A Brief History of Human Memory Systems Research

Early models and measures of memory

Some of the first notable noted research on human memory was conducted in 1890 by **William James**. Based on his research, James assumed memory consists out of **two systems**:

- **primary memory**, which lasts for a **few seconds** and holds **in our consciousness** the perception of events in our environment, and
- **second memory**, which has **unlimited duration** and can be **brought to consciousness** if wanted.

A measure for the **capacity of short-term** (primary) memory was first introduced even a bit earlier, in 1887, by **Joseph Jacobs**, who tested the span of digits his students were able to remember. Under the criterion that at least 50% of the digits need to be remembered correctly, subjects he tested mostly remembered **about 7 digits**. What he also noticed is that this result can be improved by grouping the digits (for example in groups of three), or reading aloud.

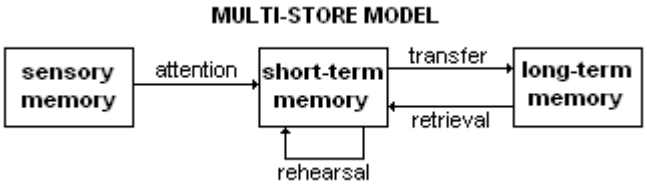
Similar results were reported by **George Miller** in 1956 in his famous work "The **Magical Number Seven**, Plus or Minus Two: Some Limits on Our Capacity for Processing Information"[1], where he suggested human short-term capacity was determined by the number of ***chunks*** or cognitive wholes one can remember, no matter if it is a letter, digit or word. This number on average equals **seven**, and may vary usually **between five and nine**.

This research increased interest in human memory research. Until then, it was commonly accepted that forgetting occurs due to interference of target information with new acquired information. This idea known as ***retroactive interference***[2] was introduced in 1900 by **Georg Elias Müller** and **Alfons Pilzecker**[3] who concluded that learning does not cause instantaneous and long lasting memories, but that memory takes time to ***consolidate*** (*Konsolidierung*). This also means that during the consolidation period the memory is vulnerable.

During the 1950s **John Brown**[4] and **Lloyd and Margaret Peterson**[5] conducted research on information forgetting, offering other explanations of forgetting. Their hypothesis was that forgetting occurs due to the rapid **decay of the memory trace** (*the neural substrate of retention*) when it is first established. Both reasons will later be accepted as correct.

One or two memory systems?

Another issue discussed during 1960s was weather human memory system has one or two components. Some authors like **Arthur Melton**[6] argued that both short term memory (STM) and long term memory (LTM) are just two subcomponents dependent on the same system. He justified his views by proofs of activation of the LTM in STM experiments. His work was very influential, yet during the years more and more evidence of at least two separate memory systems have accumulated.



The first more influential two component memory model was introduced in **1968** by **Richard Atkinson** and **Richard Shiffrin**[7]. Their model called *Multi-store model* consisted of long-term and working or short-term memory model and was later improved by an additional component, the ***sensory memory***. Sensory memory contains one register for each sense and serves as an short lasting buffer-zone before the information can enter short-term memory. Short-term memory is a temporal storage for new information before it enters long-term memory, but is also used for cognitive tasks, understanding and learning.

The thesis of two separate memory systems: the **long-term memory** and the **short-term memory** is today considered to be true. This thesis is supported by differences in[8]:

- **capacity** (small for STM and large or unlimited for LTM),
- **duration limits** (items in STM decay as a function of time, which is not a characteristic of LTM),
- **retention speed** (very high for STM and possibly lower for LTM),
- **time to acquire information** (short for STM and longer for LTM),
- **information encoding** (semantic for LTM and acoustic or visual for STM), and
- type of memory affected by physical injuries in patients[9].

Another term should be clarified here: the working memory, which is often mistaken for the short-term memory. The main difference between these two is that working memory usually includes the structure and processes performed by a system in control of the short-term memory.

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3)

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