

■ MEMORY

■ DEFINITION

Memory is defined as the ability to recall past experience or information. It is also defined as retention of learned materials. There are various degrees of memory. Some memories remain only for few seconds, while others last for hours, days, months or even years together.

Facilitation

Facilitation is the process by which memory storage is enhanced. It involves increase in synaptic transmission and increased postsynaptic activity. Often, facilitation is referred as positive memory.

The process involved in facilitation of memory is called **memory sensitization**.

Habituation

Habituation is the process by which memory storage is **attenuated** (attenuation = decrease in strength, effect or value). It involves reduction in synaptic transmission and slow stoppage of postsynaptic activity. Sometimes, habituation is referred as **negative memory**.

Basis for Short-term Memory

Basic mechanism of memory is the development of new neuronal circuits by the formation of new synapses and facilitation of synaptic transmission. Number of presynaptic terminals and size of the terminals are also increased. This forms the basis of short-term memory.

Basis for Long-term Memory

When neuronal circuit is reinforced by constant activity, memory is consolidated and encoded into different areas of the brain. This encoding makes memory a permanent or a long-term memory.

■ CLASSIFICATION OF MEMORY

Memory is classified by different methods, on the basis of various factors.

Short-term Memories and Long-term Memories

Generally, memory is classified as short-term memory and long-term memory.

1. Short-term memory

Short-term memory is the recalling events that happened very recently, i.e. within hours or days. It is also known as recent memory. For example, telephone number that is known today may be remembered till tomorrow. But if it is not recalled repeatedly, it may be forgotten on the third day.

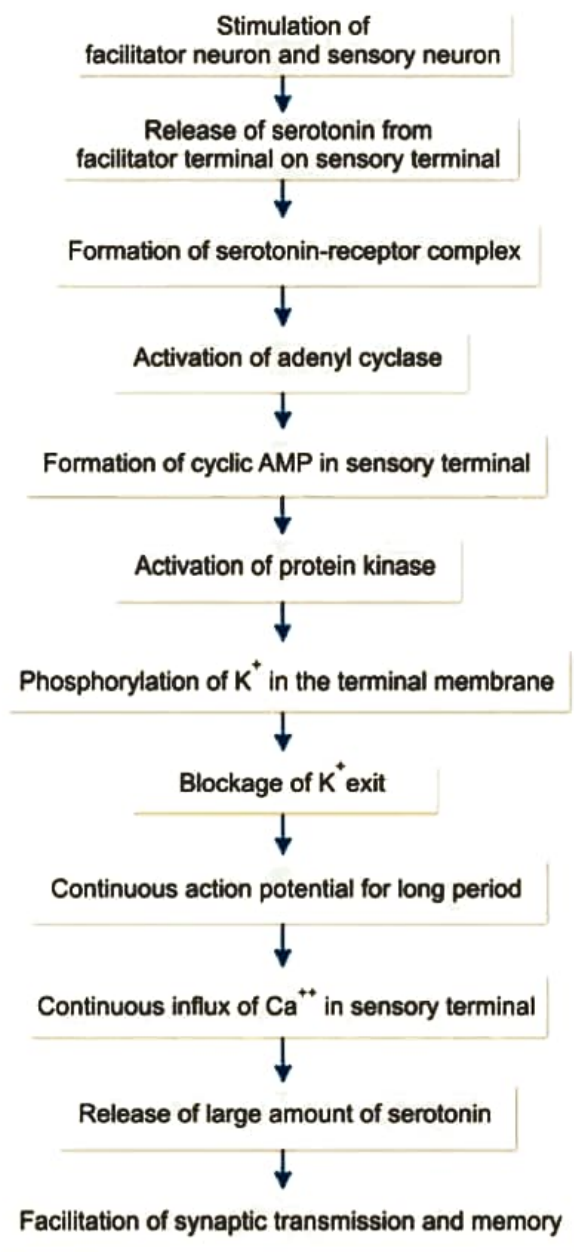


FIGURE 162.2: Memory engram

Short-term memory may be interrupted by many factors such as stress, trauma, drug abuse, etc.

There is another form of short-term memory called **working memory**. It is concerned with recollection of past experience for a very short period, on the basis of which an action is executed.

2. Long-term memory

Long-term memory is the recalling of events of weeks, months, years or sometimes lifetime. It is otherwise called the **remote memory**. Examples are, recalling first

day of schooling, birthday celebration of previous year, picnic enjoyed last week, etc. Long-term memory is more resistant and is not disrupted easily.

Explicit and Implicit Memories

Physiologically, memory is classified into two types, namely explicit memory and implicit memory.

1. Explicit memory

Explicit memory is defined as the memory that involves conscious recollection of past experience. It consists of memories regarding events, which occurred in the external world around us. The information stored may be about a particular event that happened at a particular time and place. Explicit memory is otherwise known as **declarative memory** or **recognition memory**.

Examples of explicit memory are recollection of a birthday party celebrated three days ago, events taken place while taking breakfast, etc.

Explicit memory involves hippocampus and medial part of temporal lobe.

2. Implicit memory

Implicit memory is defined as the memory in which past experience is utilized without conscious awareness. It helps to perform various skilled activities properly. Implicit memory is otherwise known as **non-declarative memory** or **skilled memory**.

Examples of implicit memory are cycling, driving, playing tennis, dancing, typing, etc.

Implicit memory involves the sensory and motor pathways.

Memories Depending upon Duration

Depending upon duration, memory is classified into three types:

1. Sensory memory
2. Primary memory
3. Secondary memory.

1. Sensory memory

Sensory memory is the ability to retain sensory signals in sensory areas of brain, for a very short period of few seconds after the actual sensory experience, i.e. few hundred milliseconds. But, the signals are replaced by new sensory signals in less than 1 second. It is the initial stage of memory. It resembles working memory.

2. Primary memory

Primary memory is the memory of facts, words, numbers, letters or other information retained for few minutes at a time. For example, after searching and finding a

telephone number in the directory, we remember the number for a short while. After appreciating beautiful scenery, the details of it could be recalled for some time. Afterwards, it disappears from the memory.

Characteristic feature of this type of memory is that the information is available for recall easily from memory store itself. One need not search or squeeze through the mind, but this memory is easily replaced by new bits of memory, i.e. by looking into another telephone number, the first one may disappear.

3. Secondary memory

Secondary memory is the storage of information in brain for a longer period. The information could be recalled after hours, days, months or years. It is also called **fixed memory** or **permanent memory**. It resembles long-term memory.

■ LEARNING

■ DEFINITION

Learning is defined as the process by which new information is acquired. It alters the behavior of a person on the basis of past experience.

■ CLASSIFICATION OF LEARNING

Learning is classified into two types:

1. Non-associative learning
2. Associative learning.

1. *Non-associative Learning*

Non-associative learning involves response of a person to only one type of stimulus. It is based on two factors:

- i. Habituation
- ii. Sensitization.

i. Habituation

Habituation means getting used to something, to which a person is constantly exposed. When a person is exposed to a stimulus repeatedly, he starts ignoring the stimulus slowly. During first experience, the event (stimulus) is novel and evokes a response. However, it evokes less response when it is repeated. Finally, the person is habituated to the event (stimulus) and ignores it.

ii. Sensitization

Sensitization is a process by which the body is made to become more sensitive to a stimulus. It is called **amplification of response**. When a stimulus is applied repeatedly, habituation occurs. But, if the same stimulus is combined with another type of stimulus, which may be pleasant or unpleasant, the person becomes more sensitive to original stimulus.

For example, a woman is sensitized to crying sound of her baby. She gets habituated to different sounds around her and sleep is not disturbed by these sounds. However, she suddenly wakes up when her baby cries because of sensitization to crying sound of the baby.

Thus, sensitization increases the response to an innocuous stimulus when that stimulus is applied after another type of stimulus.

2. *Associative Learning*

Associative learning is a complex process. It involves learning about relations between two or more stimuli at a time. Classic example of associative learning is the conditioned reflex, which is described later in this chapter.

■ SPEECH

■ DEFINITION

Speech is defined as the expression of thoughts by production of articulate sound, bearing a definite meaning. It is one of the highest functions of brain.

When a sound is produced verbally, it is called the speech. If it is expressed by visual symbols, it is known as writing. If visual symbols or written words are expressed verbally, that becomes reading.

1. Broca area

Broca area is also called speech center, motor speech area or lower frontal area. It includes areas 44 and 45. These areas are situated in lower part of lateral surface of prefrontal cortex.

Broca area controls the movements of structures (tongue, lips and larynx) involved in vocalization.

C. Wernicke Area

Wernicke area is situated in the upper part of temporal lobe. This area is responsible for the **interpretation of auditory sensation**. It also plays an important role in speech. It is responsible for understanding the auditory information about any word and sending the information to Broca area (Table 162.3).

TABLE 162.3: Role of cortical areas in control of speech

Cortical areas		Function
Motor areas	Broca area: Areas 44 and 45	Controls movement of structures involved in speech
	Upper frontal motor area	Controls movements involved in writing
Sensory areas	Secondary auditory area: Area 22	Concerned with interpretation of auditory sensation Concerned with storage of memories of spoken words
	Secondary visual area: Area 18	Concerned with interpretation of visual sensation Concerned with storage of memories of visual symbols
Wernicke area		Concerned with interpretation of auditory sensation Concerned with understanding auditory information and sending it to Broca area

■ APHASIA

Aphasia is defined as the loss or impairment of speech due to brain damage (in Greek, aphasia = without speech). It is an acquired disorder and it is distinct from developmental disorders of speech or other speech disorders like dysarthria. Aphasia is not due to paralysis of muscles of articulation. It is due to damage of speech centers.

Damage of speech centers impairs the expression and understanding of spoken words. It also affects reading and writing. Speech function is localized to left hemisphere in most of the people.

Aphasia may be associated with other speech disorders, which also occur due to brain damage.

Causes for Aphasia

Usually aphasia occurs due to damage of one or more speech centers, which are situated in cerebral cortex (Table 162.4). Damage of speech centers occurs due to:

1. Stroke
2. Head injury
3. Severe blow to head
4. Cerebral tumors
5. Brain infections
6. Degenerative diseases.

TABLE 162.4: Features and causes of different types of aphasia

Type of aphasia	Features	Cause
Broca aphasia	Non-fluent speech problem	Lesion in left frontal lobe
Wernicke aphasia	Speech without any meaning	Lesion in left temporal lobe
Global aphasia	Combined features of Broca aphasia and Wernicke aphasia	Widespread lesion in speech areas of left cerebral hemisphere
Nominal aphasia	Inability to name the familiar objects	Lesion in posterior temporal and inferior parietal gyri
Motor aphasia	Difficulty in uttering individual words	Defect in pathway between left speech center and precentral cortex
Auditory aphasia	Inability to understand spoken words	Lesion in secondary auditory area
Visual aphasia	Inability to understand written symbols	Lesion in secondary visual area
Agraphia	Inability to write	Defect in pathway between cortical areas concerned with writing