

Memory....



A Guide to the processes involved in creating memories, with practical tips to help you support your students' memory and learning capabilities.

The numerous, instantaneous processes taking place within your brain, enabling you to read this guide, are extraordinary. Did you know that on average you have 70,000 thoughts every day, and over the span of your lifetime your brain will hold up to one quadrillion pieces of information?

This guide will provide you with some insight into the types of memory an individual has, the processes that create memories and how this impacts a child's learning, along with some practical tips to aid in the learning process.

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Importance of Memory

Our memories enable us to quite literally get up in the morning, to read, listen and understand and to learn. Even individuals who may have memory disorders still use forms of memory to be able to listen, talk, move and breathe.



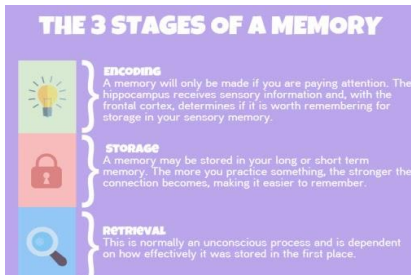
<https://medium.com/@lachachi.ghizlene/googling-a-trip-down-memory-lane-2aa3e7499c54>

Types of Memory

Brewer and Pani (1983) describe six basic forms of memory that individuals utilise throughout life:

- ✚ **Personal Memory** – subjective memories held by an individual relating to a specific experience, item, person (Locke, 1971).
- ✚ **Semantic Memory** – long term memory drawing upon conceptual information (Battaglia & Pennartz, 2011).
- ✚ **Generic Perceptual Memory** – the ability to remember generic perceptual information, usually involving visual imagery (Brewer & Pani, 1983).
- ✚ **Motor Skill** – muscle memory provides an individual with the ability to walk, write, ride a bike (Brewer & Pani, 1983).
- ✚ **Cognitive Skills** – core skills that enable your brain to think and remember – essential for learning (Brewer & Pani, 1983).
- ✚ **Rote Linguistic Skill** – the ability to learn information through repetition – skills used when recalling times tables, telephone numbers etc (Brewer & Pani, 1983)

Processing a Memory



There are three stages of memory processing, as shown in the figure to the left, to summarise you must first acquire information, store it away and then be able to retrieve or recognise the information at a later date (Roediger & Gynn, 1996).

<https://teachpsych.tumblr.com/post/142700228259/the-3-stages-of-memory/amp>

FUN FACT

James McConnell (1967) suggested that memories could be stored within brain tissue and could be transferred to another organism.

See page 5 for further information regarding this study.

Memory Structures

Research conducted to explore the biochemical events that take place within the brain during memory formation identified that the whilst the hippocampus is a necessary component during formation activity must continue in the surrounding structures following training to ensure memories are consolidated (Izquierdo & Medina, 1997). Furthermore, the authors suggest that long-term memory formation is linked with activity dependant changes in cell connectivity in differing areas following a chain of events located within the hippocampus. Thus, suggesting that in order to create long term memories there must be a level of brain activity following brain training/learning.

See page 5 for information regarding an interactive brain stimulation that can provide more information regarding brain structure and functions.

Levels of Remembering

There are six levels of remembering as detailed below

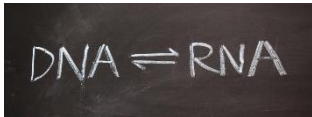
-  **No Memory** – The inability to encode, store or retrieve information, usually present in cases of anterograde amnesia following brain injury (Squire, 1982).
-  **Partial Memory** – The inability to encode, store or retrieve information following brain injury however remains able to retrieve memories from prior to any brain trauma, also known as retrograde amnesia (Squire, 1982).
-  **Recognition** – The ability to recognise information previously encountered, key for learning to read and recognising family members. Evidence suggests cognitive processes enabling recall are present in infancy and the development of long-term explicit memory is present within the first year (Carver, Bauer, & Nelson, 2001).
-  **Recall** – The ability to recall information from memory unaided, necessary for spelling. Ease of retrieval in comparison to recognition has been linked with environment conditions during encoding and retrieval (Robinson & Johnson, 1996).
-  **Eidetic Memory** – The ability to recall extremely detailed images, also referred to as ‘photographic memory’ (Lee & Zhou, 2014).
-  **Hyperthymesia** – The ability to recall extremely vivid memories, including visual and sensory information, also referred to as ‘autobiographical memory’ (Ally, Hussey, & Donahue, 2013).

An individual’s level of remembering can change throughout their life, most notably a child’s level of remembering will improve with development, memory can be negatively impacted due to brain trauma and conditions such as Dementia, Alzheimer’s (Green, Baddeley & Hodges, 1996) and Schizophrenia (Goldberg et al., 1989).

What the research says ... Memory

RNA THEORY

McConnell (1967) conducted numerous studies to examine the theory that memory could be held within the cells of planarians and



<https://62e528761d0685343e1c->

could be transferred to different planarians via cannibalism. The study found that the RNA and DNA of a trained planarian could be extracted and transferred to another planarian thus suggesting that memories are retained within cells. The studies also suggested that repeated exposure to the 'trained' RNA cells resulted in increased memory. Does this mean that our own memories could be transported into another human being? Would you be willing to ingest another human to gain their knowledge?!? Despite the possibility McConnell (1967) expresses concern that the effects would not be as effective, if at all, in humans due to the levels of acidity in the stomach.

A SPREADING ACTIVATION THEORY OF MEMORY

Anderson (1983) discusses Activation theory of memory describing how the cognitive units with the purpose of encoding and retrieval are functionally significant in creating long-term memories. In order for information to be stored as a long-term memory the units must encode all elements of the information, likewise in order to retrieve the information all elements must be retrieved. Anderson claims that the formation of a long-term memory trace is not impacted by the time spent within working memory however can be strengthened by repetition.

Both studies suggest that repeated exposure results in an increase in memory.

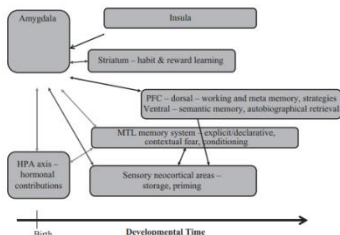
What the research says ... Children

Differences in Hippocampal Activity

Research has identified differences between a child's brain in comparison to an adult's brain during the encoding and retrieval processes (Smith & McAndrews, 2013). The differing activity patterns during these processes indicate that the hippocampus is a key component of development and the ability to successfully encode and retrieve information. In addition, Smith and McAndrew (2013) discuss how children have lower activity in the hippocampus until they reach around eight years of age thus suggesting that children younger than eight years of age have a lower ability to identify authentic memories.

Emotion and Memory Development

A link between emotions and memory has been identified suggesting that whilst cognitive development aids in memory processes explicit memory is a function which develops later and is seemingly influenced by changes in emotion linked with later cognitive development (Carver, 2014). The image above provides further insight into the development of the brain structures from birth (Carver, 2014)



The above research suggests that as the hippocampus develops so to does the capability to encode, store and retrieve memories. It also indicates that in the early years of a child's life they may have difficulty ascertaining between genuine and false memories.

What this means for education

Research has identified links between working memory and long-term memory and cognitive development. The following research articles provide further insight into how the development of brain structures enables cognitive development including memory. There are also suggestions of interventions that may aid in improving a child's cognitive and memory capabilities.

-  **Paas & Ayres (2014)** – Identified that working memory cooperating with long-term memory enables a child to comprehend and acquire complex skills and knowledge. The authors suggest that working memory underpins the development of cognitive processes that enable long-term memory, learning and development. Thus, indicating that developmental delays could have major implications on a child's ability to learn.
-  **Holmes, Gathercole, & Dunning (2010)** – Claim that poor working memory affects 15% of school age children, these children may not have severe developmental delays that would provide cause for concern meaning they would fall below requirements for special educational needs however, will continue to struggle academically. The authors describe how cognitive problems may be displayed as issues with attention, problem solving and low IQ. There is a suggestion that working memory training interventions could be beneficial for these children.
-  **Roughan & Hadwin (2011)** – Explores the potential of working memory training in children with school related difficulties such as poor attention, problem solving skills and social skills. The authors suggest that interventions of working memory training could reduce the school related difficulties and mental health problems.

Theory in practice - Explore your own memory

Whilst exploring the topic of memory in neuropsychology I had been presented with a series of experiments to conduct as part of a small group. Below I have included a copy of one of the experiments conducted, followed by an explanation of my results.

Why not have a go at recreating this experiment with your students and see if your results are like mine!

Experiment 1 – Cued Recall

Cued recall assumes that the information is in memory but not being recalled freely. A cue is presented that activates the memory and aids recall. For example, when learning a new language, we might struggle to find a particular word, but if given the start sound, find that we can recall it. In this case, the teacher provides the start sound as a cue to enable recall.

Group size: pairs

Materials: Paper and pen

Make up a list of 20 polysyllabic words. The participant is to read through the list and spend 5 minutes learning them. They are then asked to recall the list in the correct order. If they cannot remember the next word, then the experimenter provides a graduated cue:

- First letter sound
- First syllable
- First and second syllable

Things to think about

- As well as recording how much of a cue is needed you might decide to record how confident the participant was in their answer e.g. 10% confident, 100% confident. This allows introspection to help provide some information about the recall process.
- You might want to record errors as well as correct answers. This provides some indication of partial recall. What features of the incorrect word are the same as the target word? E.G. does it rhyme, have the same rhythm, start with the same word etc?
- Are there instances of Tip Of The Tongue Phenomena (TOTTP)? Perhaps the participant knows very strongly that they know the word, but they cannot bring it to mind? This occurs where there is partial activation of the route but for some reason the final activation of the word in the lexicon does not occur. The cells in the pathway continue to fire as you struggle to access the target word, however, this makes it even harder as the neurones use up neurotransmitters and need to recover.
- How could cued recall be applied to the teaching of spelling or reading?
- How could it be used to help with revision? Could you for instance develop 'cue cards'?
- Have you any advice for learners who encounter TOTTP?

(Please note this experiment was provided by Dr Garry Squires of the University of Manchester, as part of a Neuropsychology module, 2019-2020)

instances neither participant was able to recall the word at all. However, once we began to move past the word it did 'pop into our head'. Another thing that my partner and I both found useful was visualising the words when attempting to memorise them.

Results

My partner and I discovered that remembering the words in a list proved beneficial as we created links between each word to help us remember. The need for cues was minimised by doing so and when I cue was required usually the sound of the first letter was enough to enable recall. TOTTP did occur and in those

Tips for Teachers

Throughout this guide there have been references to studies and research papers describing the processes that occur within the brain in order for humans to retain information. Below are 5 takeaway suggestions that may help you as a teacher to aid in your student's ability to remember and identify when a student may need more help.

Environment – The environment is key to ensure that a child is adequately stimulated, too little or too much stimulation could result in a child feeling overwhelmed or distracted which could result in all of the information not being processed, this has been shown to have a negative impact on a child's encoding, retention and retrieval capabilities **page 7**.

Additional Support – Identifying when a child may be having difficulty with their working memory as described on **page 8**, this will ensure that a child is able to access additional support if needed. **Remember** – issues with a working memory may not be as visible as a child with another educational need.

Is multimodal best? – Some children may benefit from accessing information in a multimodal way, for example hearing words whilst seeing them may make it easier for them to recall them at a later point, **page 9**.

Recognition before Recall – A child will not be able to recall information before they are able to recognise, **page 5**, it meaning they may not be able to successfully spell words at the same level they are reading at, until they have mastered reading at a set level expecting them to spell at the same level may create negative feelings and reduced motivation which could impact on the remembering process.

REPETITION, REPETITION, REPETITION – Evidence has repeatedly suggested that repetition is a key component to creating long-term memory, **page 6**, therefore it is essential that a child is repeatedly exposed to information to ensure they are able to commit it to memory.

These suggestions have been compiled based on the information already provided and there is signposting to the relevant page for further information.

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