

04 - 4. Memory

4. Memory

© SPMM Course 4. Memory In all cognitive operations involving memory 3 different processes are thought to occur. □ Encoding - It leads to the formation of initial memory traces and receives information from the outside. □ Storage - Retention of information and maintenance □ Retrieval - Accessing and recovering information from memory stores William James divided memory to primary (short term) and secondary memory (long term). In fact 3 forms of memory are now recognised.

1. Sensory memory: This is modality specific, has a large capacity but gets disrupted by the inflow of new information in the same modality. Each sense has its own sensory memory e.g. iconic (visual) lasting 0.5 seconds, echoic (auditory) lasting 2 seconds etc. No processing is involved in sensory memory. If attention is paid to the sensory memories during perception, sensory memory gets consolidated or 'moves' into the short-term memory system.
2. Short term memory: The capacity of STM according to Miller is 7 ± 2 items. This is evident while testing digit span (but see below for chunking). Unaided, STM lasts 15 to 30 seconds. By maintenance rehearsal, this duration can be increased further up to indefinite periods. If maintenance rehearsals are prevented, then by 15 seconds the original material is completely forgotten. Brown Paterson task involves introducing distraction (such as counting a three digit number backwards) immediately after the digit span test in order to prevent rehearsal. STM uses acoustic coding (mostly) or visual coding. Recall of information is effortless and usually error-free. Information is held in STM by the process of rehearsal. Loss of information from STM occurs mainly through displacement (newly acquired items entering STM displaces existing material) and decay (older materials have a weaker trace strength than the recently acquired items). In order for memory to move from temporary to long-term storage, elaborative encoding (Daniel Schacter) must take place. NOTE: The term working memory is increasingly used to describe a large part of what was called as STM in the past. Working memory allows cognitive processes to be performed on data that is briefly stored in short-term memory.
3. Long term memory: This has unlimited capacity and lasts for an indefinite duration. The coding is largely semantic, though visual and acoustic coding can occur to some extent. According to Atkinson & Shiffrin, STM and LTM are regarded as structural components. Rehearsal is supposed to be the transient control process that can aid maintenance of STM and transfer to LTM. Other control processes include encoding, retrieval strategies and decision to STM LTM
Encoding Acoustic Semantic Retrieval Error-free Error-prone
Capacity 7 ± 2 chunks Unlimited

© SPMM Course remember. Rehearsal may be maintenance/rote rehearsal or elaborative rehearsal where encoding is semantically elaborated or changed. It is proposed that rehearsal can take place at 3 levels of processing. Shallow processing where surface features are only rehearsed, phonemic processing where sound features are rehearsed or semantic processing where deeper encoding and meaning related associations are made. Higher level of processing depends on time available and nature of the material processed. [The terms often used in psychology are short term memory (corresponds to immediate memory in clinical psychiatry) and long term memory (recent memory and remote memory in psychiatry). STM (immediate memory) is tested by the recall of digits immediately after their presentation (Digit span).] Other classifications: Recent memory is the ability to remember what has been experienced within the past few minutes (recall of items after five minutes), hours (recall of last meal), days (recall of recent news items). Remote memory is the ability to remember events in the distant past (weeks to years). This can be tested by inquiring about important dates in their lives such as date of birth, date of marriage, how many siblings they have etc. Tulving elaborated multistore model (LTM) to have two forms - declarative (explicit - includes semantic and episodic memory) and non-declarative (implicit) memory. Procedural or Implicit memory: This cannot be consciously inspected. This is not affected by an organic amnesia of hippocampal origin. It is made of procedural memory for skills and habits, priming, classical conditioning and nonassociative learning. Episodic memory is autobiographical, self-focused, spatio-temporal memory. Semantic memory includes factual knowledge of the world. It is proposed to be made of multiple episodic memory components. Priming is a form of learning that occurs without conscious recall of the episode of learning; performance demonstrates that the information is learnt but conscious episodic recall is absent. Baddley & Hitch proposed a working memory model. Working memory is proposed to have central executive and 2 arms - phonological loop and visuospatial sketchpad. The central executive is capacity limited but modality free, similar to attention system. The phonological loop consists of auditory rehearsal loops while visuospatial scratch pad consists of pattern recognition and movement perception components. It is proposed that dyslexia may be related to erratic phonological loop. The 4th component of WM is sometimes called episodic buffer. This is a multimodal store that integrates info from the slave systems onto LTM. This buffer is important for chunking. Working memory is important for various processes including executive functions, decision-making, error detection and correction, new learning (anterograde memory formation) and judgement. Serial position effect: While memorising and recollecting a list of words both primacy and recency effects are seen. Regardless of the length of a list, the initial words (primacy) and last few words

© SPMM Course (recency) are remembered better than those at the middle of the list. Primacy is supposed to be due to LTM as consolidation has occurred in the sufficient time between learning the first word and testing recall. Recency effect is due to STM wherein last heard words are freshly retained. In those with organic anterograde amnesia, recency is better preserved than primacy. Here the problem is in transferring to LTM from STM and/or retrieval from LTM. In retrograde amnesia, the physical establishment of LTM memory (called consolidation) fails. Retrieval: Modes of retrieval (i.e. moving from LTM to STM) are through □ Recognition (solving MCQs) □ Recall (actively searching and reproducing), □ Reintegration/reconstruction (recollection of past experiences based on certain cues). An eyewitness testimony is a reconstructive memory, which is a mode of retrieval from long-term memory. However, reconstructive memory of events as in eyewitness testimony is affected by the type of questioning asked to elicit the memory. Forgetting: Hermann Ebbinghaus plotted the forgetting curve by plotting the proportion of words retained in memory

against time. The curve shows a sharp drop over the first nine hours and particularly during the first hour. After nine hours, the rate of forgetting slows and declines little thereafter, even after the lapse of 31 days. The main findings from his and other studies are; □ Forgetting is maximum in the first few hours, and the rate of forgetting gets less with time. □ Forgetting is never complete, and some information is retained over longer periods of time, even for life. □ Recalling the material during the test period increases the probability of remembering items or events. □ Continuous motor skills, such as cycling and swimming, show no forgetting at all. But discrete motor skills such as typing are lost more quickly. Problems with encoding (registration), retention or retrieval, can all result in forgetting. Decay theory states that neural engrams breakdown with time. This means that disuse with time is the cause of forgetting, but no evidence exists that neurological decay occurs. Also what happens before and after learning is more important than the mere passage of time in forgetting. FLASHBULB MEMORIES

Distinctly vivid long-lasting memories of a personal circumstance surrounding a person's discovery of shocking events. These are not as accurate or permanent as photographic memories but forgetting curve for the flashbulb memories is far less affected by time than other types of memories. These memories are often associated with important historical or autobiographical events. Such events could include, for example, the 9/11 or 7/7 etc.

© SPMM Course Displacement theory states that due to capacity limitation new info replaces old information. Retrieval failure theory states that due to lack of proper cues to recall we forget things. According to encoding specificity principle, anything we encode during learning can be a cue/tag for later retrieval. Recall improves if same cues are available when recalling, but this holds true only for recall, not recognition. Hence, some times recall is better than recognition! Such cues can be the context (place, external state) specific or emotion/ inner state specific. According to interference theory forgetting occurs due to interference. When newly learnt material interferes with recall of old material, this is called retroactive interference. Proactive interference refers to the interference of new learning from older learnt material. There is a low ecological validity for interference model as most experiments were conducted with memorizing word lists, a skill that is rarely required in daily life. Strategies to improve encoding include - order and sorting info, chunking, mnemonics, using imageries, adding importance and salience to the info and using primacyrecency effects. Retrieval can be helped by cueing and reinstatement of learning context. Chunking is a method of increasing the capacity of short-term memory by combining units or information (usually numbers) into chunks. By doing so, impressive feats of memory can result. For example the numbers 1,5,2,3,5,2,5,8,5,3,7,8 would normally overload our short-term memory but if they are arranged into chunks 152, 352, 585, 378, they become a lot more manageable. The more similar the retrieval situation is to the encoding situation, the better retrieval. This is called encoding specificity principle. Amnesia refers to a marked impairment in episodic memory, although other types of memory such as working memory, semantic memory and procedural memory may remain relatively intact. Anterograde Amnesia: The loss of the ability to form or retain new episodic memories after an injury/lesion/event □ Lack memory for events taking place in immediate future after an event □ Classic cases often involve hippocampal damage □ The subject cannot learn anything new. □ Nothing can be moved from STM to LTM.

RIBOT'S GRADIENT

Theodule Ribot first suggested that recent memories might be more vulnerable to brain damage than remote memories in 1881. After damage to the hippocampal memory system, patients tend to lose more of their recent than of their remote memories. This pattern, unique to organic amnesia, is called the Ribot gradient. This may be related to the dependence of retrieval on hippocampal systems, while consolidation gradually 'pushes' stored memories to the neocortex, making them independent of the hippocampal system.

© SPMM Course Retrograde Amnesia: The loss of episodic memories that were stored before brain damage had occurred. □ Lack memory for immediately preceding events. □ Follows head injury □ The subject never consolidates the information that is already in STM (retrieval failure i.e. fails to move from LTM to STM).

Transient global amnesia is caused by transient cerebral ischemia causing a temporary lack of blood supply to the regions of the brain concerned with memory functions. The main features include sudden onset of severe anterograde amnesia with a retrograde amnesia for the preceding days or weeks. Sometimes amnesic episodes may occur in patients who have had no brain injury but suffered a traumatic or emotionally disturbing life event (hysterical or psychogenic amnesia). There are two types-Global and situation specific. Fugue state is a type of psychogenic global amnesia in which there is a sudden loss of all autobiographical memories, knowledge of self and personal identity. Usually, there is a period of wandering, and there is an amnesic gap upon recovery. It usually last a matter of hours or days. Memory recovery is complete after few hours or days. In most cases, the fugue states will clear over a few days and the amnesia is mainly transient. If not, the patient usually adopts a new name and identity and begins a new life. As in organic amnesia, fugue patients will normally retain their procedural and semantic memories. The patient may have episodic memory loss that is usually only retrograde memory loss and no anterograde impairment. Situation specific amnesia: Offenders, as well as victims of crimes commonly, claim amnesia regarding the offence. In 25-45% of homicides, 8% of other violent crimes and a small percentage of non-violent crimes, offenders claim amnesia (Kopelman 2002a). Amnesia for an offence is associated with alcohol or substance misuse and acute psychosis, but purely psychological amnesia is often limited to crimes of passion. In people with PTSD anterograde memory dysfunction has been demonstrated with some reduction in hippocampal volume on MRI (Bremner 1999) attributed to effects of glucocorticoids (Markowitsch 1996) Amnesic syndromes: Various disorders can give rise to amnesic syndromes (e.g. hypoxia, herpes encephalitis) and the features would include

1. Immediate memory is unimpaired.
2. Anterograde amnesia- inability to acquire new information (impaired delayed recall)
3. Retrograde amnesia of variable extent and severity-The degree depends on the extent of brain damage
4. Preserved global intellectual abilities
5. Preserved implicit memory

© SPMM Course Korsakoff's syndrome: It is a form of an amnesic syndrome caused by thiamine deficiency. The patient may have severe anterograde amnesia and extensive retrograde memory loss. This retrograde memory loss includes autobiographical memory loss with relative sparing of the most distant memories. Working memory and procedural memory are unimpaired. Bedside

tests: Three words learning task (e.g. apple, table, penny) is a test of anterograde memory and learning, useful to investigate Korsakoff's syndrome. Post-traumatic amnesia: The time between the injury and recovery of normal continuous memory, seen in head injury patients. The longer the PTA, the more severe the brain damage and poorer the prognosis for the recovery. PTA Retrograde amnesia is also possible after head injury – tested with recent autobiographical questions (what did you eat for dinner yesterday?). In most cases, the amnesic gap is short and (< 1 min). It is not a good indicator of prognosis. Memory loss following ECT: The impairment is usually temporary. There may be both anterograde and retrograde amnesia, both of which reduce rapidly in most patients. A third of patients report persistent memory loss following ECT (Rose et al. 2003). Memory impairment is less pronounced with unilateral ECT. Tests of memory: Digit span is the commonest test of auditory, verbal working memory. Both forward and backward digit span are tested in routine clinical practice. The average range of digit forwards is 6+/-1 and for reverse digit span is 5+/-1 Three words learning task (e.g. apple, table, penny) is a test of anterograde memory and learning. Name and address recall task (7 items) is the commonest test of recent (verbal) memory. Here the subject is asked to recall as many items, without prompts, in five or ten minutes Rey-Osterrieth complex figure test is one of non-verbal memory test. Here the subject is first asked to copy a complex geometric figure and then to draw from memory after an interval of 30 minutes. The recall is impaired in patients with dementia and amnesic syndrome. Wechsler memory tests: Here the subject is asked to read a short story from the Wechsler memory scale containing 25 elements and both immediate and delayed recall after an interval of 30 minutes is tested.

Infantile amnesia: The average age of the earliest retrieved memory is 3.5 years. There is a total lack of memories for events occurring during the first few years of life, and there is a variable degree of amnesia for events that occurred in the first 2 to 5 years. This is termed infantile amnesia. Emotion and retrieval: Retrieval is reconstructing past experiences and is influenced by a number of variables including emotion. Current mood affects what is attended, encoded and retrieved. The mood-congruent effect refers to the ability to more easily recall information if it is congruent with the current mood e.g. in a depressed mood, negative thoughts and circumstances are more readily retrieved. Mood-state dependent retrieval refers to the phenomenon wherein retrieval of information is easier if the emotional state at the time is the same as the emotional state at the time of encoding.

© SPMM Course Elaboration: Material that is fully elaborated produces stronger memory trace as it is believed that consolidation is linked to the depth with which the data is processed. Schemas are mechanisms for elaborating and for reconstructing memory at test. They are organized sets of facts. During recall, distortion can occur in order to ensure the information fit the schemas or to fit cultural stereotypes. This then impacts the recall of the information. Inference is a method where known, easily accessible information is used to piece together the retrieved information, resulting in a biased recall. Brain imaging and neuropsychological studies provide strong evidence that a. The brain areas mediating performances in STM are principally the pre-frontal lobes b. The phonological STM system is mediated by the left hemisphere regions of Broca's' area and prefrontal cortex. c. The visuospatial STM system is mediated by the parietal and prefrontal areas of the right hemisphere. d. The brain areas responsible for LTM includes the regions of the limbic system especially the hippocampus and the entorhinal cortex of the medial temporal lobe

Updated 2026-01-04 20:01:48 UTC by Omar Ayman