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Efficient Memory Storage through Subconscious Memory Chunking

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INTRODUCTION

What are our memories? How are they maintained? Can we trust them? All of these basic yet compelling questions that we are forced to ask when pondering the true nature of one of the only things that make us human, that makes us who we are. Memory, by its very nature, is necessary for most of our lives. Those whose memories fail them through diseases or disorders such as different forms of Amnesia or Alzheimer's are thought to face terrible hardships. However, memories do not fit a pattern; they do not store information like a computer or a notebook. A memory is considered to be subjective and field-specific. Some chess grandmasters can remember every single board position game from their career without fail but may struggle in attempting to memorize a simple mathematical formula. This is a small example of the workings of the intricate and complex system through which we can store and recollect memory.

Classification of Memory

History

For most of history, memory was accepted as a fact of life rather than something that could be questioned or analyzed. At the time, this idea seemed fair, given that without any form of memory, humanity as we know it would likely not exist today. But in 1885, the first official study of memory was conducted by Hermann Ebbinghaus. He tested his ability to remember a series of nonsense syllables over a period of one month. His findings are thorough and state that he has a "first fleeting grasp … of the series in moments of special concentration" but, over long periods of time, failed to recall them. While the extent to which he could recollect the syllables decreased gradually over time, after a certain point, the graph began to plateau. The fleeting grasp he had on the list stayed constant. These were the first findings that pointed to, with near certainty, the existence of different states of memory.

Forms of Memory

Since Ebbinghaus's discoveries, the study of memory has identified four stages or types of memories, each stored in different ways. Short-term memory; specific and detailed pieces of information for use in short periods of time (generally minutes). Long-term memory; pieces of information stored in the brain hours, days, years or even decades before. Sensory memory; sensory information stored often for immediate use and for an extremely short period of time. If one pays close attention to the sensory inputs, this can be stored in short-term or long-term memory. Finally, working memory; often, in practice, similar to short-term memory, working memory stores the pieces of information directly related to problems and tasks at hand. Such as the numbers in a math problem or the critical points in a debate.

Explicit and Implicit Long-Term Memory

Within these classifications, there are further categories. Long-term memory can be divided into explicit and implicit long-term memory. Explicit long-term memory includes episodic memory (recollections of events or autobiographical facts) and semantic memory (general knowledge through learning or studying). Both factual and direct memories. Implicit long-term memory, on the other hand, mainly involves subconscious memories. This includes procedural memory (muscle memory or the ability to do tasks without active participation due to repetition) and priming (the subconscious urges to repeat previous behaviours through connection).

Memory Chunking

Concept

This may not be the end of classification; the theory of another form of long-term memory can be suggested in relation to field-specific studies and memories, pieces of information stored by experts in a specific field that are too thorough to be considered semantic memory, too complex to be considered procedural memory, and too specific to be considered episodic memory.

Chess Pieces

Consider the aforementioned example of a chess player and their ability to recall chess board positions multiple times better than the average person. What gives these chess masters this ability? Do they have above-average IQs? Do they have better spacial reasoning than the average person? Do they have more extensive short-term memory spans? On average, chess masters do not particularly excel in any of these groups. In 1973, William Chase and Herbert Simon conducted an experiment to analyse this concept. They tested three chess players of different levels, a beginner, a slightly experienced amateur and a master. In the experiment, chess pieces were set up on a board in a position that could emerge in a game. The three players were then given five seconds to view the board and then were asked to replicate it on another board to the best of their recollection. They could view the original set-up as many ever times as they wished, but only for five seconds at a time. From the first look, the master could recall the positions of 16 out of 25 pieces. The amateur could recall 8, and the beginner could recall 4. The master only required 4 views to perfect the board, whereas the amateur required 7. The process was then repeated with a slight modification. The pieces were set up in a random order, a position that could never arise during a game of chess. All of the participants could all only remember three pieces, the master did no better than the amateur.

Analysis

The clear implication is that chess masters do not have better short-term or long-term memory overall; instead, they have the ability to store this information as short-term or long-term memory based on how it directly relates to a possible game of chess. These masters have seen several chess games, and their brains have been conditioned to see a plausible chess position and comprehend it quicker through pattern recognition. The theory of this classification is called '*Chunking*'. Bypassing the limited capabilities of working memory by understanding pieces of information through previously stored long-term memory. This theory was originally suggested by George A. Miller in 1956 as a means of information processing for short-term memory. Memory chunking is done subconsciously. Many people who use this method cannot explain exactly how they thought of it or how it works for them. Their brain breaks down complex stimuli into basic inputs, almost against someone's will. Other examples of chunking include phone numbers being a string of repeated digits or a memorable word (1-800-FLO-WERS). The brain stores words more efficiently in long-term memory than random digits or anything random.

Capacity

Rule of 7±2

One of the most discussed aspects of any type of memory is capacity. As our visual, auditory, olfactory, tactile, and taste are all subjective senses, it is difficult to categorise our daily life into units of capacity. Miller also suggested the rule of 'seven plus or minus two' as the number of items that could be stored in short-term memory. Not including background information inadvertently picked up by the senses as this does not affect memory unless focused explicitly on. The rule of 7±2 has, despite a lack of proof, become the rule of thumb. Although more recent studies, such as those conducted by Nelson Cowan, have claimed that the capacity is no more than 3 or 4 units. These units are arbitrary, as each item may differ in complexity, and not all entities will be entirely unrelated to one another.

Multi-Item Chunk Formation

This study also claimed that while around 7 items can be recalled, they are recalled with error, and only 3 or 4 items can be recalled without it. This is due to the drop-offs and imperfections that come with large-scale chunking. Cowan suggested that when one is asked to recite or write a large amount of information they have learned or memorised, such as the states of the United States of America. They often remember states in bursts of three or four, seemingly recollecting them as if short-term memory were a bucket that had to be emptied before it was refilled and that the bucket was refilled by other small buckets created by chunking. This is the theory of multi-item chunk formation.

Transfer of Information Within the Brain

Storage of Memory

When chunking occurs in relation to random pieces of information, it can often be unreliable and can store entirely incorrect information with a decent amount of certainty of its accuracy. This often leads to false memory where one is sure they are correct when, in fact, they are not. To understand this, we need to analyse the connection of memory. The mechanisms of the storage and recollection of short and long-term memory are entirely different. Different types of memory have different storage locations in the brain. The case of Henry Molaison showed that long-term memory was formed by the hippocampus but stored outside it, likely in the brain's neocortex. Molaison damaged his hippocampus and thus could not create new memories, but he could recall everything about himself and his life from before the damage. It is known that the pure form of these memories is created and stored this way, but the emotional and situational relevance of these memories also have to be considered; these are stored in the amygdala. The relationship between these three indicates the 'stability' of long-term memory and how vividly and correctly it will be remembered.

Implicit long-term memories are stored separately. They are formed subconsciously by the Basal Ganglia, which is responsible for habit formation. The cerebellum stores procedural memory. Finally, short-term memory and working memory are both managed by the Prefrontal Cortex, the most recent evolutionary development.

Information Loss

The process of chunking memory involves all three primary forms of memory. The information is first comprehended and stored as episodic or semantic memory. Subconsciously, the brain forms connections and links that are stored by the Basal Ganglia, and finally, these memories can be easily called upon to be recited by the Prefrontal Cortex. It is because of the transfer of information during storage and during each recollection that information loss occurs in more significant amounts.

Manipulation of Chunking

Is there a method through which we can consciously utilize memory chunking? Yes. In fact, there are several. But the most basic system with the most implications is the Peg System based on word association. Developed by Henry Herdson, the peg system involved creating a mental association between two objects. Find an arbitrary word that can easily be associated with each of the numbers one to ten. Now, whenever a list of objects or items is given, one can simply associate them word for word. A study by Denis Delprato found that using this method considerably increases memory capabilities.

CONCLUSION

While long-term memory and short-term memory are closely related, they are not the same whatsoever. One of the connections between long-term and short-term memory is chunking. The concept of memory chunking greatly simplifies man's ability to recall complex and thorough pieces of information. Chunking occurs subconsciously and often gives advantages to those who have developed the capacity to identify patterns in their field of expertise. Due to the distinctions between the different forms of memory, chunking causes a small dropout in accuracy. We can manipulate the concept of memory chunking to our advantage. But yet, we are not able to completely understand the exact workings of memory and the brain.

REFERENCES

[1]. Goelet, P., Castellucci, V. F., Schacher, S., & Kandel, E. R. (1986). The long and the short of long–term memory—a molecular framework. *Nature*, *322*(6078), 419–422. https://doi.org/10.1038/322419a0.

[2]. Izquierdo, I., Medina, J. H., Vianna, M. R. M., Izquierdo, L. A., & Barros, D. M. (1999). Separate mechanisms for short- and long-term memory. *Behavioural Brain Research*, *103*(1), 1–11. https://doi.org/10.1016/s0166-4328(99)00036-4.

[3]. Bailey, C. H., Bartsch, D., & Kandel, E. R. (1996). Toward a molecular definition of long-term memory storage. *Proceedings of the National Academy of Sciences*, *93*(24), 13445–13452. https://doi.org/10.1073/pnas.93.24.13445.

[4]. Queensland Brain Institute. (2018, July 23). *Where Are Memories Stored in the brain?* Uq.edu.au; The University of Queensland. https://qbi.uq.edu.au/brain-basics/memory/where-are-memories-stored.

[5]. *What Memories Are Made Of*. (2021).Brainfacts.org. https://www.brainfacts.org/thinking-sensing-and-behaving/learning-and-memory/2021/what-memories-are-made-of-100121#:~:text=The%20brain%20stores%20memories%20by.

[6]. *Where are memories stored in the brain? New research suggests they may be in the connections between your brain cells > News > USC Dornsife*. (n.d.). Dornsife.usc.edu. Retrieved August 14, 2022, from https://dornsife.usc.edu/news/stories/3617/where-are-memories-stored-in-the-brain-new-research-suggests-the/

[7]. Cowan, N. (2008). What are the differences between long-term, short-term, and working memory? *Progress in Brain Research*, *169*(1), 323–338. https://doi.org/10.1016/s0079-6123(07)00020-9.

[8]. November 30th, L. U., & Pm, 2018 07:08. (n.d.). *Information Processing Theory (G. Miller)*. InstructionalDesign.org.https://www.instructionaldesign.org/theories/information-processing/#:~:text=George%20A.