

Kaley Wilburn

Judy Peck

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Memory: How and Why We Recall Our Experiences

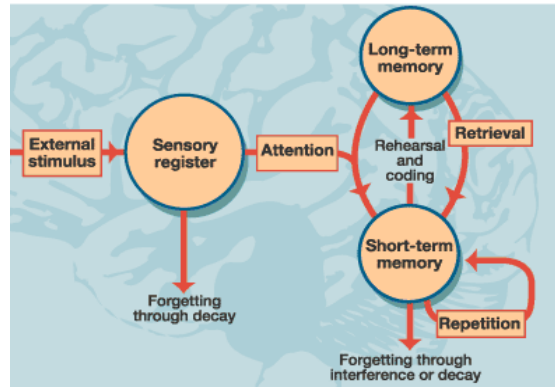
Introduction:

Confucius once said, “A common man marvels at uncommon things; a wise man marvels at the commonplace.” This quote is especially fitting when taking a glimpse into the world of the human brain’s many functions, specifically the memory. Described by some scientists as a “magic slate” of sorts, human memory has long been theorized about, but it is just within the past few decades that we have begun to fully understand its intricacy, importance, and potential. The memories each person collects and stores make up their *self*, for without the ability to recall past experiences, facts and skills, each event or day would exist without a connection to any other moment in our life. Though most people realize that it is important to have a strong memory, they rarely understand the process that is so vital to our very being. How does our brain turn a mere moment or fact into a memory? What causes us to lose our memories? What possibilities does the future hold now that scientists are developing a better understanding of how our brains operate? You will find that memory is nothing like taking a picture of a moment and looking at it in the future; it is fascinating, complicated, and surprisingly malleable.

The Process of Making Memories and the Structures Involved

To form a single memory, the integration of a collection of abilities, each depending on individual learning components and various sections of the brain, must be

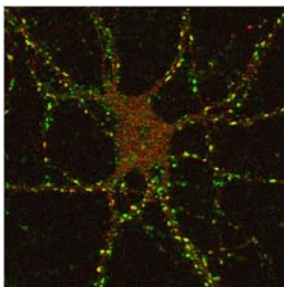
employed (Restak 104). First, the brain must experience something, receiving stimulation through the senses. The information transmitted from the sensory organs moves into an area of the brain called the sensory register which is a holding place for incoming data. It keeps information for a fraction of a second so the brain can assess it for importance. If deemed significant enough to be kept, the information moves into the short-term memory, “a temporary storage area where information is held and evaluated further...it may be held for as



The information-processing model of memory which describes how information is stored and retrieved from memory.

little as a minute or for as long as a few days” (Walker and Wood 46). If the brain decides to retain the data more permanently, it is transferred into long-term memory. In order to keep the material, the brain must consciously consider it important and focus the needed attention on the item to be remembered by shutting out most other stimuli. Long-term memory distributes and organizes a vast collection of material, and the amount of time a memory can be stored long-term ranges from days or months to years or an entire

lifetime. “It is long-term memory that maintains a person’s knowledge about themselves and the world around them” (Walker and Wood 47). Memories are initially created when an electrical impulse moves along a chain of nerve cells, but they are cemented when the impulse passes through the same neurons repeatedly, forming increasingly stronger and longer lasting



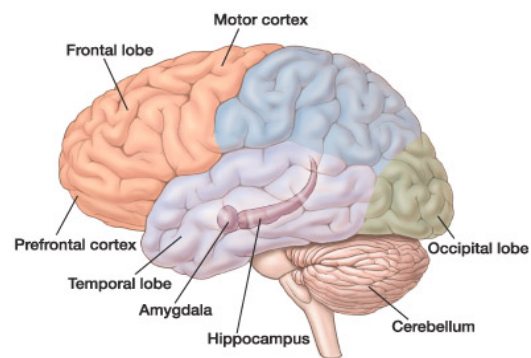
Hippocampal synapses in vitro.

connections at the points where they synapse or transfer the impulses to one another.

Paths made by short-term memories are formed quickly and are far less stable than those created by long-term memories; thus, the longevity of a long-term memory is much greater than that of a short-term memory. (Walker and Wood 46-49)

While attempting to understand the human memory system, it is also wise to consider that memories themselves fit into different categories; these include the two largest categories of declarative and non-declarative memory which are further divided into semantic, episodic, procedural, and emotional memory. Non-declarative memories, those that lie outside of your consciousness and cannot be put into words, include procedural and emotional memories. Procedural memories are skills, such as riding a bike or ice skating, that you do not need to think about after initially learning them, and emotional memories are the reactions to feelings that you have learned. The semantic memory and episodic memory are combined as terms to form the declarative memory which is “memory that we can bring into conscious awareness, reflect upon, and speak about” (Restak 104). Individually, the semantic memory involves facts about an event or subject, and the episodic memory stores the specific circumstances surrounding it. (“Human Memory”; Morris and Maisto; Restak 104)

Through the famous cases of two men named H.M. and R.B., neuroscientists have acquired much knowledge about the structures that are imperative to making memories. The first, H.M., received an operation intended to stop the spread of epileptic seizures between his cerebral hemispheres in which his amygdala, uncus, hippocampal gyrus, and the anterior two-

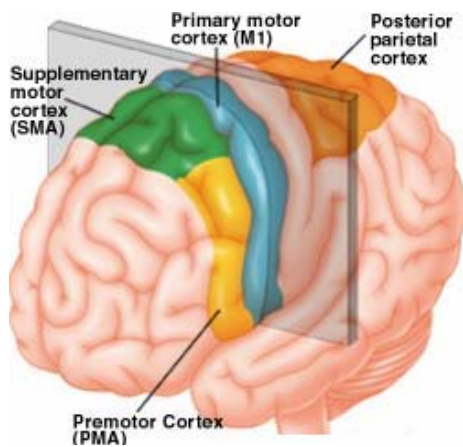


Anatomy of the brain.

thirds of the hippocampus on both sides of his brain were removed. The procedure caused severe damage to his long-term memory, and he lost the ability to form any new memories; however, the aspects of his thinking like I.Q., reasoning, abstraction, and perception were left intact. The second patient, R.B., incurred brain damage during a cardiac bypass surgery. He, too, lost the ability to form new declarative memories, and further examination revealed damage to both sides of his hippocampus. The amygdala and immediate cortical area were unchanged which intimated that damage to the hippocampus alone can decrease a person's ability to form declarative memories. Neuroscientists have concluded that the hippocampus is directly involved in forming and condensing declarative memories and that the amygdala "provides emotional coloring" based on these two cases and further research. (Christos 39-40; Restak 105-106)

Karl Lashley, a researcher during the 1950's, also greatly expanded our knowledge of the human brain. He began his experiments on rats to try to discover the storehouse of memory. In summary, Lashley began by training the rats to negotiate their way through mazes while gradually removing small sections of their brains at a time. Contrary to his hypothesis, Lashley found that before the rats' maze running abilities were compromised he had to remove large portions of their brains, and even then the rats' loss of memory was gradual and incomplete. After initially learning to maneuver the maze using long-term memory activated by its hippocampus, the rat's maze-running knowledge is spread throughout its brain. With a hippocampus damaged on both sides, a rat cannot develop the memory to negotiate the maze at all because it "can't establish that initial and crucially important interaction between the hippocampus and other brain regions that are needed to process and store long-term memory" (Restak 107). Also

confirmed by Lashley's experiments was the notion that procedural memories do not require use of the hippocampus to be stored. As an example, motor skills are catalogued mostly in the premotor cortex and structures lying underneath the cortex. To contrast that,



The cortexes of the human brain.

declarative memories rely heavily on the cortex, and the fibers extending from the hippocampus are either widely dispersed or linked to areas with specialized functions. Because humans piece the separate sights, sounds, and other sensations of a moment together to form a complete memory, all of the components of remembering need to be fastened

together into one unit, a job carried out by the association cortices. They complete a network of association fibers which accounts for the vividness and detail of human memories. (Restak 107, 110)

Surprisingly enough, experiments have shown that about 25 percent of people can be easily convinced to remember events that they never experienced (Neimark). Because a person's memory can be altered by suggestion, it is always a risk to accept the testimony of an eyewitness to a crime as the complete truth. False memories have been the root for unjust convictions and scandals not based upon real events. Memory can be influenced by assumptions, new experiences, and prejudices; thus, it is clear that "each type of memory isn't static: it changes according to time and circumstance" (Restak 104). That is both a powerful and worrisome fact which has influenced the revocation and reinstatement of laws, usually dealing with legal issues pertaining to supposedly remembered events (Neimark).

Memory Loss: Normal and Abnormal Causes

At some point, everyone experiences at least one form of memory loss. You forget where you put your cell phone, you fail to remember to pick up the dry-cleaning, or you cannot remember the name of a restaurant you went to recently. While forgetting may be bothersome, it is completely normal in those types of situations; however, in the case of some kinds of memory degradation, the situation is not normal in any sense of the word.

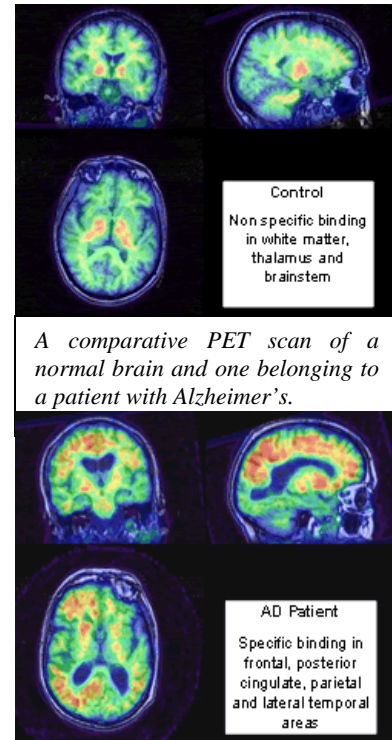
According to the Hebb postulate, memory is a reactivation of the same pattern of neurons originally activated at the time an event happened. Over time, the neurons involved in the activation of a memory may drop out of the circuit which results in a reduction in clarity or complete forgetfulness of some portions of an occurrence. Also frequently cited as a cause for memory loss is aging. Though the stored information still exists, it takes more time to retrieve it from the different parts of the brain and piece it together. This reduction in effective memory operation is referred to as AAMI (age-associated memory impairment) and is conceded to be normal since the “lessening of memory speed is part of the general slowdown in responsiveness” that age brings (Restak 118). The difficulty of recalling events from the earliest years of our lives is caused by normal amnesia. Due to the undeveloped tendencies of the cerebral cortex during the first two years of human life, the areas needed for the construction and retention of declarative memories are unavailable. Source amnesia, the inability to remember where a piece of information was gathered, is also commonplace. With source amnesia, a person can remember the fact that was learned but not the occasion on which it was absorbed. This type of amnesia is associated with the frontal lobe which is among the last areas of the

cortex to develop. Because of this, source amnesia is most prevalent among children and elderly people. (Restak 111,117-118)

On the other end of the spectrum are causes of forgetfulness, such as transient global amnesia, which are by no means common. Typically if someone experiences transient global amnesia, they suddenly cannot recall where they are or what their purpose for being there is. They often become distraught and frustrated, but, curiously enough, within several hours the amnesia recedes and the patient is left just as they were. Most neurologists think that transient global amnesia can be attributed to a temporary reduction in blood flow to the brain. Equally unusual is a type of amnesia described as the fugue state, exhibited when a person feels as though they have abruptly “come to”. They cannot remember anything about where they are, how they got there, or themselves in general. The fugue state’s cause has roots in worldly pressures like work or bills; the person enters this psychologically induced amnesia as a way to distance themselves from situations they cannot endure. Though these two types of amnesia do cause problems for those afflicted with them, they are both only temporary conditions; Alzheimer’s disease presents a different situation entirely. (Restak 111-112)

A staggering 100,000 Americans die due to Alzheimer’s each year, and the number of people affected by the disease is expected to reach 14 million by 2040. Alzheimer’s “has two devastating effects: It damages neurons in specific parts of the brain, and it reduces production of acetylcholine, a neurotransmitter” (Walker and Wood 66). The disease causes degeneration of the brain gradually over a period of five to fifteen years, annihilating the person’s ability to reason, work, think, and remember. In stages, once familiar faces become cloudy and eventually unrecognizable to those with

Alzheimer's. At first they experience subtle memory lapses, but within just a few years their memory fails entirely. It is a struggle for them to remember simple words, and they often feel momentarily confused, compulsively asking questions and repeating themselves. The symptoms visible from the outside parallel the reduction in brain substance, loss and deterioration of neurons, and the build-up of fibrous tissue within nerve cells occurring on the inside of the afflicted. The cause of Alzheimer's is yet to be determined, but scientists do know that a person with a first-degree relative who suffers from the disease has a 40 percent risk of developing the disease by age 90 (Restak



113). Other risk factors include earlier significant head trauma and limited early education—scientists base the latter upon the “use-it-or-lose-it” theory. (Restak 112-113; Walker and Wood 66)

Future Possibilities for Discovery and Development

As doctors and scientists continue to clear the fog surrounding the mechanics of our brains, the potential for manipulating our memory is increasing incontrovertibly. The day may come when physicians can therapeutically suppress traumatic memories that occurred in a person's life, such as war or physical abuse, and new drugs may be developed to obstruct or enhance memories and to prevent disorders like Alzheimer's. As researchers continue to delve deeper into molecular genetics, they inch closer to understanding a variety of diseases in the brain, including those that tamper with

memory, and finding a way to mend them; however, beyond its benefits to diseases and disorders, research about the brain may one day present the key that can unlock the door to a perfect memory. But would we want such a thing to begin with? Yes, it would be fantastic to remember all of your SAT vocabulary words or the names of all of the people you meet, but in *Mysteries of the Mind* Richard Restak disagrees with these beliefs about a completely infallible memory. He says, “While improving our memory is a common and even laudable goal, we probably wouldn’t want to accept the consequences of having a perfect one” (Restak 104). In his book *The Mind of a Mnemonist*, Alexander Luria, a neuropsychologist, writes about a patient named S who possessed the ability to precisely remember a series of words or numbers even if he had only seen them once over a period of years. It sounds as though this would be an enormous asset to have, but not so. S was hindered more than helped because he struggled to grasp only the important parts of a paragraph or sentence and to forget the rest. “Clearly, the perfectly normal process of forgetting must serve as a control on even the most powerful memory” (Restak 105). (Neimark; Restak 104-105, 113)

Conclusion

Memory is essential to the individuality of every person. Without it, each moment would be isolated from another, and learning would not exist, for there would be no database in which to store facts or reasoning abilities. The personal sense of who you are relies entirely on your memory which shapes the way you think and feel, your goals, your regrets, things you like and dislike, and what you believe. This process of cardinal significance in every person’s life is multi-faceted and engrossing. Even now, we have

much to unearth about it. Perhaps the wise man marveling at the commonplace is not admiring that which is simple and transparent; he is marveling at the common man.

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