LONG-TERM MEMORY

Long-term memory (LTM) is a memory store that holds a potentially unlimited amount of information for a very long time, possibly permanently. The two main long-term memory types are called explicit and implicit memory.

Explicit memory

Explicit memory involves memory that occurs when information can be consciously or intentionally retrieved and stated. Explicit memories are also called **declarative memories**. Explicit memory has two sub-types that are called episodic memory and semantic memory.

Episodic memory

Episodic memory is the long-term explicit memory of personally experienced events.

For example, your memory of your first day at school.

- These memories often include details of the time, place and our psychological and physiological state when the event occurred.

Semantic memory

Semantic memory is the long-term explicit memory of facts and knowledge about the world.
It includes our specialised knowledge of:

- Facts and knowledge of the kind learned in school
- Everyday facts and general knowledge
- The meaning of words
- Rules
- Areas of expertise

Unlike episodic memories, semantic memories are not 'tagged' with details of time and place.

Implicit memory

Implicit memory involves memory that does not require conscious or intentional retrieval. Implicit memories are also referred to as **non-declarative memories**. The two sub-types of implicit memory are called procedural memory and classically conditioned memory.

For example, motor skills like brushing your teeth and riding a skateboard.

Procedural memory

Procedural memory is the long-term implicit memory of motor skills and actions that have been learned previously.

For example, how to brush your teeth or how to use chop sticks.

- It involves memories of 'how to do something'.

Classically conditioned memory

Conditioned responses to conditioned stimuli acquired through classical conditioning are also considered to be a type of implicit memory, particularly those involving fear or anxiety.

For example, if you immediately experience fear or anxiety at the sight of as spider or when you think about having to go to the dentist because of past associations with anxiety or pain, implicit memory is involved, whether or not you have an explicit 'declarable' recollection of a relevant past event.

Figure 6.22 Cooking a beef casserole can involve explicit and implicit long-term memories. Procedural memory is involved in knowing how to brown the meat. Remembering the recipe involves semantic memory. A memory of the time and place of a previous cooking disaster with beef casserole would involve episodic memory.

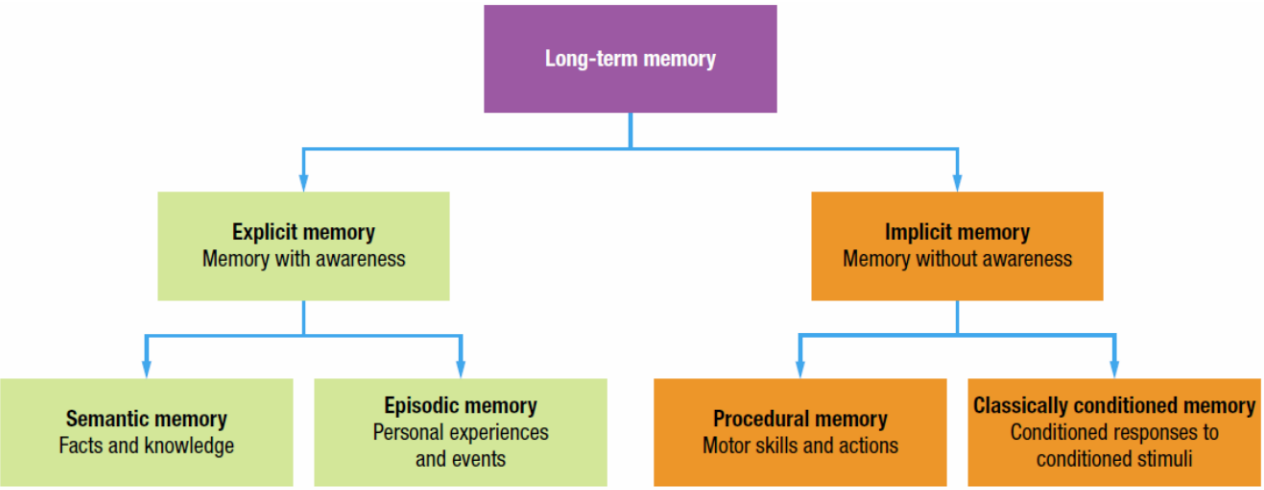


FIGURE 6.16 Long-term memory types and sub-types

BRAIN REGIONS INVOLVED IN THE STORAGE OF LONG-TERM MEMORIES

Roles of the cerebral cortex

The **cerebral cortex** is the thin outer, wrinkly looking layer of neural tissue that covers the largest part of the brain (the cerebrum) and is involved in complex mental abilities, sensory processing and voluntary behaviours.

- Generally, long-term explicit semantic and episodic memories are widely distributed throughout the cortex. Their permanent storage tends to be in the areas where the relevant information was first processed.

Roles of the hippocampus

The **hippocampus** is just above each ear, deep within the brain's medial ('middle') temporal lobe area, on the edge of and just under the surface of the cerebral cortex. It is also part of the brain's limbic system involved in emotion and various other functions, together with the amygdala and other structures. **The hippocampus has a crucial role in the consolidation of most of our memories.**

- Turns short-term memories into long-term memories.

- It is crucial in the consolidation of new semantic and episodic memories so that they are neurologically stable and long-lasting, but it is not directly involved in the formation of implicit procedural or classically conditioned memories.

- It is believed that it does not permanently store any memories itself. Instead, it transfers them to the cerebral cortex for long-term storage, most likely in the areas that initially processed the information.

- Through its interaction with the amygdala, the hippocampus also plays a role in the formation of emotional memories, particularly the explicit memory component of an emotional event.

The hippocampus is also important for **spatial memory**, which is an explicit memory for the physical location of objects in space.

Figure 6.28 The hippocampus is crucial in the consolidation of new semantic and episodic memories so that they are neurologically stable and long-lasting. This helps ensure pleasant holiday memories are stored relatively permanently.

Roles of the amygdala

The **amygdala** is a small structure located just above and interconnected with the hippocampus in the medial temporal lobe that has a crucial role in processing emotions.

- Best known for its role in processing and regulating emotional reactions, particularly emotions such as fear and anger (including aggression) that may be experienced intensely and can motivate certain types of behaviour.

- Involved in the formation of a wide range of other emotional memories.

- People with damage to their amygdala are typically unable to acquire a conditioned fear response.

- It is believed that it does not permanently store emotional memories.

Figure 6.33 The amygdala is crucial to the formation of implicit memories involving classically conditioned fear responses, and can also contribute to explicit memories by influencing the activity of the hippocampus.

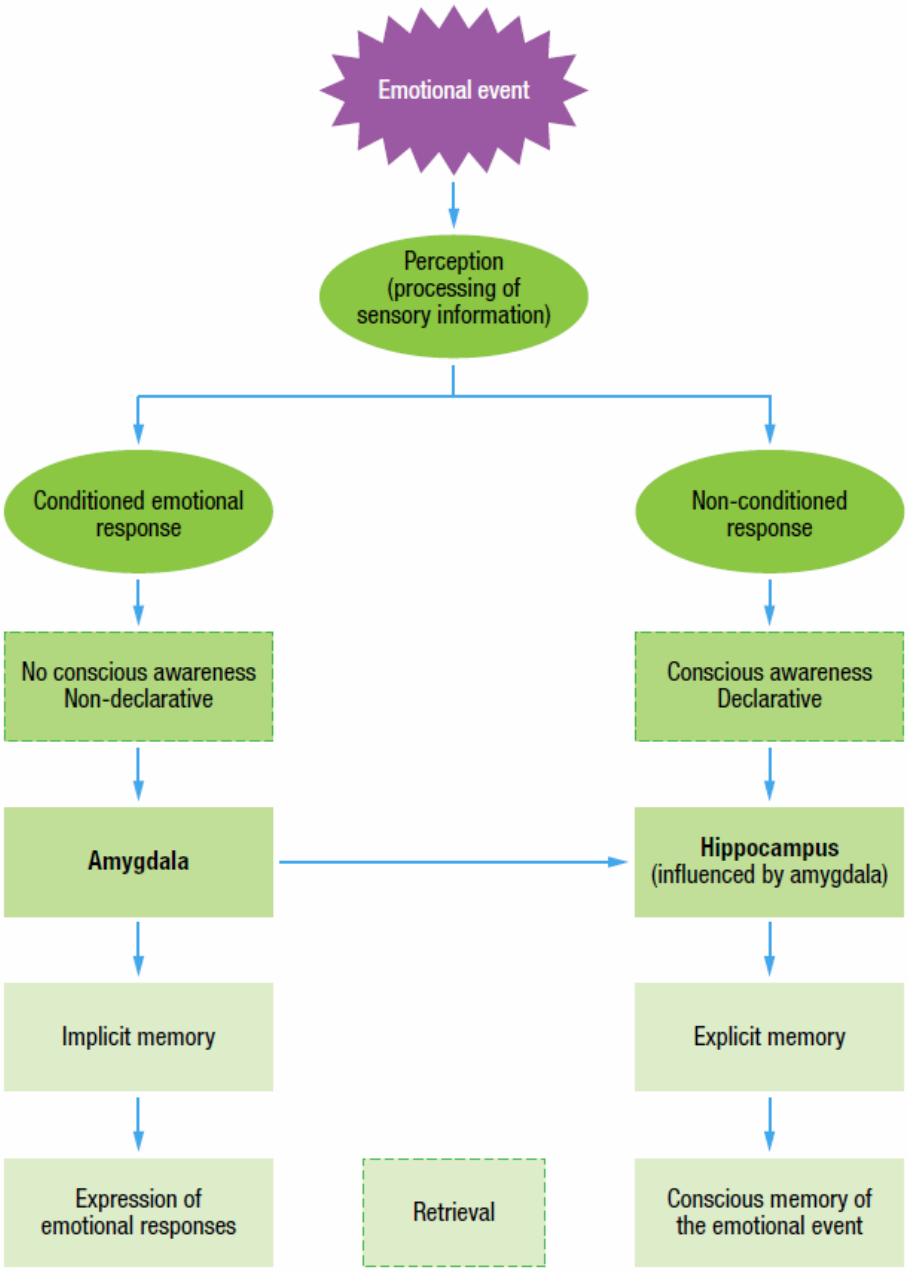


FIGURE 6.33 The amygdala is crucial to the formation of implicit memories involving classically conditioned fear responses, and can also contribute to explicit memories by influencing the activity of the hippocampus.

Roles of the cerebellum

The **cerebellum** is the cauliflower-shaped structure located at the base of the brain and at the rear that looks like a mini brain.

- Coordinates fine muscle movements, regulates posture and balance, and contributes to various perceptual and cognitive processes.

- Best known for its involvement in activities requiring a skilled sequence of movements that require timing and are made with speed, ease and fluency. **For example**, playing the piano.

- Plays important roles in everyday voluntary, purposeful movements. **For example**, picking up a cup of coffee.

- Damage to the cerebellum makes it difficult to time and coordinate muscle control for everyday activities. **For example**, talking and walking.

Figure 6.35 The cerebellum may contribute to spatial navigation at two levels, first in processing self-motion information to build spatial representation in the hippocampus at the level of place cells, and second in using this spatial representation to perform an optimal route toward a goal.

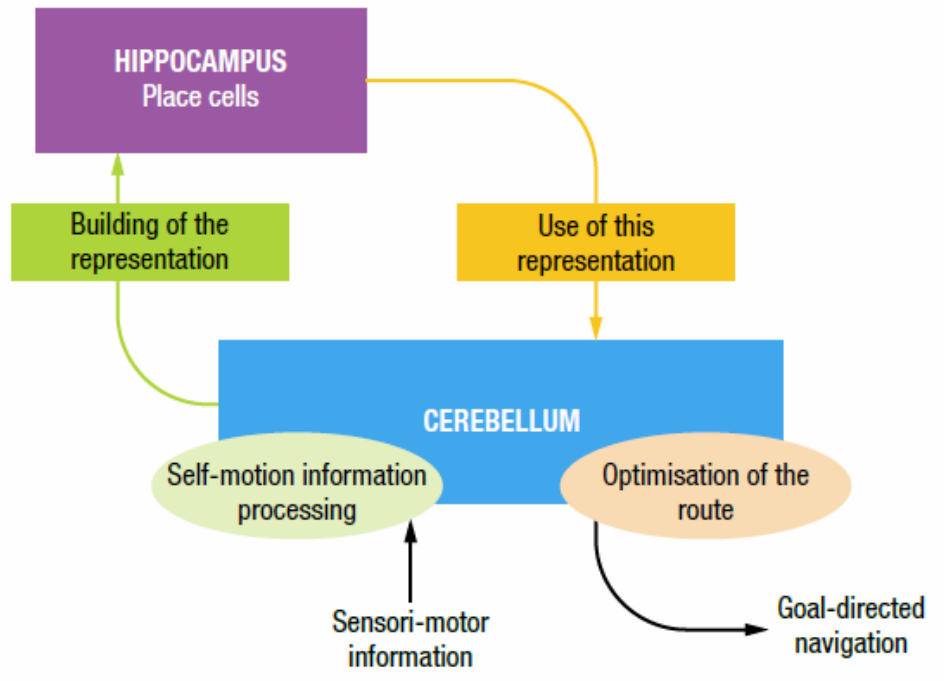
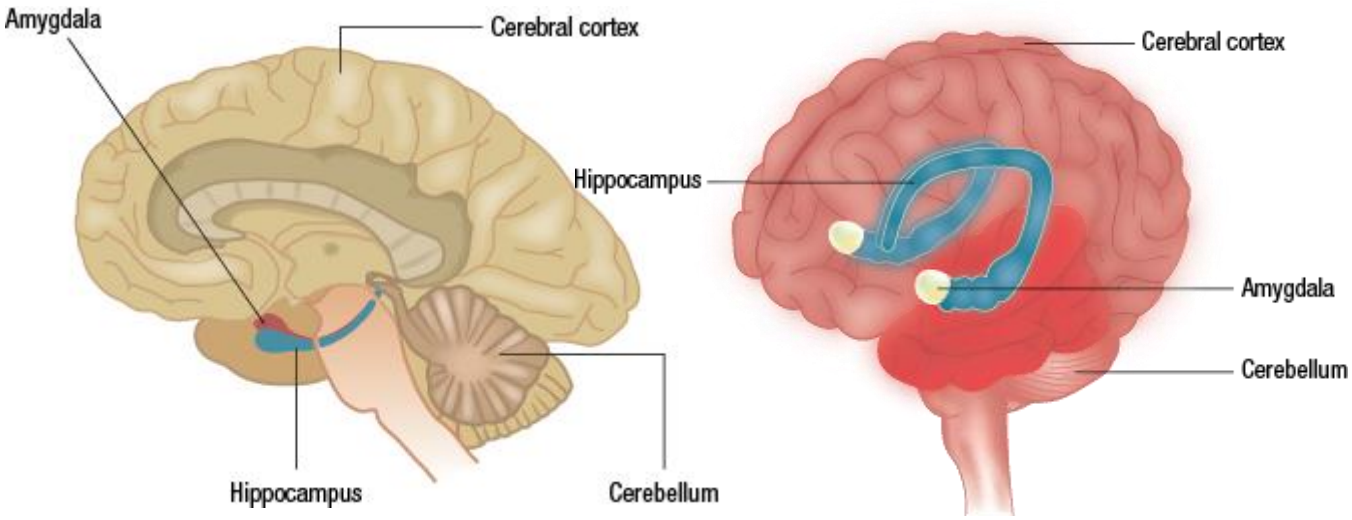


FIGURE 6.35 The cerebellum may contribute to spatial navigation at two levels, first in processing self-motion information to build spatial representation in the hippocampus at the level of place cells, and second in using this spatial representation to perform an optimal route toward a goal.



CHAPTER 7: RELIABILITY OF MEMORY

Methods to retrieve information from memory or demonstrate the existence of information in memory

A **retrieval method** is any means used to retrieve information from memory.

Three types of retrieval methods are called recall, recognition and relearning.

Recall

Recall involves reproducing information stored in memory.

Three types of recall are free recall, serial recall and cued recall.

- Free recall involves reproducing as much information as possible in no particular order without the use of any specific cue.

For example, you may attend a training course for a new job and afterwards remember a few important points without recalling the order in which they were presented.

- Serial recall involves reproducing information in the order in which it was learned.

For example, if you are telling a friend about an overseas holiday and recall the names of the cities in the order in which you visited them, then you would be using serial recall.

- Cued recall involves the use of specific prompts ('cues') to aid retrieval and therefore reproduction of the required information.

For example, trying to remember the names of the last three prime ministers when provided with their initials.

Recognition

Recognition involves identifying ('recognising') the original, learnt information.

For example, we might be called upon to identify the perpetrator of a crime from a Crime Stoppers photograph shown on TV.

Relearning

Relearning involves learning information again that has been previously learned (and was therefore stored in LTM).

For example, you may believe you have forgotten some or all of the material, yet with even a small amount of reviewing you remember the information relatively quickly.

Relearning is also called the method of savings and is calculated using the formula:

Relearning is also called the **method of savings**, or simply **savings**, because it can be used to measure the amount of information 'saved' from previous learning.

For example, suppose you were a participant in an experiment and it took you ten trials (presentations) to learn a list of 12 nonsense syllables. If in a subsequent experiment, perhaps six months later, it took you five trials to relearn the same list, then the savings would be 50% because it took you half the number of trials to relearn the information.

The savings are calculated using the formula:

$$\text{Savings} = \frac{\begin{array}{c}\text{(no. of trials for}\\ \text{original learning)}\end{array} - \begin{array}{c}\text{(no. of trials}\\ \text{for relearning)}\end{array}}{\text{(no. of trials for original learning)}} \times \frac{100}{1}$$

A savings score can also be calculated on the basis of the *time* taken to relearn information. In this case, the formula would be:

$$\frac{\text{(time for original learning)} - \text{(time for relearning)}}{\text{(time for original learning)}} \times \frac{100}{1}$$

TABLE 7.1 Comparison of retrieval methods

Method	Description	Example
Recall		
Free recall	Reproducing information in no particular order	Name the last three prime ministers of Australia.
Serial recall	Reproducing information in the order in which it was learned	Name the last three prime ministers of Australia in order from the most recent to the least recent.
Cued recall	Using a cue to assist the retrieval of information	Name the last three prime ministers of Australia. Their initials are MT, TA, KR.
Recognition	Identifying correct information from among a list of alternatives	Identify the last three prime ministers of Australia from the following list: Chifley, Gillard, Hawke, Abbot, Whitlam, Turnbull, Rudd, Howard, Keating, Menzies.
Relearning (method of savings)	Determining the amount of information saved when learning information again that has been previously learned	Time how long it takes to learn the last seven prime ministers of Australia. Time yourself two weeks later on the same task to test the amount of time saved in learning the information a second time compared with the first time.