

Practice Makes Perfect – The Science of Memory Formation

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STORY AT-A-GLANCE

- › A May 2024 study conducted by researchers at the University of California, Los Angeles (UCLA) aimed to determine how training affects the working memory, which is responsible for temporarily retaining and processing information for immediate use
- › Researchers trained mice to perform olfactory delayed-association tasks over two weeks. After doing this repetitive task for seven sessions, the mice learned to perform the task with an accuracy level of 94.2%, and their memory patterns began to “crystalize” with practice
- › While consistent practice and exposure to information can help enhance memory and learning, not all influences on your memory can be positive. One prominent example of this is the indoctrination efforts during the pandemic
- › The good news is you can reverse indoctrination and take back control of your memories by promoting the production of healthy new index neurons and optimizing mitochondrial energy production

Memory plays a crucial role in learning, decision-making and shaping your identity. It’s a continuous process of absorbing information, retaining it and retrieving that knowledge to frame your understanding of and responses to the world around you.

The cognitive function that allows you to temporarily retain and process information for immediate tasks is called the working memory.¹ For instance, during a conversation,

your working memory acts like a mental notepad, allowing you to keep track of the information you're receiving and use it in real-time.

In May 2024, researchers at the University of California, Los Angeles (UCLA) Health presented a study in the journal *Nature*,² which aimed to determine how training enhances the brain's capacity for working memory, revealing intriguing findings about the brain's capability.

How Are Memories Formed?

Memory formation is a complex process that begins with encoding. During this stage, the information captured by your sensory organs is sent to the corresponding sensory areas of the brain (visual cortex, auditory cortex, etc.), where it is processed and integrated with your existing knowledge and experiences.³

When you learn something new, your brain forms new connections called synapses between neurons. These connections create new circuits, essentially remapping your brain. The brain is a vast network of connections — each of its 100 billion nerve cells can form up to 10,000 connections with other nerve cells. These synapses get weaker or stronger depending on how much you're exposed to particular information or activities.⁴

The hippocampus, located in the temporal lobe,⁵ plays an important role in memory formation. It organizes and integrates sensory information, transforming it into coherent memory traces.⁶ Attention during encoding helps the hippocampus focus on relevant information and filter out distractions.⁷

After encoding, the memory undergoes consolidation, stabilizing the newly formed memory trace.⁸ This involves two main stages — synaptic consolidation and systems consolidation. During synaptic consolidation, which occurs shortly after learning, the connections between synapses are strengthened,⁹ primarily through a process called long-term potentiation.¹⁰

Systems consolidation happens over a more extended period, gradually transferring the memory trace from the hippocampus to the neocortex. This transition from short-term

to long-term storage is part of the consolidation process, making memories more stable and less dependent on the hippocampus.¹¹

The final stage of memory formation is retrieval, wherein stored information is accessed and brought into conscious awareness when the memory is triggered. The prefrontal cortex coordinates this process, while the hippocampus helps access the relevant memory traces stored in the neocortex.¹²

Interestingly, each time a memory is retrieved, it can be modified before being stored again, a process known as reconsolidation.¹³ This allows memories to be updated with new information but also makes them susceptible to changes and distortions.

How Practice Cements Memory Formation

In the featured UCLA Health study,¹⁴ researchers focused on understanding how consistent practice influences the overall capacity and efficiency of the brain's working memory. To evaluate this, they trained mice to perform olfactory delayed-association tasks over two weeks.

During the tests, the mice were presented with odors A or B for one second. After a five-second delay, they were presented with odors C or D for another second. If the combination is A followed by C or B followed by D, the mice need to lick during a choice period, which is three seconds after being presented with the second odor, to get a reward. If they were presented with a different combination, they were taught to withhold licking.

After doing this repetitively for seven sessions, the mice learned to perform the task with an accuracy level of 94.2%. "Tracking M2 (secondary motor cortex) neuron activity over 10 days revealed that late-delay WM (working memory) representations, which are crucial for task performance, initially fluctuate in early expert stages but stabilize with continued practice in the late expert phase," the researchers observed.¹⁵

To put it simply, as the mice performed the task, their memory patterns began to "crystalize," becoming more stable and consistent with practice. Dr. Peyman Golshani,

corresponding author and UCLA Health neurologist, likens this process to practicing a musical melody. As reported by Science Daily, Golshani notes:¹⁶

"If one imagines that each neuron in the brain is sounding a different note, the melody that the brain is generating when it is doing the task was changing from day to day, but then became more and more refined and similar as animals kept practicing the task."

He adds that these insights into the mechanisms of memory consolidation and the importance of consistent practice in cementing new skills and information in the brain "not only advances our understanding of learning and memory but also has implications for addressing memory-related disorders."¹⁷

How Indoctrination Efforts Sabotage Your Autobiographical Memory

While consistent practice and exposure to information can help enhance memory and learning, it's important to recognize that not all influences on your memory can be positive. One prominent example of this is the indoctrination efforts that the world underwent during the pandemic.

In the video above, Dr. Michael Nehls,¹⁸ author of "The Indoctrinated Brain: How to Successfully Defend Your Mental Freedom,"¹⁹ discusses the neuroscientific aspects of how brain alterations can render individuals more vulnerable to negative external influences.

According to Nehls, there are two types of thinking systems — System 1 (nonthinking) and System 2 (thinking). Our brains operate in System 1 most of the time. System 2 is only activated through conscious effort, upon recognizing the need for critical thinking. If you don't have enough mental energy to think, you're not likely to activate System 2. Instead, you get stuck in System 1, putting you on autopilot and making you more likely to follow mass thoughts or movements.

The media and global leaders have engineered a vicious cycle that makes it easier for you to be stuck in this state and get indoctrinated. It starts with fearmongering, shifting goals and poor health advice. This induces chronic stress, which, coupled with key nutritional deficiencies, leads to consistently high stress hormone levels and poor energy production. Stress hormones also inhibit hippocampal neurogenesis, reducing mental resilience and increasing stress.

Ultimately, this downward spiral erodes your autobiographical memory, which plays an important role in your individuality. Autobiographical memories are stored in the hippocampus and are heavily influenced by emotional association (how you felt when something happened).

When something is associated with fear, you're more likely to remember it – and this is what technocrats are using as a powerful tool. By hijacking your remaining index neurons and overwriting your autobiographical memories with fear-inducing propaganda narratives, they can take away your individuality and manipulate you easily.

How to Protect Your Hippocampus

The good news is you can reverse indoctrination and take back control of your memories by promoting the production of healthy new index neurons. Nehls suggests addressing these factors that influence hippocampal neurogenesis:

Purpose in life – According to Nehls, not having a sense of purpose in life increases your risk of developing hippocampal dementia, i.e. Alzheimer's disease.

Nutrition – For optimal hippocampal growth, make sure you have adequate levels of essential micronutrients. Among these, iodine and vitamin D are the most important. Maintaining a vitamin D level within the range of 40 to 60 ng/mL (100 to 150 nmol/L) will support your immune and neurological health.

Social life – Loving relationships promote the release of oxytocin, a potent hippocampal growth factor. On the other hand, isolation and loneliness have a

detrimental effect on hippocampal function. Companionship is also important because it provides the emotional experiences and conversations essential for the survival of hippocampal neurons. Without this new information, newly generated neurons will die off and their production will decline.

Exercise – Exercise can help stimulate hippocampal neurogenesis. In his book,²⁰ Nehls cites research showing that seniors who take a one-hour brisk walk every day can grow their hippocampus by 2% in a single year. For comparison, Alzheimer's patients lose about 5% of their hippocampal volume per year.²¹

Sleep – Your hippocampus generates new neurons during sleep, when it's not actively gathering new experiences. Melatonin, known to stimulate hippocampal neurogenesis, may play a key role in this process. Nehls states that it typically takes around two weeks to restart neurogenesis after experiencing chronic sleep deprivation.

Time – Trying to do more than what's manageable generates stress, which not only hinders neurogenesis but also promotes neurodegeneration. However, having too much free time can be detrimental as well, as the stimuli needed for neuron growth are absent. According to Nehls, the optimal state is eustress – "positive stress caused by challenging yet doable tasks."

Optimize Your Mitochondrial Health to Boost Your Brainpower

In addition to Nehls' recommendations, I recommend adopting the strategies below to boost your mitochondrial energy production, which will provide you with the energy needed to effectively engage your System 2 critical thinking skills.

- **Limit your linoleic acid (LA) intake** – LA severely impairs your mitochondrial function, compromising your ability to create cellular energy. Optimizing your mitochondrial energy production is crucial not only for a healthy body and mind but

also for your intuition. The energy produced by your mitochondria is virtually identical to the energy that created the universe and undergirds physical reality.

So, once you optimize your mitochondrial energy production, you also swing the door open to your higher spiritual faculties where intuition, inner guidance and pure knowing reside. Once you're connected to your inner knowing, no indoctrination attempt can succeed because you can "see" clearly, even when the truth is being hidden.

- **Limit fats, eat healthy carbs in optimal amounts** – When your fat intake exceeds about 35% of your daily calories, your body enters fat metabolism, which reduces mitochondrial efficiency by 25% to 50%. Eating optimal amounts of healthy carbs, such as fruits, raw honey and starches like white rice, will help optimize your mitochondrial glucose metabolism, resulting in higher energy production.

The paradox here is that you need good gut health to benefit from an optimal diet. If your gut health is impaired, eating fibrous fruits and starches will only feed the pathogenic bacteria in your gut. So, if your gut health is less than optimal, start by eliminating as much LA as possible (which is one of the primary destroyers of cellular energy production) and introduce healthy carbs slowly, starting with fruit juices.

Glucose metabolism also boosts the production of structured water (deuterium-depleted water) within the mitochondria and decreases the production of reactive oxygen species (ROS), enhancing overall mitochondrial function.

- **Consider supplements for healthy metabolism** – Niacinamide, also known as nicotinamide (a form of vitamin B3), is essential for healthy metabolism, mitochondrial function and cellular energy production. For general support, I recommend taking 50 milligrams three times a day.

Niacinamide may also be useful in early Alzheimer's treatment,²² especially when combined with methylene blue, as they work synergistically. Methylene blue by itself has also shown promise in inhibiting Alzheimer's progression.²³

You can also consider using nootropics for cognitive enhancement and neuroprotection. For more information about nootropics, check out my article "[5 Potent Nootropic Herbs to Supercharge Memory and Concentration.](#)"

- **Reduce your serotonin levels** – Often mistaken as the "happy hormone," serotonin actually acts as an antimetabolite, impairing mitochondrial energy production, which can lead to fatigue and a slowed metabolism. Studies have also linked elevated serotonin levels to dementia.²⁴

One way to lower your serotonin is to increase GABA, which is available as a supplement, as GABA increases the degradation rate of serotonin. People who have high GABA levels usually have low serotonin, and vice-versa.

People with high GABA/low serotonin are typically calm and gregarious, whereas GABA deficiency and elevated serotonin is associated with anxiety, fear, depression, short temper, phobias, impulsiveness and disorganization.

Another important strategy is to address your gut health. When complex carbs that aren't digested in your stomach travel down to your intestine, they end up feeding gram-negative bacteria that produce endotoxin, also known as LPS (lipopolysaccharide).

- **Maintain low estrogen levels** – Like serotonin, estrogen is also antimetabolic and will inhibit energy production. You can find tips to help lower your estrogen load [here](#).

Sources and References

- ¹ ScienceDirect, Working Memory
- ^{2, 14, 15} Nature. 2024 May 15. doi: 10.1038/s41586-024-07425-w
- ³ Harvard University, The Derek Bok Center for Teaching and Learning, How Memory Works
- ⁴ Johns Hopkins Medicine, Inside the Science of Memory
- ⁵ Ann Indian Acad Neurol. 2012 Oct-Dec; 15(4): 239–246
- ⁶ Neuroscience & Biobehavioral Reviews Volume 118, November 2020, Pages 196-208
- ⁷ J Physiol. 2009 Jun 15; 587(Pt 12): 2837–2854
- ⁸ University of California San Francisco, Memory

- ^{9, 11} [Front Synaptic Neurosci. 2019; 11: 1](#)
- ¹⁰ [Neuroscience Research Volume 183, October 2022, Pages 1-6, The molecular and cellular mechanisms underlying synaptic plasticity](#)
- ^{12, 13} [Curr Biol. 2013 Sep 9; 23\(17\): R764–R773., Prefrontal cortex–hippocampus interactions and mechanisms of memory retrieval](#)
- ^{16, 17} [ScienceDaily, May 15, 2024](#)
- ¹⁸ [Michael Nels, Informations](#)
- ¹⁹ [Amazon, The Indoctrinated Brain: How to Successfully Fend Off the Global Attack on Your Mental Freedom](#)
- ²⁰ [Amazon, The Indoctrinated Brain: How to Successfully Fend Off the Global Attack on Your Mental Freedom, Page 66](#)
- ²¹ [ISRN Radiol. 2013; 2013: 174524](#)
- ²² [Clinical Trials Nicotinamide as an Early Alzheimer's Treatment NCT03061474](#)
- ²³ [Haidut.me December 2, 2019 \(Archived\)](#)
- ²⁴ [Journal of Alzheimer's Disease, vol. 96, no. 1, pp. 215-227, 2023](#)