# Memory Storage

**http://www.human-memory.net/processes_storage.html**

**Storage** is the more or less passive process of **retaining information** in the brain, whether in the sensory memory, the short-term memory or the more permanent long-term memory. Each of these different stages of human memory function as a sort of **filter** that helps to protect us from the flood of information that confront us on a daily basis, avoiding an overload of information and helping to keep us sane. The more the information is repeated or used, the more likely it is to be retained in long-term memory (which is why, for example, studying helps people to perform better on tests). This process of consolidation, the stabilizing of a memory trace after its initial acquisition, is treated in more detail in a separate section.

Since the early neurological work of **Karl Lashley** and **Wilder Penfield** in the 1950s and 1960s, it has become clear that long-term memories are not stored in just one part of the brain, but are widely **distributed** throughout the **cortex**. After consolidation, long-term memories are stored throughout the brain as groups of neurons that are primed to fire together in the same pattern that created the original experience, and each component of a memory is stored in the brain area that initiated it (e.g. groups of neurons in the visual cortex store a sight, neurons in the amygdala store the associated emotion, etc). Indeed, it seems that they may even be encoded **redundantly**, several times, in various parts of the cortex, so that, if one **engram** (or memory trace) is wiped out, there are duplicates, or alternative pathways, elsewhere, through which the memory may still be retrieved.

Therefore, contrary to the popular notion, memories are not stored in our brains like books on library shelves, but must be actively **reconstructed** from elements scattered throughout various areas of the brain by the encoding process. Memory storage is therefore an **ongoing process** of reclassification resulting from continuous changes in our neural pathways, and parallel processing of information in our brains.

The indications are that, in the absence of disorders due to trauma or neurological disease, the human brain has the capacity to store almost **unlimited** amounts of information **indefinitely**. Forgetting, therefore, is more likely to be result from incorrectly or incompletely encoded memories, and/or problems with the recall/retrieval process. It is a common experience that we may try to remember something one time and fail, but then remember that same item later. The information is therefore clearly still there in storage, but there may have been some kind of a mismatch between retrieval **cues** and the original encoding of the information. "Lost" memories recalled with the aid of **psychotherapy** or **hypnosis** are other examples supporting this idea, although it is difficult to be sure that such memories are real and not implanted by the treatment.

Having said that, though, it seems unlikely that, as **Richard Schiffrin** and others have claimed, **ALL** memories are stored somewhere in the brain, and that it is only in the retrieval process that irrelevant details are "fast-forwarded" over or expurgated. It seems more likely that the memories which are stored are in some way **edited** and **sorted**, and that some of the more peripheral details are never stored.

**Forgetting**, then, is perhaps better thought of as the temporary or permanent inability to retrieve a piece of information or a memory that had previously been recorded in the brain. Forgetting typically follows a **logarithmic curve**, so that **information loss is quite rapid at the start, but becomes slower as time goes on.** In particular, information that has been learned very well (e.g. names, facts, foreign-language vocabulary, etc), will usually be very resistant to forgetting, especially after the first three years. Unlike amnesia, forgetting is usually regarded as a normal phenomenon involving **specific** pieces of content, rather than relatively broad categories of memories or even entire segments of memory.

Theorists disagree over exactly what becomes of material that is forgotten. Some hold that long-term memories do actually decay and disappear completely over time; **others hold that the memory trace remains intact as long as we live, but the bonds or cues that allow us to retrieve the trace become broken, due to changes in the organization of the neural network**, new experiences, etc, in the same way as a misplaced book in a library is “lost” even though it still exists somewhere in the library.

Increasing forgetfulness is a normal part of the **ageing process**, as the neurons in ageing brains lose their connections and start to die off, and, ultimately the brain shrinks and becomes less effective. The **hippocampus**, which as we have seen is crucial for memory and learning, is one of the first areas of the brain to deteriorate with age. Recent studies in mice involving **infusions of blood from young mice into older mice have shown that the old mice that received young blood showed a significant burst of brain cell growth in the hippocampus region** (and vice versa), leading to speculation that young blood might represent the antidote to senile forgetfulness (and other ravages of old age). Similar studies on humans with Alzheimers disease are currently in progress.

Interestingly, it **appears NOT to be possible to deliberately delete memories** at will, which can have negative consequences, for example if we experience traumatic events we would actually prefer to forget. In fact, such memories tend to be imprinted even more strongly than normal due to their **emotional content**, although recent research involving the use of **beta blockers** (such as **propanonol**) suggests that it may be possible to tone down the emotional aspects of such memories, even if the memories themselves cannot be erased. The way this works is that the act of recalling stored memories makes them "malleable" once more, as they were during the initial encoding phase, and their re-storage can then be blocked by drugs which inhibit the **proteins** that enable the emotional memory to be re-saved.

## ??? Did You Know ???

Research using **functional magnetic resonance imaging** (fMRI) suggests that **verbs** and **nouns** are stored in different ways in the brain.
**Concrete nouns** are stored in areas of the brain used to sense or manipulate the referent objects, leading to a theory of meaning based largely on **function**.

## ??? Did You Know ???

Genuine **eidetic** or **photographic memory** (an “unprocessed” sensory memory of sensory events that is as accurate as if the person were still experiencing the original objects or events) is extremely rare, although not unheard of.

Most **extraordinary memory skills** which make claims of photographic memory, however, result from a combination of innate skills, learned tactics, **mnemonic devices** and extraordinary knowledge bases, rather than eidetic memory as such. **Young children**, with their lack of verbal and conceptual systems, are more likely to have real eidetic memories than adults.

A classic case from the 1970s was a woman named **Elizabeth**, who was able to write out poetry in a foreign language (of which she had no prior knowledge) several years after seeing the original text.

## ??? Did You Know ???

A recent study has shown scientifically what criminal lawyers have known for decades, namely that memory is an **adaptive process**.
Apparently trivial or mundane memories from just **before** an important or traumatic event appear to be kept for a period in a kind of **"just-in-case file"**, and may be **retroactively enhanced** in case they are useful in interpreting the event.
This retroactive strengthening is **not immediate**, and can take several hours or days to take effect.