

MEMORY - SOME KEY TERMS:

Memory:

- Active systems that receive, stores, organize, alter, and recover information

Encoding:

- Converting information into a usable form.
- To be able to sort or organize you need some kind of conversion for your system to read.

Storage:

- Holding this information in memory for later use.

Retrieval:

- Taking memories out of storage.

- Incoming Information:

- You get information from the world.
- It would be coming in from sensation

- Sensory Memory:

- A second or 2 after you get the incoming information and that information is stored in your mind.
- You will see a stimulus and hold onto that sensory information.
- If you don't hold onto that memory, it is forgotten.

- Short-term Memory:

- Information is held in mind.
- It is a mental 'scratchpad,'
- Information you're actively holding in your mind and thinking about.
- You don't rehearse it and do not get encoded into long-term memory.
- If the new information is not rapidly encoded it is forgotten.

- Long-term Memory:

- If something is very important is rehearsed a lot then it gets encoded into long-term memory.

- It is relatively permanent.

SENSORY MEMORY:

- Storing an exact copy of incoming information for a few seconds.
- It is the first stage of memory.

Icon:

- A fleeting mental image or visual representation.
- It is a visual representation that is stored in memory.

Echo:

- After a sound is heard, a brief continuation of the sound in the auditory system.

- Partial Report Technique:

- Developed by George Sperling (1960).
- Participants saw flashed arrays of letters or numbers on the screen for 50 milliseconds.
- Within the next 10 milliseconds to 30 milliseconds, high, medium, or low tone signals indicated the participant in which row of arrays to recite.
- Participants say the correct row most of the time.
- Because it is really fast, the idea is that you are tapping into your sensory memory fast.
- It would be stored for a couple of seconds just in sensory memory as an icon.
- The tone would then cue a person to relay a part of that icon.
- We are able to track something in sensory memory.

SHORT-TERM MEMORY (STM):

- Holds small amounts of information briefly
- What you are keeping in your mind.
 - It is like a mental "scratchpad"

Example:

- Doing a math equation in your mind.
- You have to keep representations of one number and the other number, and the execution you're doing to those 2 numbers.

- You have to know how all these representations are related together as you work through the math problem.
- That is like the mental scratchpad as you're keeping all these numbers and things in mind and the operation you're doing.
- The process of the math equation will be short-term memory because once you get the answer, you don't need to remember the work.

Selective Attention:

- Focusing on a selected portion of input such as selective hearing.

Example:

- If you're at a busy restaurant with your friend, you're able to selectively attend to what your friend is saying and block out all the noise.

Short-Term Memory Concepts:

Digit Span:

- Test of attention and short-term memory.
- Participants look at a string of numbers and they have to recall them forward or backward.
- It is typically part of an intelligence test

Magic Number 7:

- STM is limited to holding 7 (plus or minus two) information bits at once.
- Some people are able to hold 9 bits of information.
- Generally, short-term memory capacity is limited to 7 bits.

More Short-Term Memory Concepts:

Recoding:

- Reorganizing or modifying information in STM.
- **Information Bits:** Meaningful units of information such as numbers, letters, or words.
 - If you heard the numbers 1,7,6,8 then you would use up 4 memory slots of your mind.
- **Information Chunks:** Information bits that are grouped into larger chunks.

- If you are told that those numbers represent the year 1768, then you will store it as an information chunk, which only uses 1 slot of memory and frees up 3.

Maintenance Rehearsal:

- Links new information with existing memories and knowledge in LTM (Long-Term Memory).
- Repeating information silently to prolong its presence in STM.

Elaborative Rehearsal:

- Links new information with existing memories and knowledge in LTM.
- A good way to transfer STM information into LTM.

Example:

- Studying a lot of terms for a class that is memorization-heavy for an exam.

LONG-TERM MEMORY (LTM):

- Storing information is relatively **permanent**.
- Stored on basis of **meaning** and **importance**.

LTM Concepts:

Constructive Processing:

- Re-organizing or updating long-term memories on basis of logic, reasoning, or adding new information.

Example:

- You had co-workers and you thought they were nice and you interpret their behavior and it dawns on you that they don't like you.
- You discover they don't like them and then you re-interpret all your interactions with that person.
- All those LTM get re-interpreted and changed.

Pseudo-Memory:

- False memories that a person believes are true or accurate.

Network Model:

- Memory model that views the structure of long-term memory as an organizational system of linked information.

Example:

- If you hear the word doctor it can remind you of memories of you in a hospital.

Redintegration:

- One memory can serve as a cue to trigger another memory.

Example:

- You experience food poisoning after the last thing you ate, so every time you think of that food, you'll think of the time you had food poisoning from it.

Organizational Structure of Long-Term Memory:

Sensory Store:

- **Capacity:** Whatever you see or hear at one instant.
- **Duration:** Fraction of a second.
- **Example:** You see something for an instant, and when someone asks you to recall one detail.

Short-Term Memory:

- **Capacity:** 7 (plus or minus 2) information bits in healthy adults.
- **Duration:** About 20 seconds if not rehearsed.
- **Example:** You look up a telephone number and you remember it long enough to dial it.

Long-Term Memory:

- **Capacity:** Vast and uncountable.
- **Duration:** Perhaps a lifetime.
- **Example:** You remember the house where you lived when you were 7 years old.

Types of Long-Term Memories:

Procedural:

- Long-term memories of conditioned responses and learned skills (not always aware).

Declarative:

LTM section that contains factual information

Semantic Memory:

- A subset of declarative memory.
- Imperial facts and everyday knowledge.

Episodic:

- A subset of declarative memory.
- Personal experiences are linked with specific times and places.

- **LTM** is kind of everything that isn't working memory and short-term memory.
- The **Hippocampus** plays a role in **consolidating** episodic and sometimes semantic **LTM** information.
- **Retrograde** and **antegrade** amnesia represent episodic and sometimes semantic **LTM** impairments.

FLASHBULB MEMORIES:

- Many victims of crimes have something called a **flashbulb memory**.
- It is a vivid recollection of dramatic or emotionally charged events.

Example - Can anyone tell me what you were doing... :

- You first saw or heard about September 11.
- When Barack Obama became president.

VISUAL WORKING MEMORY AKA STM:

- The working memory system is used to **hold** information actively in the mind and to **manipulate** that information to perform a cognitive task.

Constraints on visual working memory:

- Number of items Fidelity
- Capacity - Number of items * fidelity.

Example:

- A USB drive has a capacity of how many files can be stored on it.
- Let's say the USB is full of images.

- The capacity of it is limited to how many images there are and how detailed and high res they are.
- People's constraint on visual working memory is 3-4 objects.
- There was a study that showed 4 squares and the scientist changed the color of one of the objects and the participants were able to catch that.
- When there were more than 4, the performance of the participants decreased and it was much harder for them to tell what object changed color.
- **Visual working memory however is not a constraint to just the number of objects.**
- If the change is very subtle a lot of people will miss it.
- Visual working memory can store 3 number of items no matter how complex they are.

The Tradeoff model (Alvarez and Cavanagh 2004):

- There is a trade-off between the number of items and the fidelity of items stored.
- Memory fidelity is consistent up until 3-4 items and then it dramatically decreases.

Capacity of visual working memory:

- It's flexible and limited in resources.
- There is a trade-off between the number of items and the fidelity of items stored.

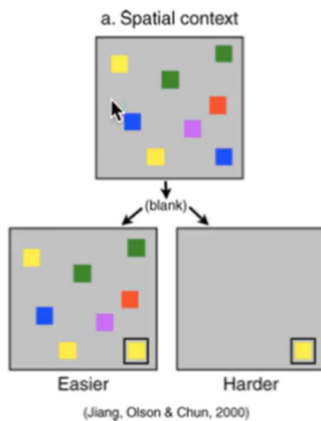
Example:

- 1 Item can be represented with greater fidelity than 3-4 items.

Format of visual working memory:

- The format is objects.
- However, working memory does not always store integrated object representations.
- **The more features are on an object, the more costly it is to remember it.**
- It is sensitive to both objects and features.

Spatial Context:

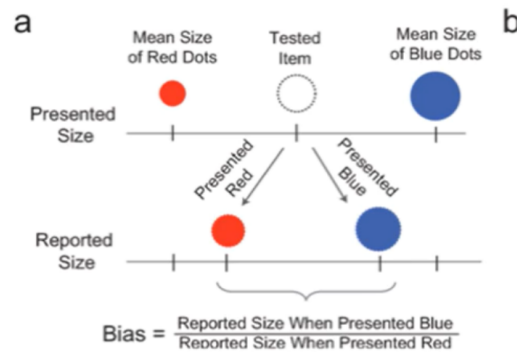
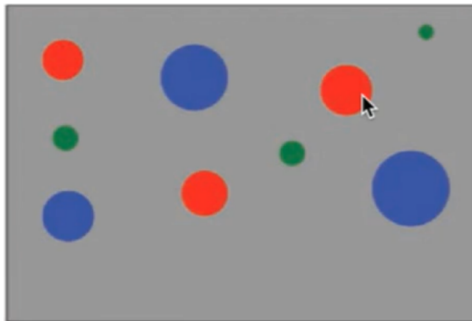


other blocks.

- Participants did better in identifying the change in the newly altered scene.
- They did worse when all the blocks were removed except one.
- It suggests that the entire scene is being encoded and represented together and the participants are looking at the relationship between the scene and the blocks.
- Your working memory system is representing those relationships, so it is much easier to tell if one of the blocks has changed when in relation to

Ensemble Encoding:

(Brady & Alvarez 2011)



- Participants were asked to report the size of the dots that have been present before they disappear off the screen.
- The results were when people were trying to remember the red dots, they would tend to say it was smaller.
- When people remembered the blue dots, they would adjust them to be bigger.
- The idea here is that they are representing an ensemble encoding.

- Our visual system is using shortcuts to average across features because participants knew red dots were smaller and that blue dots were bigger.
- Our perceptual system is tracking regularities across the scene and seeing what dots are bigger and smaller.
- It then uses those regularities and biases the way we are manipulating the information that we're holding in our working memory.
- We are editing our working memory representation according to the kind of ensemble encoding we are doing.

VISUAL LONG-TERM MEMORY:

- The ability to explicitly remember an image that was **seen previously** but that has **not been continuously held** actively in mind.

Capacity of Visual Long-Term Memory:

Shepard's experiment (1967):

- Showed 600 images in 6 seconds and participants were able to remember the images with 97% accuracy.

Standing's experiment (1973):

- Showed 10000 images in 5 seconds, participants were able to remember the images with 83% accuracy.

Format of Visual Long-Term Memory:

- The format is kind of like a "gist" meaning if scenes are similar in some way you are able to fill in the missing information of it.
- They can also be encoded of how specific a scene is.
- It is not about the capacity but rather the format of the scene a person is looking at.
- Visual Long-Term Memory's capacity is very **large** but **not unlimited** capacity.
- The format goes **beyond mere "gist"** to lower-level visual features of the scene.

BOUNDARY EXPANSION EFFECT:

- When asked to remember a photograph of science, people remember more than was in the original photograph.

- Particularly when the view is a close-up.
- Specific to scenes (not objects out of context).
- Scene representation is not limited to the physical input but instead projects outward to integrate the sampled view into a broader real-world environment.

CASE STUDY CLIVE:

- He suffered from **Retrograde Amnesia** (an inability to access memories formed prior to damage to the brain).
- **Procedural memory:** The unconscious memory of how to carry out an activity without conscious control or attention.

VERBAL SHORT-TERM MEMORY:

- Being able to keep words or digits in mind.

Typically measured by span tasks:

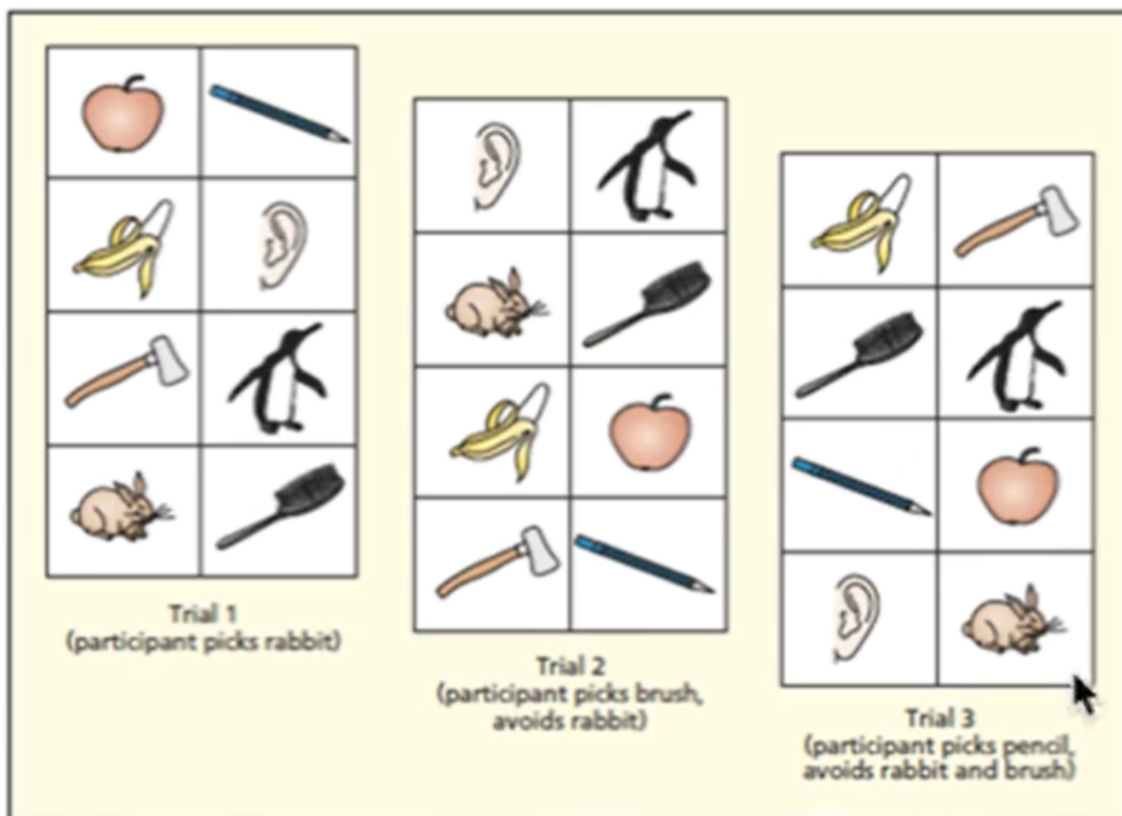
- Patients have to read a sequence of digits and immediately recall them.
- Humans have a span of plus or minus seven.
- Span units are chunks, not words or digits
 - **Ex:** "1776" vs. "4396"
- **Limit is lower if not rehearsed:**
 - **Ex:** articulatory suppression
- **Capacity is not strictly related to mindfulness of chunks because:**
 - Span length lower for polysyllabic words
 - **Ex:** skeleton, binoculars, etc.
 - Span length lower for phonologically similar words:
 - **Ex:** map, cat, cap, etc.

SHORT-TERM MEMORY VS WORKING MEMORY:

- Information is passively retained in limited capacity short term stores
 - **Ex:** phonological STM, visual-spatial STM
- Short-term stores located posteriorly
 - **Ex:** parietal lobes.
- Working memory is the information you're actively manipulating.

Working memory in the prefrontal cortex (PFC):

- It refreshes information in STM stores (rehearsal)
- It manipulates that information:
Example: Using a list of numbers in STM to perform calculations.
- Lesions in the **lateral prefrontal cortex** (LPFC) impair the ability to hold stimulus in mind during the short delay (Butters & Pandya, 1969; Funahashi et al., 1989).
- Patients with LPFC lesions are impaired on the Petrides and Milner (1982) task.



A self-ordered pointing task based on Petrides and Milner (1982). Participants are required to point to a new object on each trial and, as such, must keep an online record of previous selections.

- Participants had to choose one object in each trial but in the next one, they could not choose the same one.
- Participants with impaired lesions had trouble keeping track of all the objects.
- **Ventrolateral PFC:** activating and retrieving information, having to bring information forth.

- **Dorsolateral PFC:** active manipulation of information.

The difference between WM and STM:

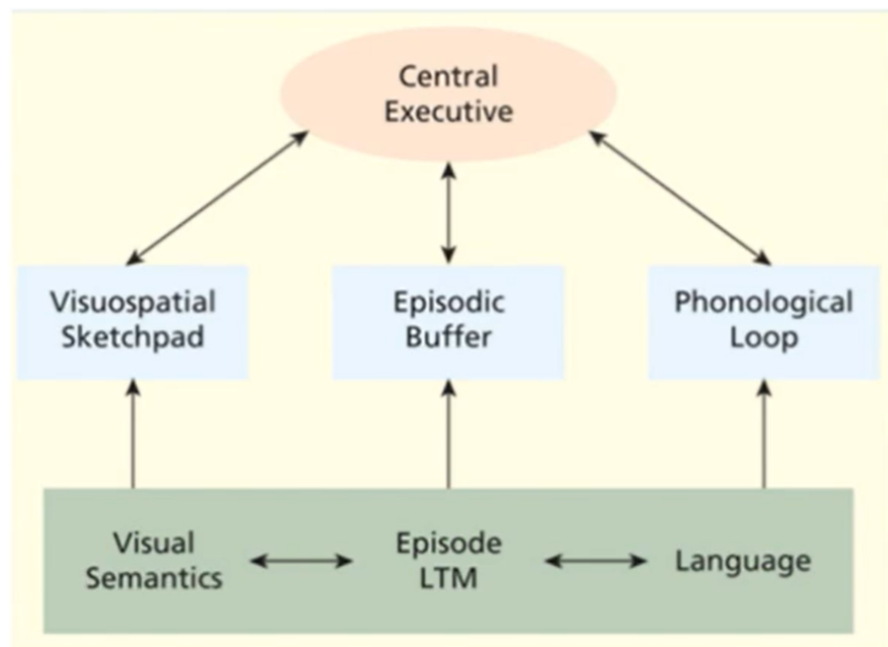
Working Memory:

- More active.
- Manipulates information in mind
- Is controlled by PFC.

Short Term Memory:

- More passive
- Maintains information
- Is controlled by the parietal lobes.

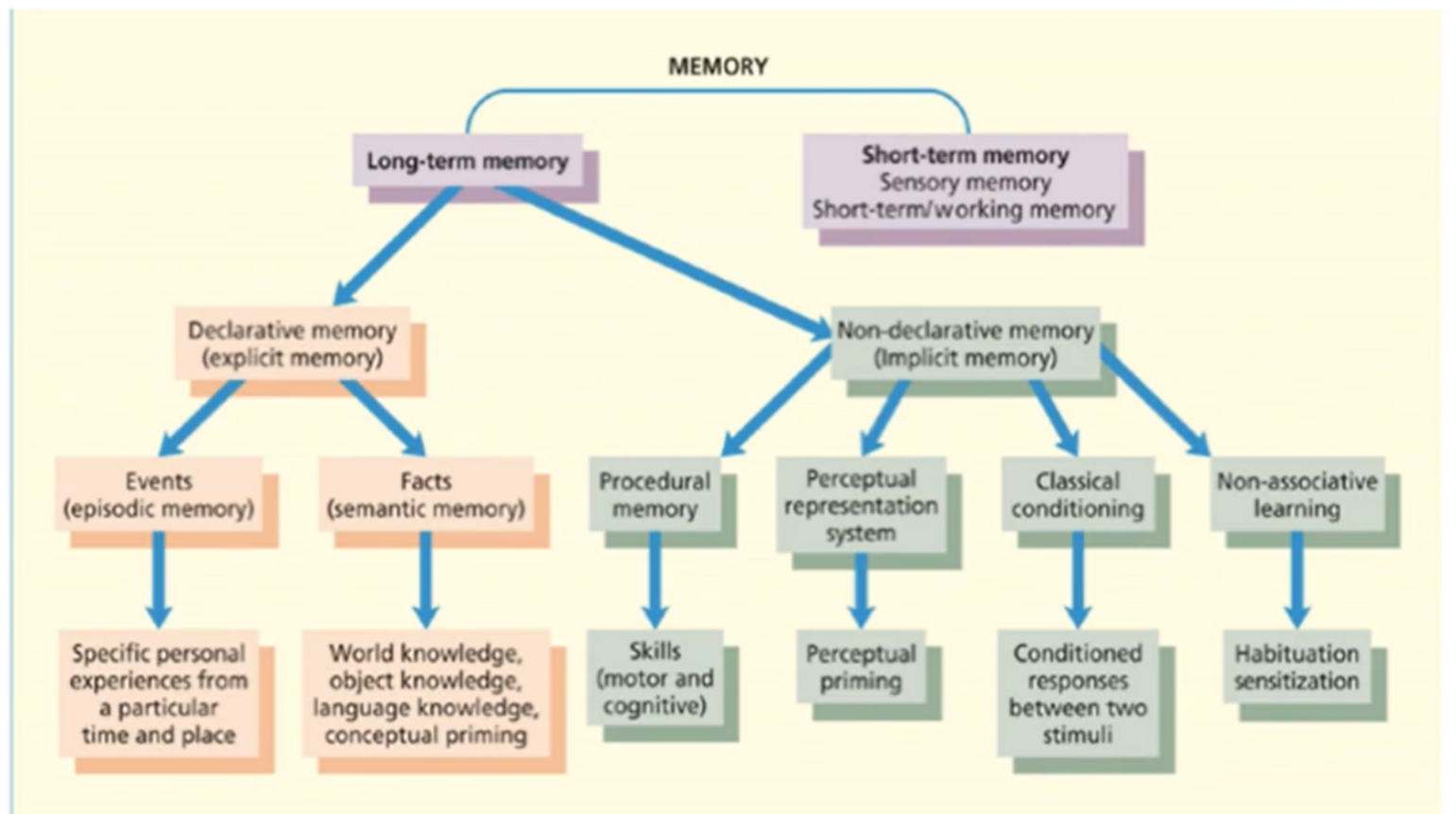
Baddeley (2000)



- The central executive is the working memory.
- It then coordinates these lower systems such as visual short-term memory and verbal short-term memory.
- It specifies specific task goals.

- The episodic buffer just brings in episodic memory.

THE DIFFERENCE BETWEEN SHORT TERM MEMORY AND LONG TERM MEMORY:



STRUCTURES OF THE BRAIN THAT HANDLE MEMORY:

- **Striatum and Putanmeric:** Handles procedural memory.
- **Amygdala:** Handles emotional memory and emotional responses in classical conditioning.
- **Many regions of the Cortex:** Handles short and long-term semantics and episodic memory

- **Cerebellum:** Handles procedural memory
- **The Medial temporal lobe & Hippocampus:** Handle long-term semantic and episodic memories.

AMNESIA: THE CASE OF HM:

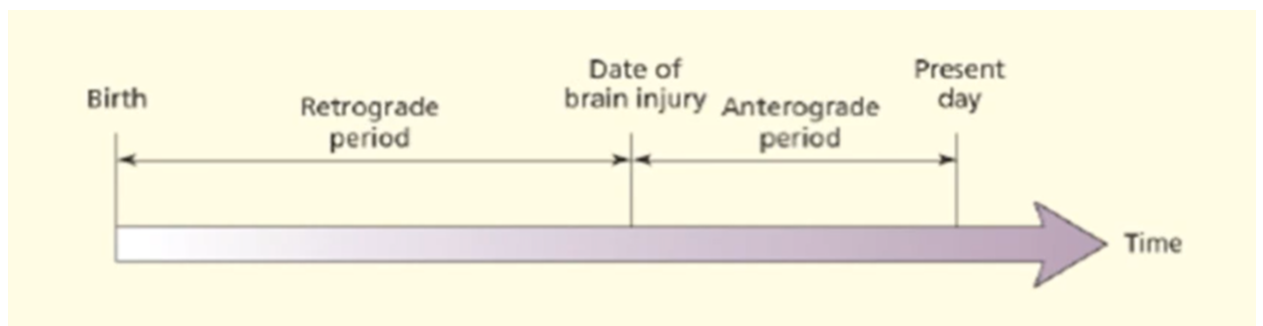
- Experienced seizures from age of 10.
- Had medial temporal lobes been removed, including the hippocampus (Scoville and Milner 1957).
- Are not able to form any new memories due to profound damage in the hippocampus.

Etiology:

- Neurosurgery
 - **Ex:** hippocampus removal **HM**
- Stroke
- Head injury
- Viruses:
 - **Ex:** herpes simplex encephalitis, Lonnie Sue, Clive, and **EP**
- Prolonged thiamine deficit (alcoholism, Korsakoff's syndrome).

Different types of amnesia:

- **Anterograde amnesia:** acquiring new memories
- **Retrograde amnesia:** remembering pre-brain injury events (variable)



What systems are impaired?:

- STM is spared (Baddely & Warrington, 1970).
- Non-declarative memory is typically spared.

Episodic memory:

- People with anterograde are completely impaired.
- People with retrograde are impaired for recent events.

Semantic memory:

- People with anterograde are always impaired
- People with retrograde are sometimes impaired.
- Implicit learning is not impaired.