

Memory

Dr. Rawan Masri

What is **MEMORY**?

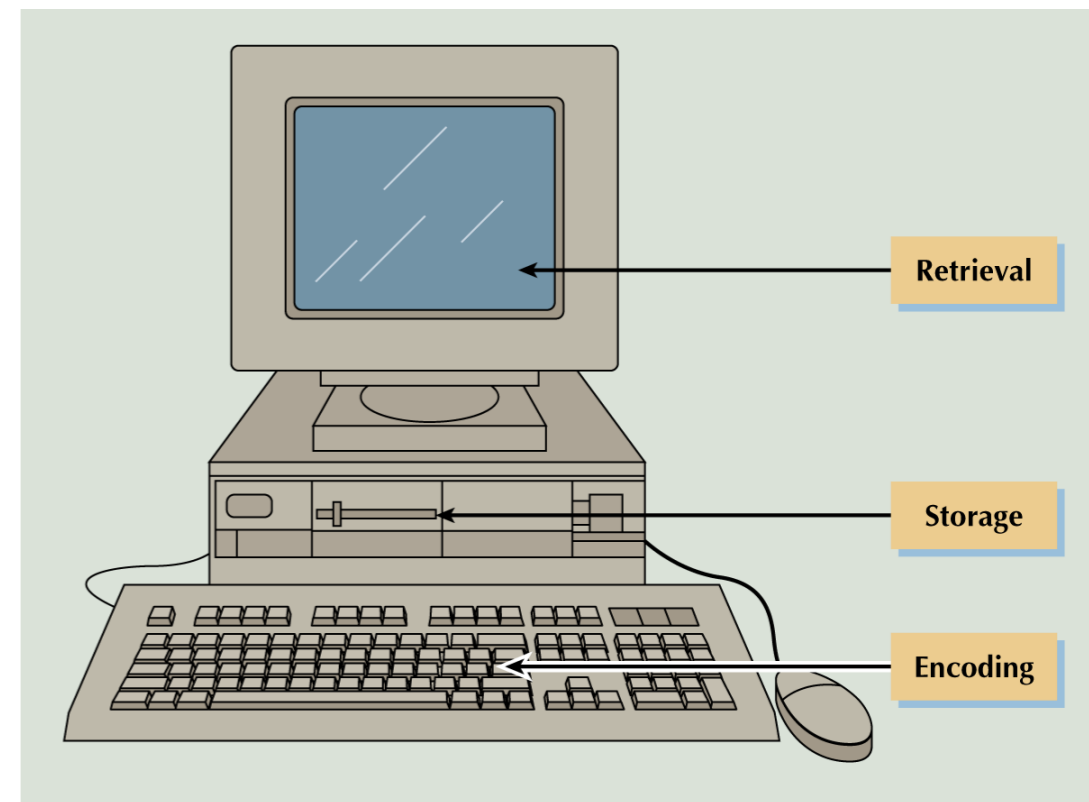
- **Memory** – internal record of some prior event or experience; a set of mental processes that receives, encodes, stores, organizes, alters, and retrieves information over time

The clinical assessment of memory should test three periods. Immediate memory functions over a period of seconds; recent memory applies on a scale of minutes to days; and remote memory encompasses months to years.

A related concept, incorporating immediate and recent memory, is working memory, which is the ability to store information for several seconds, whereas other, related cognitive operations take place on this information.

Integrated Model Concepts

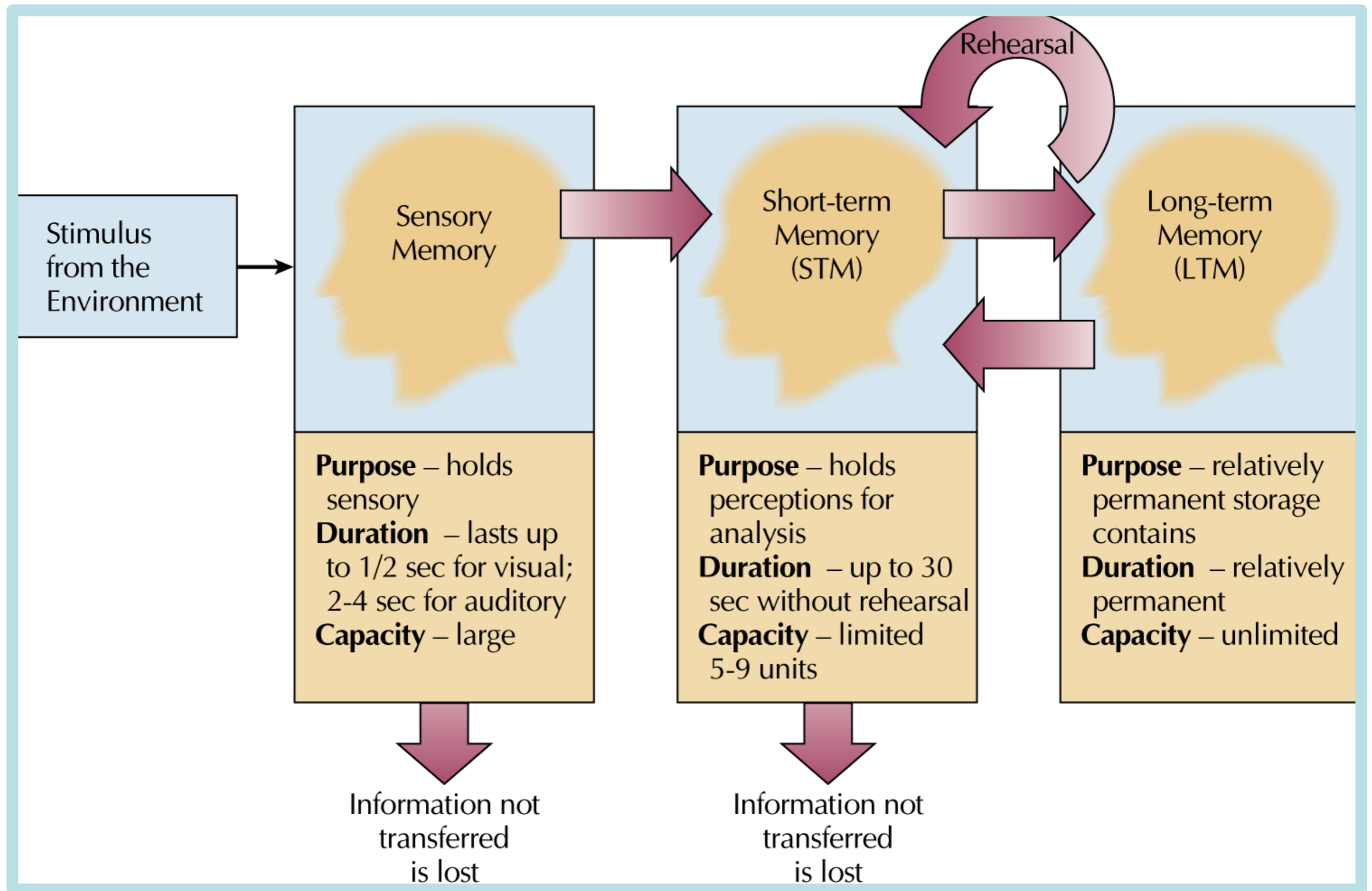
- These are the processes involved in memory:
- **Encoding** – process of translating info into neural codes (language) that will be retained in memory. Information is Developed into a usable form.
- **Storage** – the process of retaining neural codes info over time. After information has been encoded , it is stored for later use.
- **Retrieval** – the process of recovering info from memory storage; when memory is brought to our awareness



Three Stages of Memory

- Stage 1 - Sensory Memory is a brief representation of a stimulus while being processed in the sensory system
- Stage 2 - Short-Term Memory (STM) is working memory
 - Limited capacity (7 items)
 - Duration is about 30 seconds
- Stage 3 - Long-Term Memory (LTM) is large capacity and long duration

Overview of Memory Model



Sensory Memory

It is the first stage after information gets to a sense organ. It is large, accurate, but very brief, lasting about a second. It is a temporary storage buffer between sensory input and the next stage, short term memory.

During every moment of your existence, your senses are constantly taking in an enormous amount of information about what you see, feel, hear, and taste. While this information is important, there is simply no way to remember each and every detail about what you experience at every moment. Instead, your sensory memory creates something of a quick "snapshot" of the world around you, allowing you to briefly focus your attention on relevant details. We can then transfer important details into the next stage of memory, which is known as short-term memory

The different types of sensory memory have also been shown to have slightly different durations.

Iconic memory, also known as visual sensory memory, involves a very brief image. This type of sensory memory typically lasts for about one-quarter to one-half of a second.

Echoic memory, also known as auditory sensory memory, involves a very brief memory of sound a bit like an echo. This type of sensory memory can last for up to three to four seconds.

Haptic memory, also known as tactile memory, involves the very brief memory of a touch. This type of sensory memory lasts for approximately two seconds..

Short term Memory

Short-term memory, also known as working or active memory, is the information we are currently aware of or thinking about. The information found in short-term memory comes from paying attention to sensory memories.

Short-term memory is very brief. Most of the information kept in short-term memory will be stored for approximately 20 to 30 seconds,

When short-term memories are not rehearsed or actively maintained, they last mere seconds.

Short-term memory is limited. It is commonly suggested that short-term memory can hold seven plus or minus two items.

For example, imagine that you are trying to remember a phone number. The other person rattles off the phone number, and you make a quick mental note. Moments later you realize that you have already forgotten the number. Without rehearsing or continuing to repeat the number until it is committed to memory, the information is quickly lost from short-term memory.

However, information in short-term memory is also highly susceptible to interference. Any new information that enters short-term memory will quickly displace any old information.

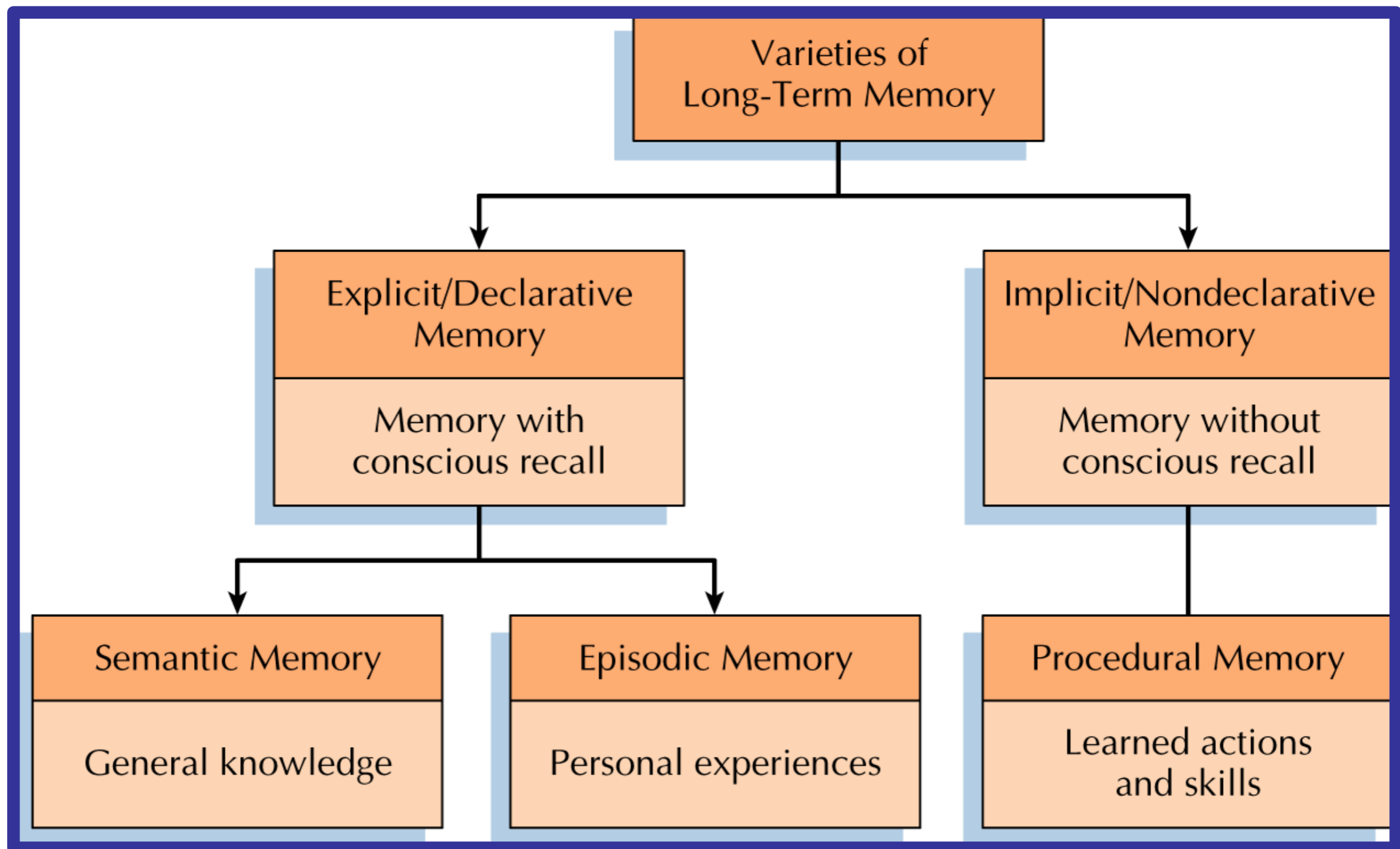
While many of our short-term memories are quickly forgotten, attending to this information allows it to continue the next stage — long-term memory.

Long Term Memory

Long-term memory refers to the storage of information over an extended period. If you can remember something that happened more than just a few moments ago whether it occurred just hours ago or decades earlier, then it is a long-term memory. This information is largely outside of our awareness but can be called into working memory to be used when needed.

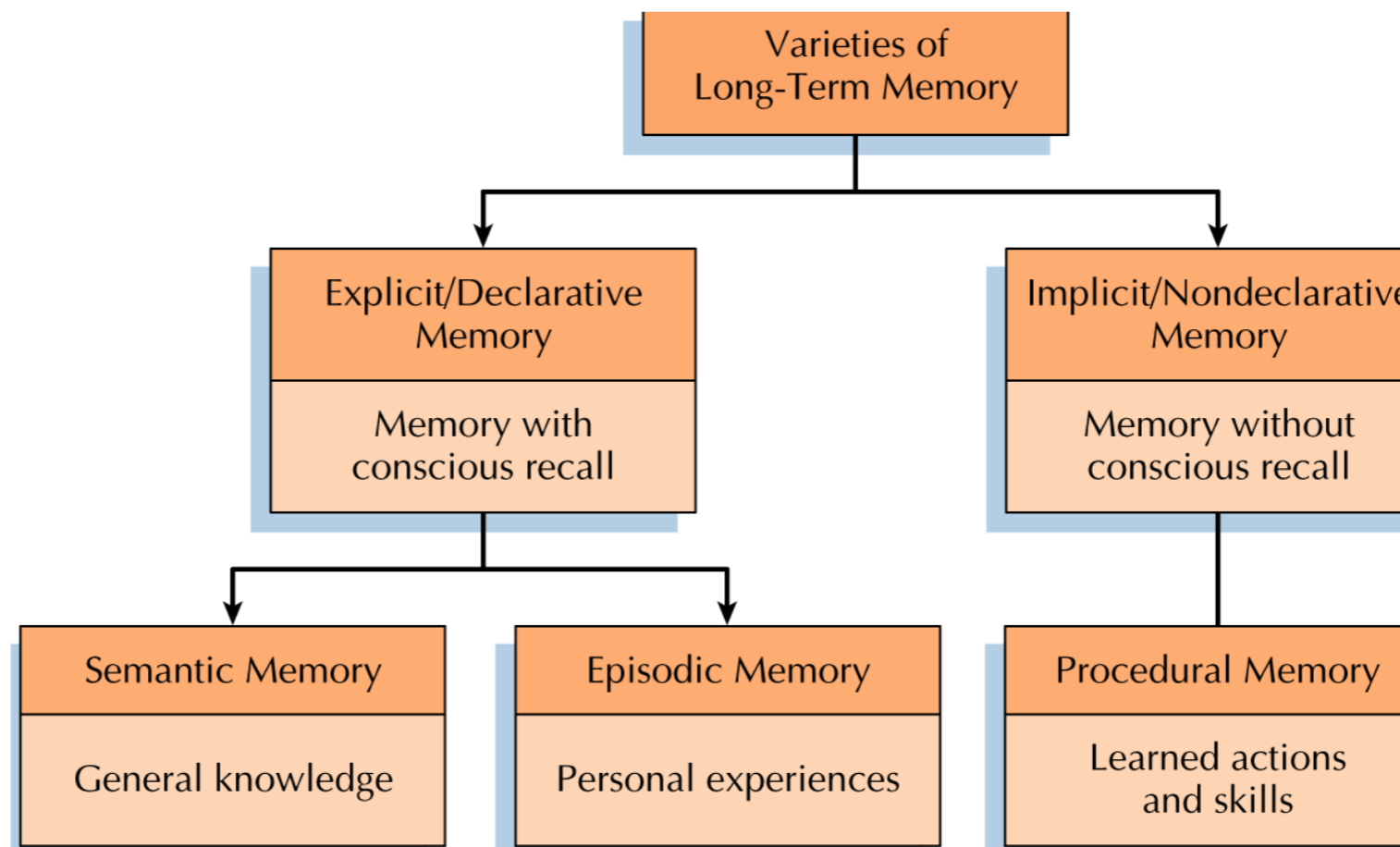
Through the process of association and rehearsal, the content of short-term memory can become long-term memory. While long-term memory is also susceptible to the forgetting process, long-term memories can last for a matter of days to as long as many decades.

Overview of LTM



Varieties of LTM

- Two types of Explicit LTM
 - Semantic memory refers to factual information.
 - Episodic memory refers to autobiographical information as to where and when an event happened.



Implicit Memory

Implicit memories are those that are mostly unconscious. This type of memory includes procedural memory, which involves memories of body movement and how to use objects in the environment. How to drive a car or use a computer are examples of procedural memories.

Organization of LTM

- Retrieval Cue – a clue or prompt that helps stimulate recall and retrieval of a stored piece of information from long-term memory_
 - 2 types:
 1. Recognition
 2. Recall

Memory Measures

- Recognition is when a specific cue (face or name) is matched against LTM
- Recall is when a general cue is used to search memory
- Relearning - situation where person learns material a second time.
 - Quicker to learn material 2nd time
- Tip-of the tongue phenomenon: person can't easily recall the item, but shows some recall for its characteristics ("...it begins with the letter")

Anatomy of Memory

Three brain structures are critical to the formation of memories : the medial temporal lobe, certain diencephalic nuclei (mammillary nuclei in the hypothalamus, the dorsomedial nucleus of the thalamus, the anterior nucleus, the internal medullary lamina, and the mamillo-thalamic tract), and the basal forebrain. The medial temporal lobe houses the hippocampus, an elongated, highly repetitive network. The amygdala is adjacent to the anterior end of the hippocampus. The amygdala has been suggested to rate the emotional importance of an experience and to activate the level of hippocampal activity accordingly. The hippocampus is also involved in memory consolidation, the slow process by which memories are converted from short to long term memory .

The Hippocampus and the amygdala are both involved in memory consolidation.

Damage to the hippocampus and surrounding area can cause anterograde amnesia, the inability to form new memories. This implies that the hippocampus is important not only for storing cognitive maps, but for encoding memories.

Anatomy of Memory

Unlike the hippocampus which is involved in the encoding of complex memories, the cerebellum plays a role in the learning of procedural memory, and motor learning.

Individuals with [transient global amnesia](#) that have difficulty forming new memories and/or remembering old events may sometimes retain the ability to perform complex musical pieces, suggesting that procedural memory is completely dissociated from conscious memory, also known as [explicit memory](#).

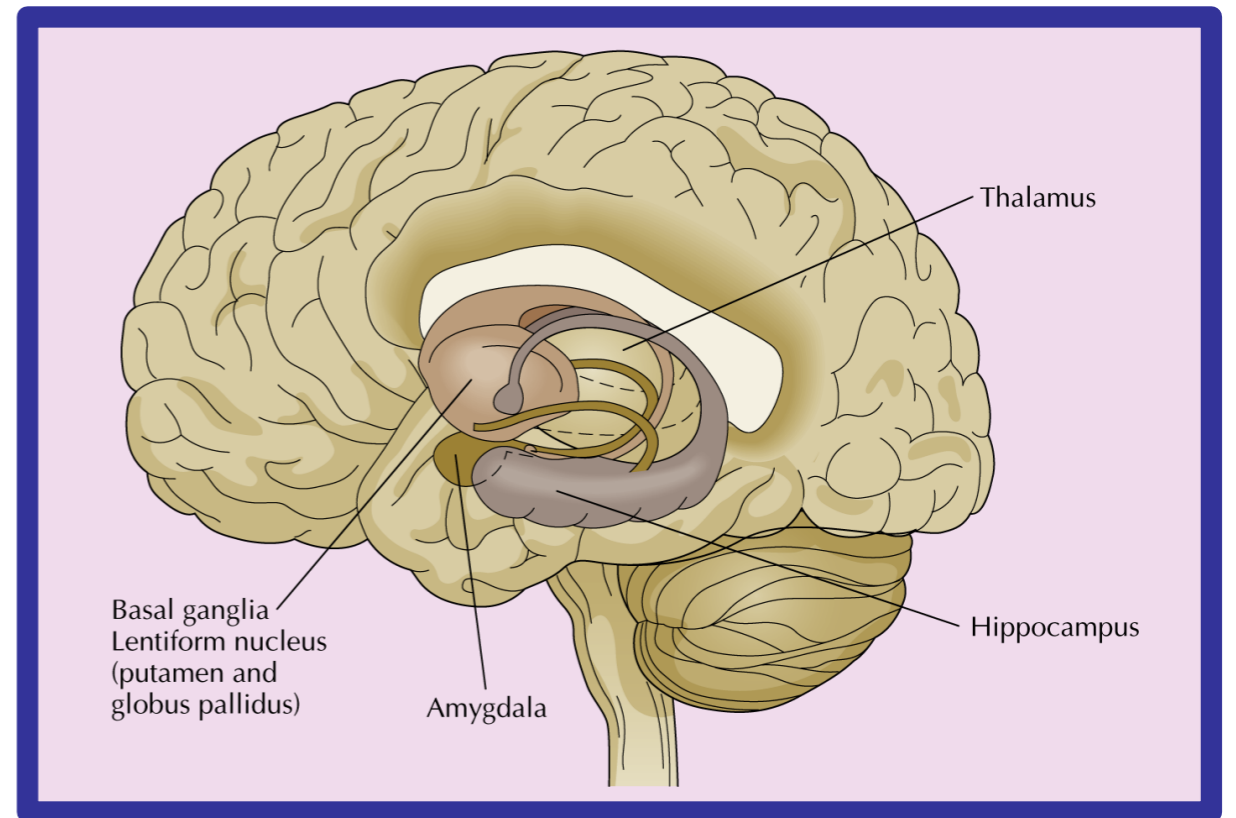
The frontal lobes are important in working memory

Anatomy of Memory

Memorized motor acts initially require activation of the medial temporal lobe. With practice, however, the performance of ever-larger segments of an act necessary to achieve a goal become encoded within discrete areas of the premotor and parietal cortices, particularly the left parietal cortex, with the result that a much more limited activation of the cortex is seen during highly skilled acts, and the medial temporal lobe is bypassed. This process is called the **corticalization of motor commands**. In lay terms, the process suggests a neuroanatomical basis for the adage "practice makes perfect."

Within the diencephalon, the dorsal medial nucleus of the thalamus and the mamillary bodies appear necessary for memory formation. These two structures are damaged in thiamine deficiency states usually seen in chronic alcoholics, and their inactivation is associated with Korsakoff's syndrome. This syndrome is characterized by severe inability to form new memories and a variable inability to recall remote memories.

Anatomy of Memory



Amygdala: emotional memory and memory consolidation

Basal ganglia & cerebellum: memory for skills, habits and CC responses

Hippocampus: memory recognition, spatial, episodic memory, laying down new declarative long-term memories

Thalamus, formation of new memories

Cortical Areas: encoding of factual memories, storage of episodic and semantic memories, skill learning.

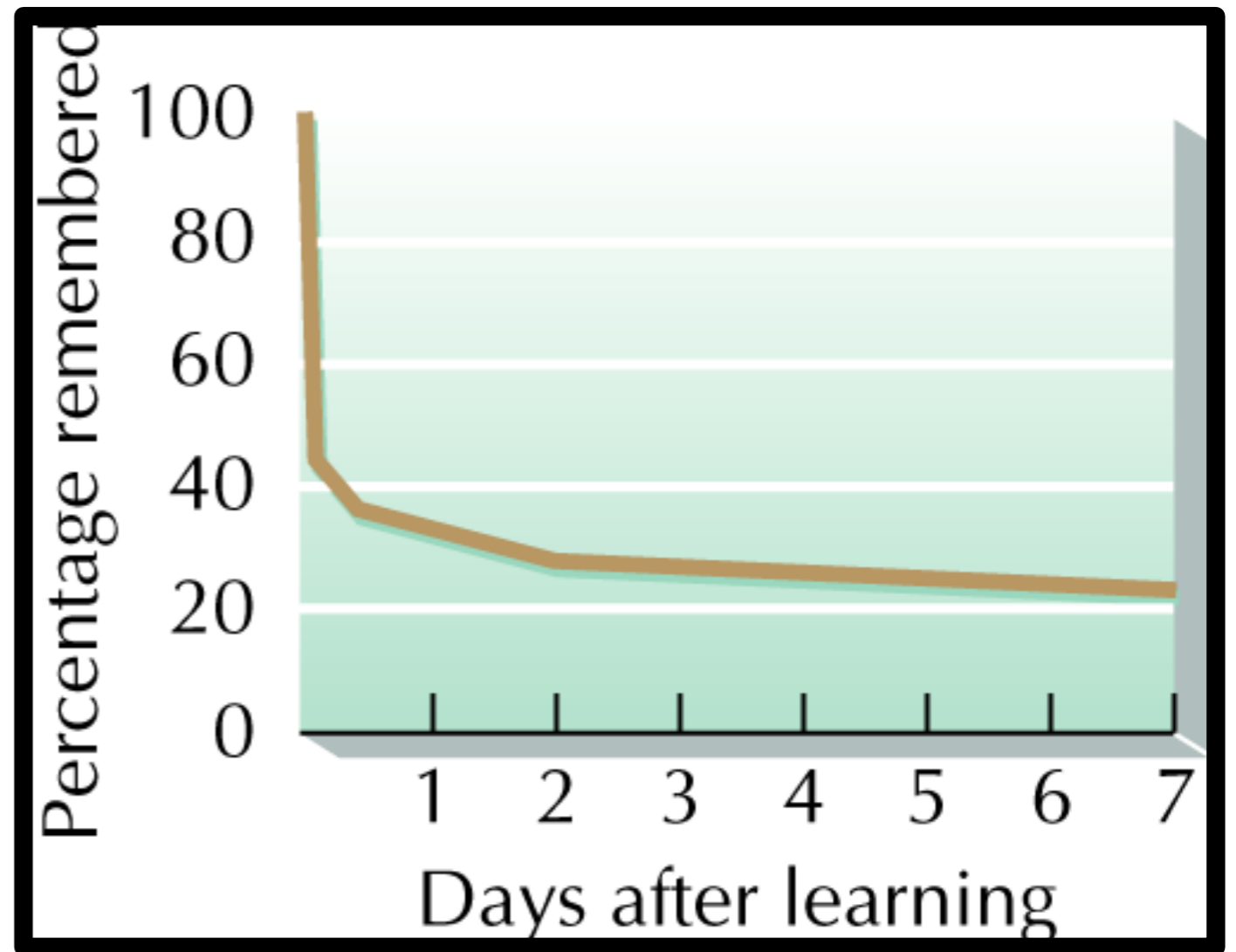
The most common clinical disorder of memory is **Alzheimer's disease** which is characterized pathologically by the degeneration of neurons and their replacement by senile plaques and neurofibrillary tangles.

Initially, the parietal and temporal lobes are affected, with relative sparing of the frontal lobes leading to early loss of memory, which is a temporal lobe function and syntactical language comprehension and visuospatial organization, functions that rely on the parietal lobe. In contrast, personality changes, which reflect frontal lobe function, are relatively late consequences of Alzheimer's disease.

In contrast, **Pick's disease**, first affects the frontal lobes while sparing the temporal and parietal lobes. Disinhibition, personality changes and impaired language expression, which are signs of frontal dysfunction, appear early, with relatively preserved language comprehension and memory.

Forgetting

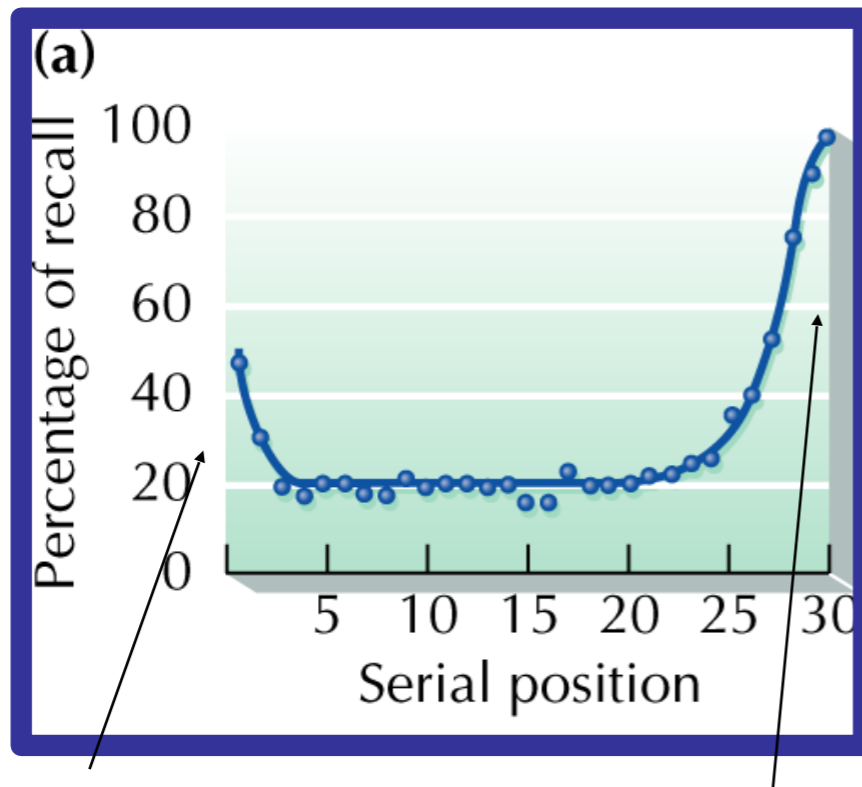
- **Forgetting** is the inability to recall previously learned information



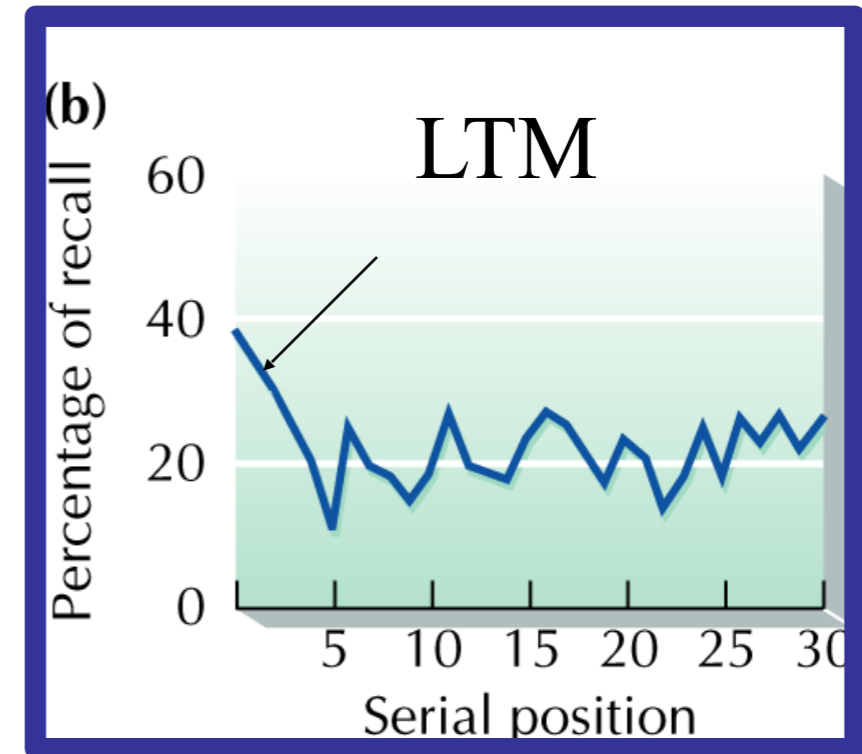
 Forgetting rate is steep just after learning and then becomes a gradual loss of recall

Serial Position Effect

Recall immediately after learning



Recall several hours after learning



Recall from
LTM

Recall from
STM

Primacy effect – remembering things at the beginning of a list better than middle

Recency Effect – remembering things at the end of a list better than middle

Serial Position Effect

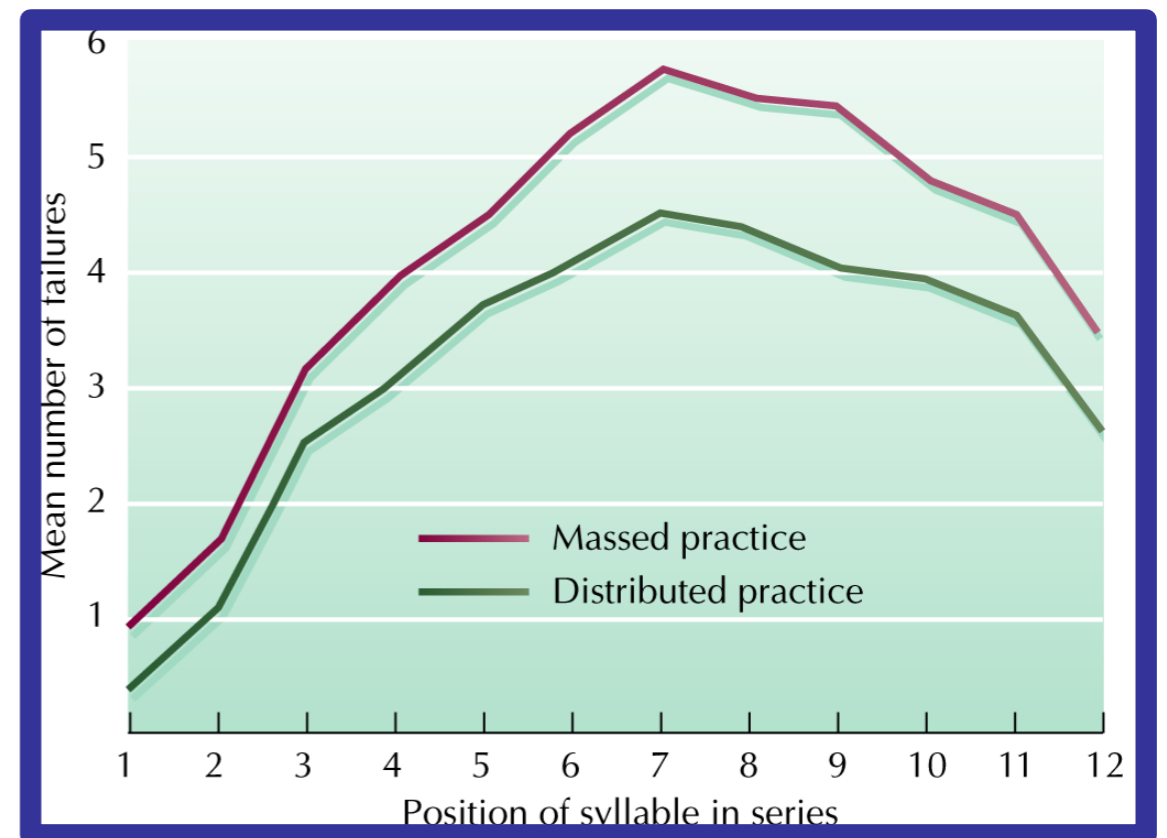
Murdock asked participants to learn a list of words that varied in length from 10 to 40 words and free recall them. Each word was presented for one to two seconds.

He found that the probability of recalling any word depended on its position in the list (its serial position). Words presented either early in the list or at the end were more often recalled, but the ones in the middle were more often forgotten. This is known as serial position effect.

Murdock suggested that words early in the list were put into **long term memory** (primacy effect) because the person has time to rehearse each word acoustically. Words from the end of the list went into **short term memory** (recency effect) which can typically hold about 7 items.

Study Strategies

- **Distributed practice** refers to spacing learning periods in contrast to **massed practice** in which learning is “crammed” into a single session
- **Distributed practice** leads to better retention

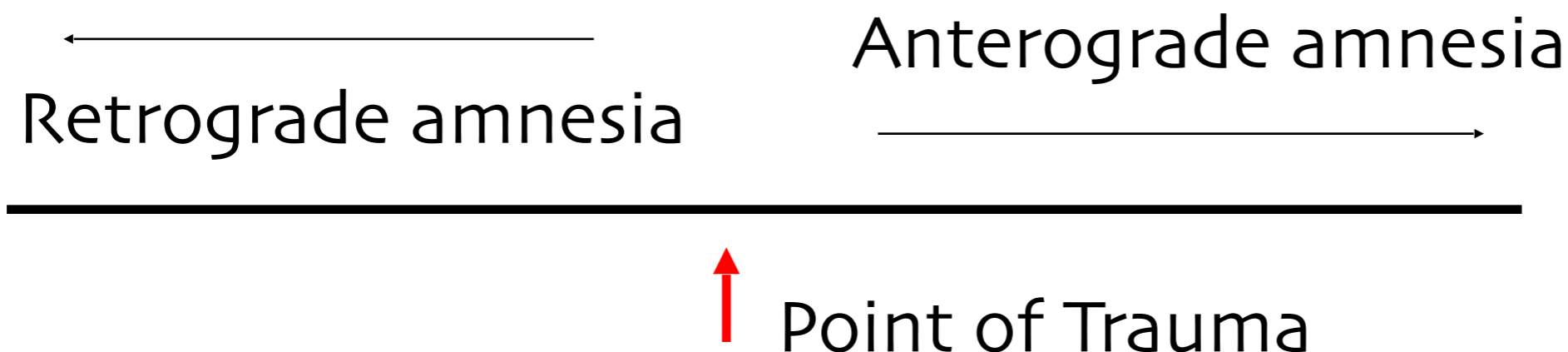


Theories of Forgetting

- **Proactive interference**: old information interferes with recall of new information
- **Retroactive interference**: new information interferes with recall of old information
- **Decay theory**: memory trace fades with time
- **Motivated forgetting**: involves the loss of painful memories (protective memory loss)
- **Retrieval failure**: the information is still within LTM, but cannot be recalled because the retrieval cue is absent

Amnesia

- Amnesia is forgetting produced by brain injury or by trauma
 - **Retrograde amnesia** refers to problems with recall of information prior to a trauma . Retrograde deficits often have a temporal gradient, following a principle known as Ribot's law; deficits are most severe for information that was most recently learned.
 - **Anterograde amnesia** refers to problems with recall of information after a trauma



The End