural pathways—you have to really care about what you're learning.

Protect Your Brain with Wise Lifestyle Choices

Lifestyle strategies proven to promote neurogenesis and target BDNF include the following:

- Exercise, especially high-intensity interval training
- Reducing overall calorie consumption
- Reducing carbohydrate consumption (especially grains and sugars)
- Enough healthy fat consumption to eliminate insulin resistance
- Enough high-quality omega-3 fats and eliminating damaged omega-6 fats (processed vegetable oils) will improve your omega-3 to omega-6 ratio. I prefer krill oil to fish oil, as krill oil also contains astaxanthin, which is particularly beneficial for your brain. Astaxanthin is a carotenoid that's very good for reducing free radical-mediated damage to fat—and your brain is 60 or 70 percent fat.

There are three other important considerations for brain health:

1. **Vitamin D:** This vitamin/hormone plays a fundamental role in brain health, inflammation, and immune function. Vitamin D influences the expression of 2000-3000 genes. Researchers have located metabolic pathways for vitamin D in the brain’s hippocampus and cerebellum, areas that are involved in planning, information processing, and memory formation. In older adults, research has shown that low vitamin D levels are associated with poorer brain function. Appropriate sun exposure is all it takes to keep your levels where they need to be. If this is not an option, a tanning bed that uses electronic ballasts is the next best alternative, followed by a vitamin D3 supplement.

2. **Gut Health:** Your gut is your "second brain;" gut bacteria transmit information from your GI tract to your brain via your vagus nerve. Just as you have neurons in your brain, you also have neurons in your gut—including neurons that produce neurotransmitters like serotonin, which is linked to mood. Abnormal gut flora has been associated with abnormal brain development. In addition to avoiding sugar, one of the best ways to support gut health is to consume beneficial bacteria. You can take a probiotic supplement, but I'm particularly fond of using fermented vegetables, as they can deliver extraordinarily high levels of beneficial bacteria for minimal cost.
3. **Choline**: Choline reduces inflammation, plays a roll in nerve communications, and prevents the buildup of homocysteine in your blood (elevated homocysteine is linked to heart disease). Eggs and meat are two of the best dietary sources of choline. If you do not consume animal foods, you may be at risk of a deficiency and want to consider supplementation. If you're pregnant, make sure your diet includes plenty of choline-rich foods, as research shows higher choline intake leads to changes in epigenetic markers in the fetus.

**Stress Hormones Will Shrink Your Brain—So Shrink Your Stress Instead**

Research shows that how you respond to stress may be a key factor in how your brain ages. An animal study showed how elevated stress hormones may speed up short-term memory loss in older adults. Previous research has also linked chronic stress with working memory impairment. Chronic stress can actually trigger a genetic switch that results in loss of brain volume, and this in turn contributes to both emotional and cognitive impairment. Given this, it makes sense why a recent study showed that your daily stress responses have long-term implications for your mental health. Researchers found that people with increased stress have increased risk for mental disorders a decade later, especially anxiety and depression. The message is clear: managing daily stress is a key factor in keeping your brain healthy as you age, and this has implications for everything from depression to dementia. My favorite tool for stress management is Emotional Freedom Technique (EFT), an energy psychology tool that can help reprogram your body's reactions to everyday stress.

Recent research has shown that EFT (or “tapping”) significantly increases positive emotions, such as hope and enjoyment, and decreases negative emotional states, such as anger and shame. EFT has been shown to lower cortisol levels (one of your major stress hormones) and is actually an epigenetic intervention that can alter gene expression. EFT is a powerful tool for transforming your stress reactions into more adaptive ones, and replacing old dysfunctional patterns with new. For more information, I invite you to visit my [EFT page](#).

**You CAN Take Control of Your Brain Function...**

Again, the good news is that you’re not at the mercy of your genes or the dysfunctional neural pathways you might have developed in childhood. Your brain can literally be rewired, and you are doing so already—every day of your life! Old neural patterns are continuously being overwritten by new ones. Diet, exercise, sleep, stress, and other lifestyle choices all impact your brain’s structure and function, and how “gracefully” it ages. You are in the driver’s seat, so pay attention to the choices you make today, as they are forming the brain you’ll have tomorrow.