Memory:

Case study – Clive Wearing:

⇒ Was a professional broadcaster and musician until he suffered **bilateral** (both sides) **hippocampal damage.**

⇒ His recall of autobiographic episodes (episodic memory) = poor.

⇒ His capacity to learn new things and facts = poor.

⇒ His recall of facts learned prior to illness (semantic memory) = good,

⇒ His ability to attend to & understand current conversation (short-term/working memory) = fully preserved.

⇒ His musical ability (procedural memory) = fully preserved.

⇒ Whenever he shifts his attention to a new aspect of his environment, he loses the ability to recall what happened immediately before doing so.

⇒ He no longer had any **episodic memory** – that is, memory of events that had happened to him throughout the course of his life.

⇒ However, he could remember general things (**semantic memory**) – for example, he knew that he was married (semantic) but was unable to recall his wedding (episodic).

What is memory?

⇒ **A set of systems for encoding, storing and retrieving information** acquired through our senses, and for relating this information to previously acquired knowledge.

⇒ The **mental and neural representation of information** we have experienced, imagined and learned.

⇒ **Encoding:** the processing of incoming information to be stored (information is bound/integrated together into a unified memory representation).

⇒ **Acquisition** registers inputs in temporary sensory storage.

⇒ **Consolidation** creates a stronger representation to enable retrieval (results in 'storage').

Storage:

⇒ After consolidation, long-term memories are stored throughout the brain as networks of neurons that fire together, to regenerate the same pattern that created the original experience.

⇒ For example, groups of neurons in the visual cortex store a sight, neurons in the amygdala store the associated emotion, etc.

Retrieval:

⇒ The creation of a **representation** that recreates elements of a previous experience, or the execution of a learned behaviour.

⇒ The **success of retrieval** depends on interactions between factors such as the match between cues present at encoding and those present at retrieval, the (storage) strength of the memory trace, and the recency with which the memory has been accessed (retrieval strength).

⇒ Retrieval cues activate part of a memory trace in the medial temporal lobe that then sends activation back out to reconstruct the rest of the representation.

⟹ We have **full consolidation of a memory** when the memory process of retrieval is no longer dependent on the back and forth with the hippocampus.

⟹ Damage to the medial temporal lobes will mean you won't be able to remember anything new, but will still remember those memories that have been consolidated and are no longer dependent on the hippocampus.

The multi-store model of memory:

⟹ Proposed by *Atkinson & Shiffrin*

⟹ Places STM as a crucial temporary storage space for maintaining information in an active state through **maintenance rehearsal** through repeated reinstatement of the input results in transfer to LTM.
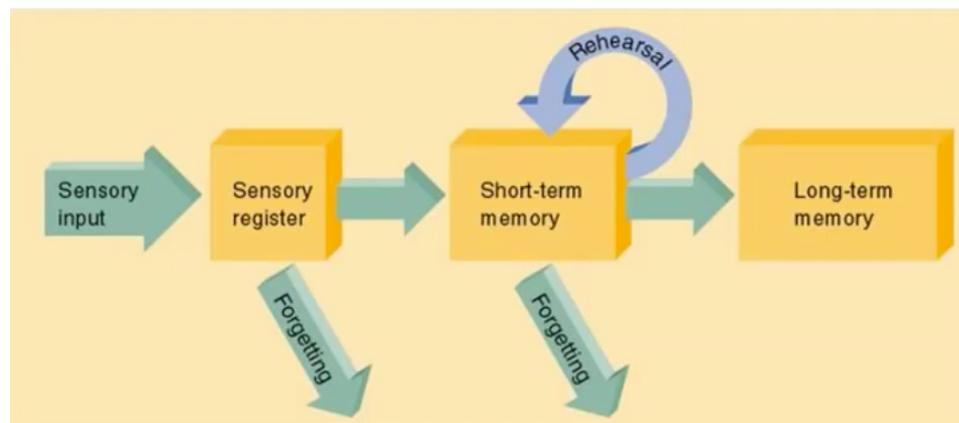
⟹ Information comes into the sensory register via our separate sensory channels (acquisition), and each are processed by the 5 separate sensory cortices. There is lots of forgetting here, because we simply cannot attend to all of the information coming in at once.

⟹ Short-term memory is your ability to represent the present moment to yourself consciously. Short-term memory exists for as long as we can attend to it, and this model proposes that we need to actively rehearse the information in short-term memory in order to store it in long-term memory.

Sensory memory:

⟹ A temporary, sensory-based representation of input received through sensory channels.

⟹ Provides a buffer ('holding area') between early sensory processes and later cognitive processes.

⟹ Only some of the information stored in sensory information will be retained.

⟹ We have **iconic** (visual) and **echoic** (auditory) memory

⟹ Sensory memory is of brief duration (decays quickly) and has a large capacity (relative to short-term memory).

Determining the capacity of visual sensory memory:

⟹ From his *partial-report* method experiment, Sperling drew the conclusion that the capacity of the iconic (visual) trace is 12 items (and duration of the iconic trace is

~500 milliseconds. If a participant can accurately report back any one of the lines, it means that the entire set of 12 items is briefly available to them for a moment after it has disappeared.

$\Rightarrow$ This is compared to full-report, where participants only had a limited capacity to recall the lines.

Short-term (working) memory:

To solve a mental problem such as 324 + 368...

$\rightarrow$ First, you must create a *temporary representation* in memory for the two numbers that can survive for several seconds to complete the task.

$\rightarrow$ Then, you need to *allocate attention* to different portions of the representation so that you can apply the rules of arithmetic required by the task.

$\rightarrow$ For example, you may focus your attention on the 'tens' digits and *supress interference* from the other digits and from partial results of previous operations.

$\rightarrow$ And, whilst attending to local portions of the problem, you must also *keep accessible the parts of the problem that are not in the current focus of attention.*

$\Rightarrow$ Short-term memory was initially thought of as a temporary storage site.

$\Rightarrow$ **Capacity:** 7 +/- 2 items, or the amount of verbal information that can be rehearsed for 2 seconds.

$\Rightarrow$ **Duration:** seconds to minutes, depending on ability to maintain attention on stimulus.

$\Rightarrow$ Information is kept active in STM through a process of active rehearsal mediated by verbal representations.

$\Rightarrow$ *Rehearsal* results in transfer from STM to LTM storage site.

$\rightarrow$ **Capacity of verbal short-term memory** can be assessed during a *digit-span task*, where participants are required to recall as many letters as they can in one go (***immediate serial recall***).

$\rightarrow$ The *change-detection task* (recall of differences in colours) suggests that the capacity of visual short-term memory is ~3-4 items at a time.

Chunking:

$\rightarrow$ **Chunking** (*Miller, 1956)* is where you group information into meaningful units. Chunking can increase STM capacity. Recent studies that reduce the potential capacity for chunking **estimate the pure capacity of STM** at approximately 3+/- 1 units of information (rather than 7).

$\rightarrow$ Miller suggested that the capacity limit on STM should be viewed in relation to the number of *meaningful chunks* rather than meaningless 'bits' of information.

Duration of short-term memory:

$\rightarrow$ Assessed via the *Brown-Peterson task* – where participants were required to remember 3 consonants and then to count backwards in 3's until being given a signal to stop and recall the consonants.

$\rightarrow$ Verbal rehearsal was prevented through a counting task during the retention interval, and it was found that the STM trace would decay rapidly over 12-18 seconds.