



# Long-term Memory and Brain Injury

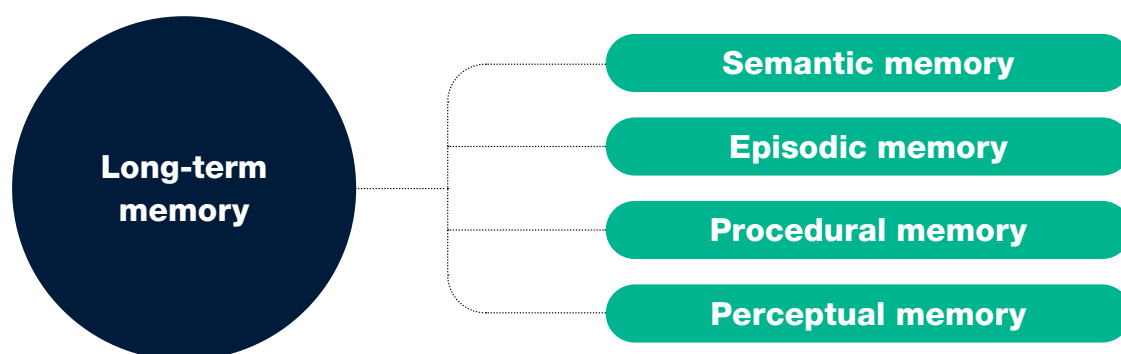
## What is long-term memory?

Memory is divided into working memory and long-term memory. Working memory is the ability to keep information available for a short while as it comes to hand. Therefore, working memory has a limited holding capacity. Longterm memory has a high holding capacity and the availability of the memories are more prolonged. For example, it has been shown the memories which remain three years after learning also remain after 30 years.

The process that leads to a long-term memory has several steps. To encode and store new memories, we must first pay attention to and process information. We perceive the information through our senses; sight, hearing, touch, smell and taste. The more senses involved in the memory process then the easier it will be remembered. For example,

a smell can amplify the memory of an event and writing information down can further support memory. The last part of the process is the retrieval. We need to be able to find the information and apply it whenever we wish to.

Long-term memory is not a single memory system. It consists of several different parts that have different interacting functions. The most familiar long-term memory systems are memory for events (episodic memory) and memory for facts (semantic memory). The longterm memory system also includes the memory of skills (procedural memory) and perceptual memory (memory for identifying objects and orienting ourselves in the outside world). Longterm memory contains both memories of past events (retrospective memory) and a planning memory for things that you intend to do in the future (prospective memory).



## Memory for events

Thanks to this memory, we remember what we have experienced, such as people we met, trips we made and what we ate for breakfast this morning. These memories can be likened to diary entries because they are linked to time and space and are unique to our past experiences, values and attitudes. Even though we share many experiences with others, our episodic memory is personal. An event which triggers strong feelings to us and has stimulated many of our senses is most likely to become a strong and vivid memory. Because of this the event in question is easy to remember as there are plenty of association paths to it.

## Memory for facts

The memory for facts can be described as our internal book of reference. In this memory, our general knowledge is stored, such as names of countries and people, knowledge of what words mean and when events occurred. Knowledge of different rules and laws is also found in this memory system. Unlike the memory for events, the memory for facts is more unbiased and is shared by people within similar cultural and educational backgrounds.

## Procedural memory

Procedural memory is the memory we use when learning motor skills such as when we learn to shower and groom, ride a bike, kick a footy, dance or play the piano. Procedural memory is a memory system that is used unconsciously. We are not necessarily aware of when we learn new skills like cycling or driving. Once we have learnt, for example, swimming, the knowledge of how we do it remains. The more we practice motor skills, the better we become. Ultimately, the skill is so well learned it becomes automatic or a habit.

## Perceptual memory

Perceptual memory is the memory we need to identify objects and familiarize ourselves in the outside world. It is the memory of things we cannot say, such as how we recognize a face, someone's voice or how coffee smells and tastes. Perceptual

memory is an unconscious memory and it helps us build our knowledge of what is happening around us in the outside world. For example, we can move freely in the room without having to think about what the objects around us are or why they are positioned the way they are.

---

## Long-term memory and brain injury

The structure of the brain that is essential to long-term memory is the hippocampus. Its function is primarily to coordinate the retrieval of memory for facts or events stored in different parts of the brain.

A brain injury can affect all long-term memory systems. Memory of events is affected more often and to a greater extent than the other long-term memory systems. What is usually affected is the memory of events from the time of the injury and forward. If I were to have this type of memory impairment, my descriptions of events could become vague and imprecise. A clear indication of impaired long-term memory for events is the person repeats the same story or repeatedly asks the same question within short intervals. Memories for events prior to the injury are, on the other hand, often unaffected. However, in cases of severe brain injuries, the memories leading up to the time of the injury are also lost. In more extreme cases, memories from several years before the injury can be lost. Most people regain at least some of the previously imprinted memories.

Our working memory and long-term memory are connected. Important information held in our working memory system is then transferred into the long-term memory for storage. People with long-term memory difficulties may not necessarily have direct long-term memory impairment. Rather, it is a consequence of the dysfunction in working memory. Impaired working memory in people with brain injury is common. It is less common to have a well functioning working memory and directly impaired long-term memory. People who have an impaired working memory and a well functioning long-term memory can still store long-term memories under good conditions.

Other post-brain injury impairments can also make it harder to store information or to access stored memory. Other examples of impairments that affect long-term memory are impaired concentration, being easily distracted, slowness in thinking and fatigue.

Although less common, people can experience major impairment in memory after a brain injury. In this instance it is usually after injury to the hippocampus or other key areas of memory. Usually, the person still has retained memory for much of the time before experiencing the brain injury. However, they completely lose or largely lose the ability to store new facts or events and/or the ability to retrieve memories. This condition is called amnesic syndrome. People with amnesic syndrome do not remember what they did or talked about a short time ago (a few minutes ago). They have trouble with time (day, month, year) and space (where they are) and remembering what has happened recently. They consequently find it very difficult to manage and live independently.

---

## **What to do if you have impaired long-term memory**

There are several ways to directly or indirectly affect impaired long-term memory. There is a distinction between methods to rebuild memory capacity and methods aimed at compensating impaired memory to improve function.

### **Training of long-term memory**

There is some evidence that working memory can be improved in specific tasks through training or by appropriate stimulation. However, there is no indication that long-term memory can be improved through direct training.

### **Compensation**

Compensation means doing something to try to 'get around' impairments. When compensating we use our strengths in such a way so that our impairments or weaknesses causes as little disruption as possible.

There is a distinction between internal and external compensation strategies. Internal compensation

means we use strategies in the form of alternative ways of thinking to find our own way around the memory problem. External compensation means we use external support in the form of another person, adaptations to the environment or using aids. Some people can successfully use a mix of internal and external methods. Often, it is the severity of the memory impairment which determines what type of compensation will be most effective. The general rule is the least significant the memory impairment is, the greater the chance to be successful in using internal compensation.

Compensation means change. It is often the case that the problem, which needs to be compensated, is significant in nature and perceived as important to the person with a brain injury. This is needed to motivate the person to apply the effort and focus needed to implement compensatory strategies to the point where they become routine and successful. Succeeding in finding effective ways to compensate for impairments often increases the experience of control and reduces the feelings of stress.

### **Internal compensation**

Internal compensation for a person with impaired long-term memory is mainly about increasing the focus on learning. This includes focusing on the situation around the learning experience. Because brain injury has caused the memory impairment, it is not possible to strengthen learning in general. Instead you must focus on the elements that are important to remember and filter out unimportant information. For example, you can use repetition to develop routines, or learn new information in smaller chunks, such as, only reading parts of a book at a time. Most people with brain injury usually need longer time for new learning to be successful.

There are plenty of mental tricks that focus on how to improve memory. They include putting together rhymes based on first letters or remembering lists through visualization. These memory methods are generally less successful because it requires a well-functioning memory to remember to consciously use them. However, these methods may be useful for very limited and specific tasks.

## External compensation

### To use aids

Memory aids are used to assist with the management of information we fail to keep in our memory.

A memory aid needs to be easy to use and easily accessible to be an effective support for a person with memory impairment.

Impaired memory capacity can often be compensated with good planning, for example, by using a calendar (paper calendar or mobile phone) for planning what will happen during your day or the week. Here is some advice on what to do to help ease everyday life if you have impaired long-term memory.

- Write down important meetings or activities
- Have a calendar easily accessible both at home and away from home
- Use a mobile phone or clock with timers for reminders
- Use voice recorder for short messages
- Write a diary with short notes

General advice is to try to record important information in one place, for example, a calendar, mobile phone or in storage folders. Post-it notes can be helpful. However, if you use many systems or aids, it can be confusing and information will easily be lost.

Most mobile phones have many features that can be helpful in memory compensation such as a calendar with reminder functions. Many phones also have note pages or voice memos for things that need to be remembered or quickly memorised. The camera can also serve as memory support by taking pictures of places or of texts, such as a bus timetable. The GPS feature can be helpful when there is a difficulty in remembering how to get to different places. Additionally, the phones can be customized by downloading applications (apps) to the phone. An app can be more developed and specialized than the basic applications in the phone. There are a very large number of apps to choose from and finding an app that suits can be challenging.

Other aids that may support memory are:

- Notepad and pens by the phone to write down messages or important details from calls
- List with items that need to be purchased or checklists for recurring activities
- Sort, collect and keep important papers in order. Store important papers in the same place in a box or in storage folders.
- Setting up direct debits can be a good help to get bills paid on time.
- For individuals with significant memory problems dealing with finances may need the help of an appointed administrator.

### Environmental adjustment

For people who find it difficult to remember to search for information, it is helpful if the information is clearly visible, for example, by placing objects strategically. Here are some examples:

- A weekly schedule that is clearly visible in a place often visited
- A whiteboard where the current schedule or important events are written
- Place items to remember by the front door
- Always place important items such as keys, wallet and phone in the same place

Other examples of environmental adaptations that may be helpful are:

- Stove guard, a good aid for people who forget to switch off the stove
- A timer that turns off the power to electronic devices
- A timer at the stove and oven for cooking

It can be difficult for a person with extensive memory impairment to use memory aids themselves or make adjustments to their own environment. It must then mainly be other people who can provide support with learning and making adaptations in the environment to maintain safety and an active life.

## Good physical and mental health

How well we perform with all our thinking skills is related to how well we feel mentally and physically. This applies to all people in all situations.

People with brain injuries can often have less ability to cope with stress which impacts on physical and mental health. For people with working memory problems following a brain injury, different stressors may further impact on their working memory function.

Good routines relating to physical activity, nutritional intake, sleep and rest can improve everyday functioning. Reducing anxiety and stress and increasing self-esteem can also increase the ability of the person to function to the best of their ability.

---

### **Reviewed by:**

*Björn Johansson, MD, PhD, Consultant, Department of Rehabilitation Medicine, Uppsala University Hospital and Curtis Reddell, Rehabilitation Coordinator, Brightwater Care Group, Perth, Western Australia.*

*The original text comes from Infoteket om funktionshinder, Uppsala County Council, Sweden <https://www.regionuppsala.se/infoteket>*