# **Topic: Memory**

# 1. Factsheet

Memory is the faculty by which the brain encodes, stores, and retrieves information. It is a record of experience for guiding future action.

* **Sensory memory:** Humans process stimuli first with their sensory memory; that information is typically held in the brain for less than a second, which may explain why most people report that when shown an object quickly, they feel like they take in more details than they're able to recall later.
* **Short-term memory:** Next, the information is transferred to short-term memory or working memory, which allows someone to mull things over and hold key information in their mind.
* **Long-term memory:** Finally, people store past events and patterns in their long-term memory, also known as episodic or semantic memory.

Different areas of the brain affect different aspects of memory.

* The hippocampus is related to spatial memory, which helps the brain map the surrounding world and find its way around a known place.
* The amygdala is linked to emotional memory.

Research is being done on the [genetics](http://www.psychologytoday.com/us/basics/genetics) of memory—and particularly a possible genetic root for Alzheimer's disease—but the science is still preliminary; it is unclear why some people remember things much more efficiently than others.

# 2. Live Science Article

# **Memory Definition & Types of Memory**

For us to recall events, facts or processes, we have to commit them to memory. The process of forming a memory involves encoding, storing, retaining and subsequently recalling information and past experiences.

Cognitive psychologist Margaret W. Matlin has described memory as the “process of retaining information over time.” Others have defined it as the ability to use our past experiences to determine our future path.

When they are asked to define memory, most people think of studying for a test or recalling where we put the car keys. However, memory is essential in our everyday lives. We would not be able to function in the present or move forward without relying on our memory.

# **How we form memories**

The process of encoding a memory begins when we are born and occurs continuously. For something to become a memory, it must first be picked up by one or more of our senses. A memory starts off in short-term storage. We learn how to tie our shoe, for example. Once we have the process down, it goes into our long-term memory and we can do it without consciously thinking about the steps involved.

Important memories typically move from short-term memory to long-term memory. The transfer of information to long-term memory for more permanent storage can be happen in several steps. Information can be committed to long-term memory through repetition — such as studying for a test or repeatedly taking steps until walking can be performed without thinking — or associating it with other previously acquired knowledge, like remembering a new acquaintance Mrs. Emerald by associating her name with an image of the green jewel.

Motivation is also a consideration, in that information relating to something that you have a keen interest in is more likely to be stored in your long-term memory. That's why someone might be able to recall the stats of a favourite baseball player years after he has retired or where a favourite pair of shoes was purchased.

We are typically not aware of what is in our memory until we need to use that bit of information. Then we use the process of retrieval to bring it to the forefront when we need to use it. Again, much of this recall happens without having concentrate on it — particularly with common tasks such as shoe tying — but there are other types of memories that take more effort to bring to the forefront.

Memory loss is often associated with aging, but there are a number of things that can trigger short- and long-term memory loss, including injury, medications and witnessing a traumatic event.

**Types of memory**

While experts have varying definitions for short-term memory, it is generally described as the recollection of things that happened immediately up to a few days. It is generally believed that five to nine items can be stored in active short-term memory and can be readily recalled. Patients who suffer from short-term memory loss can't remember who walked into the room five minutes before, but can remember their childhood friend from 50 years ago.

**Implicit memory** is sometimes referred to as unconscious memory or automatic memory. Implicit memory uses past experiences to remember things without thinking about them. Musicians and professional athletes are said to have superior ability to form procedural memories.

**Procedural memory,** which is a subset of implicit memory, is a part of the long-term memory responsible for knowing how to do things, also known as motor skills. You don't have to delve into your memory to recall how to walk each time you take a step.

Some examples of **procedural memory:**

* Playing piano
* Ice skating
* Playing tennis
* Swimming
* Climbing stairs

While **implicit memory** requires little if any effort to recall, explicit memory — sometimes referred to as declarative memory — requires a more concerted effort to bring the surface. Declarative memory involves both semantic and episodic memory.

While most people can tick off the days of the week from the time they are in grade school — which is implicit memory — it takes explicit memory to remember that your mother's birthday is next Wednesday.

**Semantic memory** is not connected to personal experience. Semantic memory includes things that are common knowledge, such as the names of states, the sounds of letters, the capitals of countries and other basic facts that are not in question. Some examples of semantic memory include:

* Knowledge that the sky is blue
* Knowing how to use a knife and fork
* Remembering what dog is

**Episodic memory** is a person's unique recollections of a specific event or an episode. People are usually able to associate particular details with an episodic memory, such as how they felt, the time and place, and other particulars. It is not clear as to why some memories of events in our lives are committed to memory, while others don't get recorded, but researchers believe that emotions play a critical role in what we remember.

Some examples of episodic memory:

Where you were and the people you were with when you found out about the Challenger space shuttle disaster

* Your beach vacation last summer
* The first time you travelled by plane
* Your first day at a new job
* The restaurant you went to on your first date with your spouse

(<https://www.livescience.com/43713-memory.html>)

# 3. Diagram

**Figure 1**. According to the Atkinson-Shiffrin model of memory, information passes through three distinct stages in order for it to be stored in long-term memory.

# Storage | Introduction to Psychology

# (<https://courses.lumenlearning.com/wmopen-psychology/chapter/reading-storage/>)

# 4. Science Daily Article

**Can't remember something? Try waiting until later in the day. Researchers identified a gene in mice that seems to influence memory recall at different times of day and tracked how it causes mice to be more forgetful just before they normally wake up.**

"We may have identified the first gene in mice specific to memory retrieval," said Professor Satoshi Kida from the University of Tokyo Department of Applied Biological Chemistry.

Every time you forget something, it could be because you didn't truly learn it -- like the name of the person you were just introduced to a minute ago; or it could be because you are not able to recall the information from where it is stored in your brain -- like the lyrics of your favourite song slipping your mind.

Many memory researchers study how new memories are made. The biology of forgetting is more complicated to study because of the difficulties of distinguishing between not knowing and not recalling.

"We designed a memory test that can differentiate between not learning versus knowing but not being able to remember," said Kida.

Researchers tested the memories of young adult male and female mice. In the "learning," or training, phase of the memory tests, researchers allowed mice to explore a new object for a few minutes.

Later, in the "recall" phase of the test, researchers observed how long the mice touched the object when it was reintroduced. Mice spend less time touching objects that they remember seeing previously. Researchers tested the mice's recall by reintroducing the same object at different times of day.

They did the same experiments with healthy mice and mice without BMAL1, a protein that regulates the expression of many other genes. BMAL1 normally fluctuates between low levels just before waking up and high levels before going to sleep.

Mice trained just before they normally woke up and tested just after they normally went to sleep did recognize the object.

Mice trained at the same time -- just before they normally woke up -- but tested 24 hours later did not recognize the object.

Healthy mice and mice without BMAL1 had the same pattern of results, but the mice without BMAL1 were even more forgetful just before they normally woke up. Researchers saw the same results when they tested mice on recognizing an object or recognizing another mouse.

Something about the time of day just before they normally wake up, when BMAL1 levels are normally low, causes mice to not recall something they definitely learned and know.

According to Kida, the memory research community has previously suspected that the body's internal, or circadian, clock that is responsible for regulating sleep-wake cycles also affects learning and memory formation.

"Now we have evidence that the circadian clocks are regulating memory recall," said Kida.

Researchers have traced the role of BMAL1 in memory retrieval to a specific area of the brain called the hippocampus. Additionally, researchers connected normal BMAL1 to activation of dopamine receptors and modification of other small signaling molecules in the brain.

"If we can identify ways to boost memory retrieval through this BMAL1 pathway, then we can think about applications to human diseases of memory deficit, like dementia and Alzheimer's disease," said Kida.

However, the purpose of having memory recall abilities that naturally fluctuate depending on the time of day remains a mystery.

"We really want to know what is the evolutionary benefit of having naturally impaired memory recall at certain times of day," said Kida.

**About the research**

Mice are naturally nocturnal. When measured in units of time using zeitgeber, the environmental cue of light turning on, mice are usually asleep from Zeitgeber Time 1 to 12 and awake from Zeitgeber Time 12 to 24. The term "just before normally waking up" refers to Zeitgeber Time 10, while the term "just after normally going to sleep" refers to Zeitgeber Time 4.

Collaborators at the Tokyo University of Agriculture and the University of Toronto also contributed to this research.

(<https://www.sciencedaily.com/releases/2019/12/191218090152.htm>)

# 5. Questions

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| 1. What is memory?  |
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| 2. Describe the different types of memory |
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| 3. How do we form memories? |
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| 4. Describe the Atkinson-Shriffin model of memory  |
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| 5. Describe the main differences between implicit and explicit memories and semantic and episodic memories |
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| 6. How did the scientists carry out their research into memory recall? |
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| 7. What conclusions did the scientists come to? What else do they still need to find answers to? |
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