Study into Memory Loss

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Memory is the process of receiving, storing, and retaining information in the brain. It allows one to reflect on the past and impacts how they will act in the future. It may sound like a simple concept, but in reality, the process is made up of multiple stages and complex mechanisms.

When receiving new information, connections are formed between neurons in the brain. Neurotransmitters flow between synapses, the gaps between neurons, when a neuron's electrical field changes (East Carolina University, 2024). These circuits arrange memories, and the more contact with an event, the stronger the connection (John Hopkins Medicine, n.d.). The amygdala, derived from "amygdale," the Greek word for "almond" (which reflects its shape), is responsible for the corresponding emotion to memories, especially fear (East Carolina University, 2024). It is the reason for the sympathetic nervous system's "fight or flight" response as well as emotional intelligence (East Carolina University, 2024).

Forming memories consists mainly of three stages, the sensory register, short-term memory, and long-term memory. During the sensory register stage, the brain picks up on information about the environment through the five senses (Cleveland Clinic, 2024). It is an unconscious reaction, passively done within the span of a few seconds in the sensory cortex, parietal lobe, and temporal lobe (Lesley University, n.d.). After the consumption of information during the sensory register stage, the formation of short-term memory—also known as active memory— begins in the prefrontal cortex (Cleveland Clinic, 2024). The key difference from the previous stage is that during the short-term memory stage, conscious mental activity starts (East Carolina University, 2024). This memory type is formed by paying attention to specific details from the information received during sensory registry (East Carolina University, 2024). Highlighted by its name, short-term memories last for a very brief period and act as a storage space for temporary but easily accessible knowledge (East Carolina University, 2024). During long-term memory formation, the hippocampus gathers information to create new connections (Lesley University, n.d.). These connections stay strong as long as they are continually used (Lesley University, n.d.). Long-term memory is divided into two subunits, explicit and implicit memory. Implicit memories are ones about skills and habits that can help one complete a learned procedure and can be accessed consciously or unconsciously, while explicit memories hold information about facts, events, and locations and need to be actively recalled (Cleveland Clinic, 2024). Explicit memories can be further divided into episodic and semantic memories: episodic refers to knowledge of events occurring to a specific individual, and semantic refers to general knowledge (Lesley University, n.d.). The hippocampus is part of the brain that is responsible for the storage of memories, and it allows for the conversion of new experience into long-term memory connections (East Carolina University, 2024).

Memories can be consciously or unconsciously accessed (East Carolina University, 2024). Retrieval cues, one mode of inadvertent memory retrieval, are triggered by stimuli of the five senses, and the recalled memory stimulates the recollection of related memories (East Carolina University, 2024). There are four types of memory: access, recall, recollection, recognition, and relearning. Recall occurs without a cue, such as the response when answering a question. Recollection involves the amalgamation of different memory fragments to form deeper, more cohesive thoughts (East Carolina University, 2024). Recognition allows for the identification of details due to past experiences (East Carolina University, 2024). Finally,

relearning occurs when (as the name states) information is refreshed in the mind, leading to easier access and strengthened memory in the future (East Carolina University, 2024).

Forgetting over time is a natural part of life, as it is the way the brain sorts out unnecessary information to make space for the essential memories (East Carolina University, 2024). There are many theories on how the natural elimination of memories occurs. One such theory is the decaying theory, arguing that if a memory is not continually used, it will eventually deteriorate and fade (Lesley University, n.d.). Another one is the interference theory, based on the hypothesis that old memories are replaced by newer related information—like forgetting an old password after changing it (Lesley University, n.d.). Some other theories include bias, the distortion of memories due to opinion; transience, memories becoming increasingly difficult to access due to the natural aging process; and motivated forgetting, intentionally trying to fail to remember memories because of a variety of reasons, such as grief or post-traumatic stress disorder (Lesley University, n.d.). External factors can also contribute to memory loss, especially poor lifestyle choices (East Carolina University, 2024). Excessive alcohol or drug use, smoking, lack of sleep or nutrition, and mental disorders can all hinder an individual's ability to remember, hampering memory and brain functionality (East Carolina University, 2024).

Forgetfulness itself is not a major problem; however, it becomes an issue once it occurs repeatedly and excessively (East Carolina University, 2024). Once that occurs, it is suggested to consider the possibilities of serious brain impairments to memory (East Carolina University, 2024). Memory loss can happen rapidly (acute memory loss), or it can come about gradually (progressive memory loss) (Cleveland Clinic, 2023). Acute memory loss—amnesia—is typically due to an injury or illness that disrupts memory retrieval ability (Cleveland Clinic, 2023). Examples of injuries and illness bringing about amnesia include traumatic events, brain surgeries, strokes, psychosis, and seizures (Cleveland Clinic, 2023). Progressive memory loss generally results over time, stemming from issues like brain diseases such as Alzheimer's disease, Huntington's disease, and dementia (Campellone, 2021).

Currently, there is no cure for memory loss, though there are methods to prevent its beginning and slow its progression. Acute memory loss requires immediate medical attention, and it is advised to not try to deal with it independently (Cleveland Clinic, 2023). Treatments for progressive memory loss are very dependent on the issue's root. The solution may be clear, such as switching to a different medication or undergoing a surgery to remove a brain tumor; currently incurable illnesses like Alzheimer's Disease, however, are more complicated (Silva, 2025). Medications targeting degenerative diseases like Alzheimer's include cholinesterase inhibitors and partial N-methyl D-aspartate (NMDA) (Silva, 2025). Cholinesterase inhibitors prevent the enzyme cholinesterase from degrading acetylcholine, which is a neurotransmitter that is vital to the memory and learning process (Ewumi, 2025). Scientists believe that maintaining high acetylcholine levels help strengthen memory and alleviate memory loss symptoms (Medical News Today, 2025). Examples of cholinesterase inhibitors are donepezil, rivastigmine, galantamine, and glutamate regulators (Medical News Today, 2025). A glutamate regulator called memantine is an NMDA receptor inhibitor that prevents calcium from invading neurons and causing nerve damage (Ewumi, 2025). Taking such medications will help slow manifestation of diseases' effects, but it will not completely eradicate the problem at its source (Cleveland Clinic, 2023). Moreover, drugs such as donepezil have side effects such as nausea, diarrhea, vomiting, insomnia, muscle cramps, and fatigue (Ewumi, 2025).

A healthy lifestyle can help prevent memory loss before it appears. For example, being physically active helps sharpen memory because it increases blood flow to the brain (Mayo

Clinic, 2024). Staying mentally active also ensures the strength of circuits and connections in the brain, leading to slower deteriorations of memory (Mayo Clinic, 2024). Sleeping well and eating a healthy diet can also contribute to better mental capacity and robustness (Mayo Clinic, 2024).

Memory loss negatively impacts millions of people, and although there is currently no cure for most patients, scientists are working as hard as possible to at least ease their pain. Maintaining brain functionality is essential, especially before the appearance of brain diseases. The only way forward is to continue research into human memory and develop more efficient ways to combat its loss.

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