End Semester Preparation

Summary of Vishnu's Slides (Memory)

Definition & Components of Memory

- **Memory**: the ability to store and retrieve information over time
- There are three key components of memory:
  - **Acquisition/Encoding**: the process by which we transform what we perceive, think, or feel into a memory.
  - **Storage**: the process of maintaining information in memory over time
  - **Retrieval**: the process of bringing to mind information that has been previously encoded and stored

Modal Model of Memory

The Modal Model of Memory, proposed by Richard Atkinson and Richard Shiffrin in 1968, is a widely accepted model that describes how information is processed and stored in memory. It consists of three main components: sensory memory, short-term memory (STM), and long-term memory (LTM).

1. Sensory Memory: Sensory memory is the first stage of the memory process and involves the brief retention of sensory information from the environment. It is divided into different types, such as iconic memory for visual information and echoic memory for auditory information. Sensory memory has a large capacity, but the duration of retention is very short, typically lasting only a few seconds.

Example: When you look at a fireworks display, the bright and colorful visual stimuli you see are held briefly in your iconic memory, allowing you to perceive the ongoing display as a continuous flow of images.

2. Short-term Memory (STM): STM, also known as working memory, is the second stage of the memory process and involves the temporary retention and manipulation of information. STM has limited capacity and duration, and it is responsible for holding information in our conscious awareness for brief periods of time, typically around 20-30 seconds, unless it is rehearsed or encoded into long-term memory.

Example: Remembering a phone number that you just heard and keeping it in your mind while you dial the number is an example of STM. If you don't rehearse or actively process the information, it is likely to fade from STM and be forgotten.

3. Long-term Memory (LTM): LTM is the third stage of the memory process and involves the relatively permanent storage of information over longer periods of time, ranging from minutes to a lifetime. LTM has virtually unlimited capacity and can store various types of information, including facts, events, skills, and concepts.

Example: Remembering your childhood home address, your first day of school, or how to ride a bike are examples of information stored in long-term memory. These memories can last for years or even a lifetime, depending on the strength of the memory and the processes involved in its consolidation.

The Modal Model of Memory suggests that information initially enters sensory memory, then moves to STM for temporary processing, and can be transferred to LTM for long-term storage through processes like rehearsal and encoding. Retrieval processes can then bring information back from LTM to STM or to conscious awareness. The model has provided a framework for understanding how information is processed and stored in memory, and it has been influential in shaping our understanding of human memory processes.

Important updates to Modal Model view of Memory

While the Modal Model of Memory proposed by Atkinson and Shiffrin has been widely influential in our understanding of memory processes, there have been several updates and modifications suggested by subsequent research. Some important updates to the original model include:

1. Multiple Memory Systems: The original model proposed a linear flow of information from sensory memory to short-term memory and then to long-term memory. However, subsequent research has shown that memory is a complex and multifaceted process involving multiple memory systems that work in parallel. For example, the distinction between declarative memory (memory for facts and events) and procedural memory (memory for skills and habits) has been recognized, and it has been suggested that these types of memories are processed and stored differently in the brain.

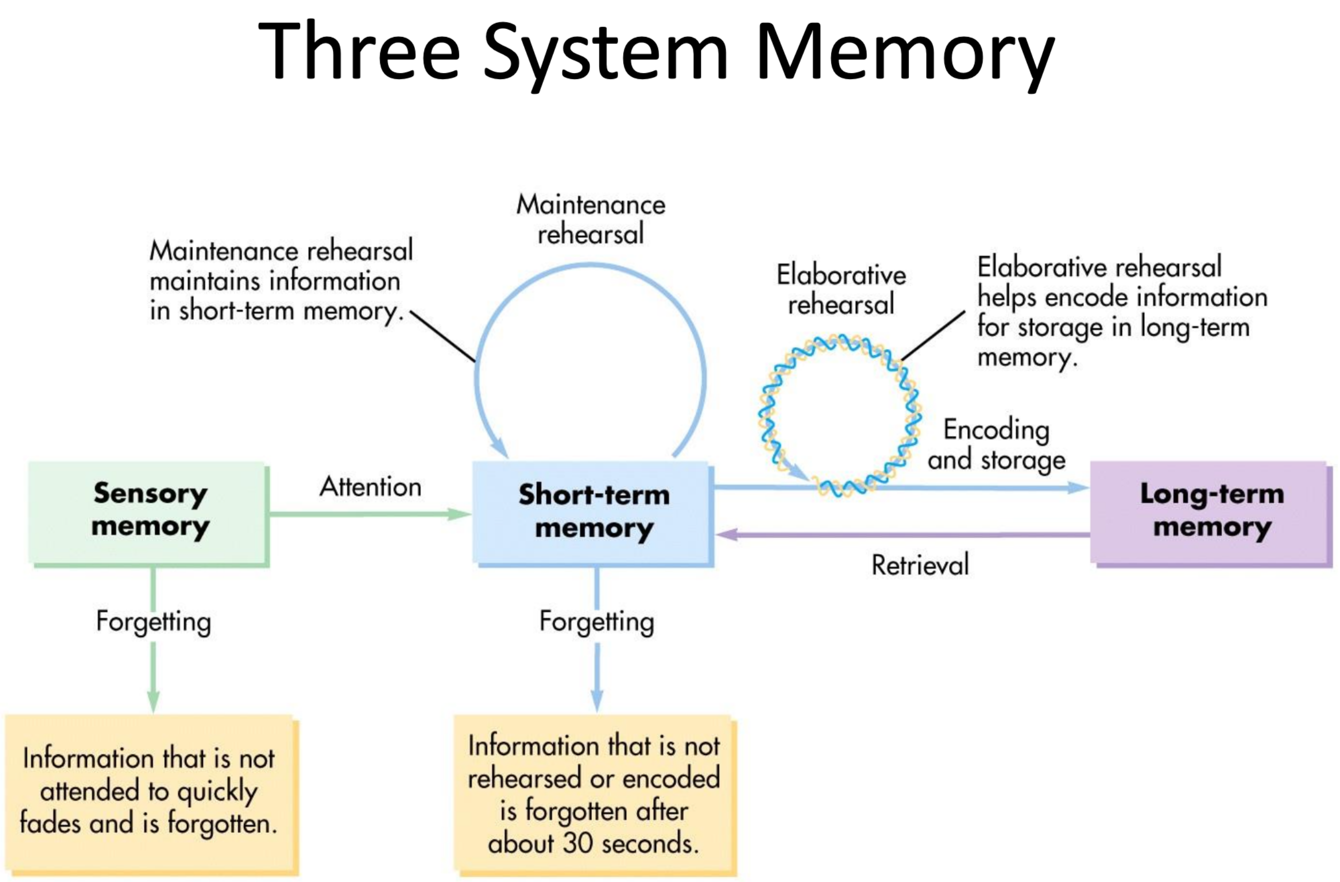
2. Working Memory: The concept of working memory, which is closely related to short-term memory in the original model, has gained prominence as a crucial component of memory processes. Working memory refers to the temporary storage and manipulation of information needed for ongoing cognitive tasks, such as problem-solving, decision-making, and language comprehension. It involves not only the retention of information but also active cognitive processes, such as attention, rehearsal, and executive functions, which play a critical role in memory performance.

3. Levels of Processing: The original model emphasized the structural aspects of memory (sensory memory, short-term memory, and long-term memory), whereas subsequent research has highlighted the importance of the depth of processing in memory. The Levels

of Processing theory proposed by Craik and Lockhart suggests that the extent to which information is processed deeply (i.e., semantically or meaningfully) during encoding influences its later retrieval. This suggests that the quality of processing, rather than the mere duration of retention, plays a significant role in memory performance.

4. Memory Consolidation: Research has shown that memories are not instantly consolidated into long-term memory, but instead, this process takes time. Memory consolidation refers to the process by which newly acquired information is gradually integrated and stabilized in long-term memory. It has been suggested that memory consolidation involves multiple stages, including synaptic consolidation (involving changes at the cellular level in the brain) and systems consolidation (involving the reorganization of memory representations in different brain regions over time).
5. Memory Retrieval: The original model focused on the encoding and storage of information, but subsequent research has highlighted the importance of memory retrieval processes. Memory retrieval refers to the process of accessing stored information from memory. Research has shown that retrieval cues, context, and the act of retrieval itself can influence memory performance and that memory is a reconstructive process influenced by various factors during retrieval, such as interference, biases, and suggestibility.

Memory Storage



The three main kinds of memory storage are sensory memory, short-term memory (STM), and long-term memory (LTM), each serving different roles in the process of memory formation.

- Sensory Memory: Sensory memory is the first stage of memory processing and refers to the brief retention of sensory information from the environment. It has a very short duration and a large capacity, allowing us to process and make sense of the constant stream of sensory input that we receive from our senses.
    - Iconic Memory: Iconic memory is a type of sensory memory that involves the retention of visual information. It lasts for a very brief duration, typically around 0.5 to 1 second, and allows us to perceive the visual world as a continuous flow of images. For example, when you see a sparkler being lit, the visual image of the bright sparks trailing behind it is briefly held in your iconic memory.
    - Echoic Memory: Echoic memory is a type of sensory memory that involves the retention of auditory information. It lasts slightly longer than iconic memory, typically around 2 to 4 seconds, and allows us to retain and process auditory stimuli. For example, when someone speaks to you, the sound of their voice is held briefly in your echoic memory, allowing you to process and understand the spoken words.
- Short-term Memory (STM): Short-term memory, also known as working memory, is the second stage of memory processing and involves the temporary retention and manipulation of information. STM has limited capacity and duration, and it is responsible for holding information in our conscious awareness for brief periods of time, typically around 20-30 seconds, unless it is rehearsed or encoded into long-term memory.
    - Capacity of STM: The capacity of STM is limited, and it is generally believed to be able to hold around 5 to 9 items or chunks of information at a time. This capacity can vary depending on the individual and the nature of the information being processed.
    - Rehearsal: Rehearsal is a process that helps to maintain information in STM. It involves repeating or mentally manipulating the information to prevent it from fading away. Rehearsal can be done through different strategies, such as verbal repetition or elaborative rehearsal, which involves relating new information to existing knowledge.
- Long-term Memory (LTM): Long-term memory is the third stage of memory processing and involves the relatively permanent storage of information over longer periods of time, ranging from minutes to a lifetime. LTM has virtually unlimited capacity and can store various types of information, including facts, events, skills, and concepts.
    - Declarative Memory: Declarative memory refers to memory for facts and events that can be consciously recalled and expressed in words. It is further divided into two subtypes: episodic memory, which involves the memory of specific events and

experiences, and semantic memory, which involves the memory of general knowledge and concepts. For example, remembering your first day of school or knowing the capital of a country are examples of declarative memory.

- Procedural Memory: Procedural memory refers to memory for skills and habits that are not consciously controlled but are expressed through actions and behaviors. It involves the memory of motor skills, such as riding a bike or playing an instrument, and cognitive skills, such as typing or solving a puzzle.
- Retrieval from LTM: Retrieval from LTM is the process of accessing stored information from long-term memory. It can be influenced by various factors, such as the strength of the memory, retrieval cues, context, and interference.

In summary, sensory memory provides a brief retention of sensory information, STM holds information temporarily in conscious awareness, and LTM is responsible for the relatively permanent storage of information over longer periods of time. These three main types of memory storage work together to allow us to encode, store, and retrieve information, forming the basis of our overall memory system.

Sensory memory serves as the initial filter for incoming sensory information, STM allows for temporary processing and manipulation of information, and LTM provides the long-term storage of memories that can last a lifetime. However, it's important to note that our understanding of memory and its different storage systems is constantly evolving as research continues to uncover new insights into the complexities of human memory.

Comparision & Contrast between three systems of memory

Three System Memory

	Sensory Memory	Short-term Memory	Long-term Memory
Function	Temporary storage of sensory info	Storage of info currently being used	Storage of info indefinitely
Span	High	Limited (*Chunking)	Unlimited
Duration	Less than 1 sec or a few sec	Less than 20 sec	For a lifetime

- Span
  - Sensory Memory: Sensory memory has a large span, allowing us to briefly retain a vast amount of sensory information from the environment. However, its capacity is limited to the information received from the specific sensory modality (e.g., visual, auditory) at any given moment.
  - STM: STM has a limited span, typically holding around 5 to 9 items or chunks of information at a time. This capacity can vary depending on the individual and the nature of the information being processed.
  - LTM: LTM has virtually unlimited span, allowing for the storage of a vast amount of information over longer periods of time, ranging from minutes to a lifetime.
- Duration
  - Sensory Memory: Sensory memory has a very short duration, lasting only for a brief period of time (e.g., a few milliseconds to a few seconds).
  - STM: STM has a relatively short duration, typically lasting around 20-30 seconds, unless the information is rehearsed or encoded into LTM.
  - LTM: LTM has a relatively long duration, potentially lasting a lifetime, although some memories may fade or be subject to forgetting over time.

- Function
    - Sensory Memory: Sensory memory serves as a temporary storage for incoming sensory information, allowing us to briefly retain and process sensory input from the environment to make sense of the world around us.
    - STM: STM serves as a temporary workspace for processing and manipulating information, allowing for conscious awareness and active mental processes, such as decision-making, problem-solving, and planning.
    - LTM: LTM is responsible for the long-term storage of information, allowing for the formation and retention of memories that can last a lifetime. LTM is further divided into declarative memory (for facts and events) and procedural memory (for skills and habits), serving different functions in our memory system.

In summary, sensory memory has a large span, but a very short duration, serving as a temporary buffer for sensory information. STM has a limited span and duration, serving as a temporary workspace for conscious processing of information. LTM has virtually unlimited span and duration, allowing for the long-term storage of information and the formation of memories. Each system of memory serves a unique function in the overall process of memory formation, retention, and retrieval.

Sensory Memory

Sensory memory is the initial stage of memory processing that involves the brief retention of sensory information from the environment. It acts as a buffer that holds incoming sensory input for a short period of time before it is either forgotten or transferred to short-term memory (STM) for further processing. Sensory memory allows us to briefly retain and process sensory information, such as visual or auditory stimuli, in order to make sense of the world around us.

Selective attention plays a critical role in sensory memory. It refers to the cognitive process by which we selectively focus on specific sensory inputs while filtering out others. When we are exposed to sensory stimuli, not all of the information is processed equally. Our attention selectively focuses on certain aspects of the sensory input based on our interests, goals, and cognitive processes.

The attentional gate is a mechanism that determines what information from sensory memory is transferred to STM for further processing. It acts as a filter, allowing only a portion of the sensory input to be processed further while the rest is quickly forgotten. The information that passes through the attentional gate is transferred to STM for more elaborate processing and potential encoding into long-term memory.

The Sperling Task, conducted by George Sperling in 1960, is a classic experiment that provides evidence for the existence of sensory memory. In the Sperling Task, participants are briefly presented with a matrix of letters or numbers and are asked to recall as many of the items as possible. Sperling found that participants were able to recall a limited number of items from the matrix, typically around 4-5 items, suggesting the capacity of STM. However, when a cue was given after the matrix disappeared, participants were able to recall more items from the cued row, suggesting that the entire matrix was initially stored in sensory memory, but decayed rapidly before it could be fully transferred to STM. This experiment supports the idea that sensory memory holds a large amount of information but has a short duration, and the attentional gate determines what information is processed further into STM.

Sperling Task

In Sperling's classic study conducted in 1960, participants were presented with a matrix of letters for a very brief duration of 1/20th of a second. Immediately following the presentation, a low, medium, or high tone was presented as a cue, indicating which row of the matrix the participants should report from their memory.

The findings of the study revealed that participants were able to recall the letters from the cued row with near-perfect accuracy. This suggested that the sensory memory, specifically the iconic memory (visual sensory memory), was able to hold a large amount of information for a very short duration of time, but the information quickly decayed if not attended to or processed further.

This study provided evidence for the existence of sensory memory, a type of memory that briefly holds incoming sensory information before it is processed or lost. It also demonstrated the importance of selective attention, as the cue (tone) helped to direct attention to a specific row, allowing for more accurate recall. Overall, the Sperling task has been influential in shaping our understanding of sensory memory and the role of attention in memory processes.

Chunking & Organisation - Enlarging Span of STM

Chunking and organization are cognitive strategies that can be used to increase the amount of information that can be held in short-term memory (STM). STM has limited capacity, typically estimated to be around 7 ± 2 items, but these strategies can help maximize the amount of information that can be temporarily stored in STM.

Chunking refers to the process of grouping individual items or bits of information into larger, meaningful units or "chunks." For example, instead of trying to remember a long list of unrelated numbers (e.g., 149271855912), chunking can be used to group them into meaningful units (e.g., 14-92-71-85-59-12). By organizing the information into chunks, each chunk is treated as a single item, reducing the number of items that need to be remembered and increasing the capacity of STM.

Organization involves structuring or arranging information in a meaningful way. For example, instead of remembering a random list of unrelated words, organizing them into categories or using a hierarchical structure can facilitate memory. For instance, if given a list of fruits (e.g., apple, banana, orange) and animals (e.g., dog, cat, elephant), organizing them into categories (e.g., fruits vs. animals) or into a hierarchical structure (e.g., fruits -> apple, banana, orange; animals -> dog, cat, elephant) can help in encoding and retrieving the information more efficiently from STM.

Both chunking and organization help in reducing the cognitive load on STM by allowing more information to be encoded and processed as meaningful units, rather than individual items. These strategies can effectively increase the amount of information that can be held in STM and improve short-term memory performance by facilitating encoding, storage, and retrieval processes.

Brown Peterson Task & Short Term Memory

The Brown-Peterson task is a classic experimental paradigm used to study the duration of short-term memory (STM) and the process of forgetting. It was developed by Lloyd R. Peterson and Margaret Jean Brown in 1958.

In the Brown-Peterson task, participants are presented with a series of stimuli, such as words or letters, and are instructed to remember them. After a short delay, typically filled with an interference task, participants are then asked to recall the original stimuli. The interference task is used to prevent rehearsal, which is the process of repeating or mentally refreshing information in STM, thus preventing it from being transferred to long-term memory (LTM).

The key idea of the Brown-Peterson task is to investigate the decay of information in STM over time. The longer the delay between the presentation of the stimuli and the recall task, the more likely the information in STM will decay or fade away. The task measures the duration of STM, or how long information can be held in STM without rehearsal or further processing.

The Brown-Peterson task has been widely used in memory research to study various factors that affect the duration of STM, such as the length of the delay interval, the type of interference task, and individual differences in working memory capacity. It has provided important insights into the temporal dynamics of STM and the process of forgetting, shedding light on how information is maintained or lost from STM over time.

Reconstructive view of memory

The reconstructive view of memory is a psychological theory that proposes that memories are not stored in the brain like recordings of past events, but rather they are reconstructed or re-created each time they are recalled. According to this view, memory is a dynamic process that involves the integration of various cognitive processes such as perception, attention, interpretation, and inference, which can influence the accuracy and reliability of a recalled memory.

The reconstructive view of memory was first proposed by psychologists Frederic Bartlett and Sir Frederic Charles Bartlett in the 1930s, and it challenges the traditional "storage and retrieval" model of memory, which suggests that memories are stored as fixed traces in the brain that can be retrieved intact later on. Instead, the reconstructive view suggests that when we recall a memory, we don't retrieve an exact replica of the original event, but rather we reconstruct the memory by piecing together various fragments of information stored in our brain.

According to the reconstructive view, memory is influenced by a variety of factors, including the context in which the memory is being recalled, our personal beliefs, expectations, emotions, and other cognitive biases. For example, when we recall an event, we may unintentionally fill in gaps in our memory with information from other sources or interpret the memory in light of our current beliefs or emotions, leading to distortions or inaccuracies in the recalled memory.

One well-known example of the reconstructive view of memory is the misinformation effect, where the introduction of misleading information after an event can alter a person's memory of that event. Studies have shown that when people are exposed to misleading information, such as through leading questions or suggestive comments, it can influence their subsequent recall of the original event, leading to false memories or distorted memories.

Overall, the reconstructive view of memory suggests that our memories are not fixed or infallible records of the past, but rather they are dynamic and subject to various influences during the process of recall. It highlights the constructive nature of memory, where memories are reconstructed based on a combination of stored information and current cognitive processes, and it has important implications for understanding the fallibility and malleability of human memory.

Example of memory reconstruction

Sure! Here's an example of the reconstructive view of memory:

Imagine you witnessed a car accident on a busy street. A week later, you are asked to recall the details of the accident by a police officer and a lawyer. The police officer asks, "How fast were the cars going when they smashed into each other?" while the lawyer asks, "How fast were the cars going when they bumped into each other?"

The use of the word "smashed" in the police officer's question and "bumped" in the lawyer's question can influence your memory of the event. Research has shown that when people are asked leading questions that contain suggestive information, it can impact their memory recall.

In this case, the use of "smashed" suggests a more severe collision, while "bumped" implies a less severe collision.

As per the reconstructive view of memory, when you try to recall the event, you may rely on the question's wording and incorporate it into your memory. You may remember the cars as going faster if you were asked about them "smashing" into each other compared to if you were asked about them "bumping" into each other, even though the actual speed of the cars may not have been mentioned or may have been the same in both cases.

This example illustrates how the reconstructive view of memory suggests that our memories can be influenced by the language used in questions, which can lead to memory distortion or inaccuracy. It highlights how memories are not fixed records of past events, but rather they can be reconstructed or altered based on various factors, including the wording of questions or other contextual cues.

Visual Systems

Visual Agnosia

Visual agnosia is a neurological condition characterized by the inability to recognize or interpret visual information, despite having normal vision. It is a type of agnosia, which is a broader term for the inability to recognize or make sense of sensory information, such as visual, auditory, or tactile stimuli.

In visual agnosia, individuals may have difficulty recognizing familiar objects, faces, or scenes, and may also have difficulty with visual-spatial tasks, such as navigating in familiar environments or copying drawings. They may still be able to see and describe the physical features of the object, but cannot understand its meaning or purpose.

There are different types of visual agnosia, depending on the specific area of the brain that is affected. For example, damage to the ventral visual pathway, which processes the visual information necessary for object recognition and identification, can result in a form of visual agnosia called apperceptive agnosia. In contrast, damage to the dorsal visual pathway, which is responsible for visual-spatial processing and attentional control, can result in a form of visual agnosia called associative agnosia.

Visual agnosia can be congenital (present at birth) or acquired as a result of brain damage, such as stroke, head injury, or neurodegenerative disorders. There is currently no cure for visual agnosia, but cognitive rehabilitation and compensatory strategies, such as using contextual cues and memorizing non-visual characteristics, can help individuals with the condition to improve their visual recognition abilities.

Prosopagnosia

Prosopagnosia, also known as face blindness, is a neurological condition characterized by the inability to recognize and distinguish between faces, including familiar faces of friends, family, and even oneself. It is a type of visual agnosia, which is a broader term for the inability to recognize or interpret visual information despite having normal vision.

People with prosopagnosia may have difficulty recognizing facial features, such as eyes, nose, and mouth, and often rely on non-facial cues such as hair, voice, and clothing to identify individuals. Prosopagnosia can be congenital (present at birth) or acquired as a result of brain damage, such as stroke, head injury, or neurodegenerative disorders.

There are different types of prosopagnosia, and some individuals may only have mild impairment while others may be completely unable to recognize faces. Some people may also experience difficulty with other visual recognition tasks, such as recognizing objects or scenes.

Prosopagnosia can have a significant impact on daily life, including social interactions, employment, and personal relationships. There is currently no cure for prosopagnosia, but cognitive rehabilitation and compensatory strategies, such as using contextual cues and memorizing non-facial characteristics, can help individuals with the condition to improve their face recognition abilities.

Difference between Cones and Rods

Cone cells and rod cells are two types of photoreceptor cells in the retina of the eye that respond to light and play a key role in vision. Here are some of the main differences between cones and rods:

1. Sensitivity to light: Rod cells are more sensitive to low levels of light, making them important for vision in dimly lit environments, while cone cells require brighter light to be activated.

2. Color vision: Cone cells are responsible for color vision, allowing us to perceive a wide range of hues and shades, while rod cells do not distinguish between different colors and are only able to detect black, white, and shades of gray.

3. Location in the retina: Cone cells are concentrated in the center of the retina, in an area called the fovea, which is responsible for sharp and detailed vision, while rod cells are more distributed throughout the retina, including the peripheral regions.

4. Density: There are fewer cone cells in the retina compared to rod cells, but they are packed more tightly together, resulting in higher visual acuity and sharper vision.

5. Adaptation to light: Rod cells adapt more quickly to changes in light levels, allowing us to see better in a range of lighting conditions, while cone cells adapt more slowly and are

better suited for bright, steady light.

Overall, cones and rods work together to provide us with a rich and dynamic visual experience, allowing us to perceive colors, contrast, and depth in the world around us.