



- Memory stages:

- **Encoding:** in which information are managed to be easily stored in the brain.
- **Storage.**
- **Retrieval:** our ability to recall memories.

- Memory formation:

- **Sensory memory:** which is representing very brief information held/stored in the receptors (for 1 second). Example: when you see a person and then close your eye all of a sudden → you can still imagine the image of that person for nearly 1 second (after which this memory will be lost).
 - ✓ Notice that sensory memory of sound (echoic) stays more than sensory memory of vision (iconic).
- **Short-term memory:** in which thoughts and experiences are stored for a short time. This type of memory can be erased easily by head trauma or electrical shock because it is not consolidated (it is not in a fixed state).
 - ✓ Working memory: in which information are not stored in a specific place/area but they are ready in the brain whenever we need them to perform our works. Example: when you read a long sentence, you will memorize the first few words so you can understand the sentence when you finish reading it (this is working memory). If the sentence is very long, you might not understand it because working memory has a very limited capacity, short duration and is only capable of memorizing 6-7 digits \pm 2).
 - ❖ Working memory and chunking is the function of prefrontal and parietal lobes.
 - ❖ Notice that working memory is very short and not mature in babies. Example: when a mother plays with her baby by hiding her face behind her hands and then remove her hands all of a sudden → the baby will start laughing but as soon as the mother covers her face again he will stop (why?) → because he doesn't have a working memory and he will forget that his mother face is behind those hands!
- **Long-term memory:** in which information are stored for years or even for life!

- Frontal, temporal and parietal lobes are all involved in storage and consolidation of memory.

- Hippocampus and perirhinal cortex are involved in conversion of short-term memories into long-term memories.

- There are 2 types of memory systems:

- **Explicit (declarative memory):** it is the memory which can be explained/declared. It is further classified into:
 - ✓ Events memory (episodic).
 - ✓ Facts memory (semantic).Note: explicit memory is effortful processing (needs effort and repetition to be formed). Therefore, this type of memory is "easy to form, easy to forget". Explicit memory occurs in hippocampus, amygdala and rhinal cortex → it needs sleep → and the neurotransmitter which is released is glutamate.
- **Implicit (non-declarative memory):** they cannot be explained. They are further classified into:
 - ✓ Procedural memory (skills and habits): basal ganglia
 - ✓ Classical conditioning which include:
 - ❖ Skeletal musculature (cerebellum)
 - ❖ Emotional responses (amygdala).Note: implicit memory is automatic processing. Therefore, this type of memory is "requires repetition but not easy to forget". Implicit memory occurs in cerebellum

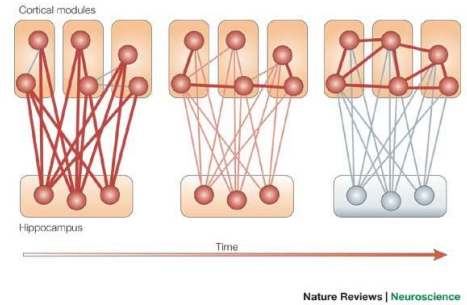


and basal nuclei → and the neurotransmitter which is released is dopamine. Non-associative implicit memory involves:

- ❖ *Habituation*: learning to neglect.
- ❖ *Sensitization*: learning to be very sensitive.

- The best way to remember things is to make a story from them. Notice that the brain loves happy endings!

- The standard model (STM): theories suggesting how is memory produced:



- **Single-trace theory**: at the beginning there are strong connections between different areas in the cortex and the hippocampus. When time passes, those connections will only be present between the scattered areas in the cortex. Disadvantage of this theory is that the event can be changed (re-consolidation).
- **Multiple trace theory**: in which there is still connections between hippocampus and cortex. Therefore, the story can be manipulated.

- There are 2 types of amnesia:

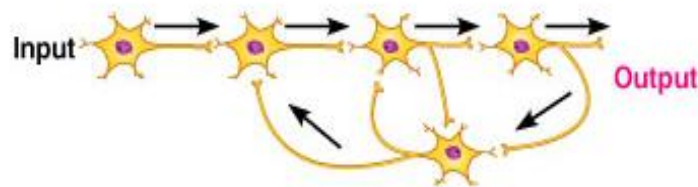
- **Retrograde**: inability to retrieve memory of the past. This condition can be caused by:
 - ✓ Head injury.
 - ✓ Emotional trauma.
- **Anterograde**: inability to form new long-term declarative/explicit memory.

- Why is our memory full of errors?

- Because every time we recall our memories there will be reconstruction and reconsolidation.
- **Imagination inflation**: means that once we have inaccurate memory, we tend to add more imagined details, as perhaps we do for all memories.

- Memory (electrophysiology and mechanisms):

- **Short-term memory (seconds to hours.. 7-8 information): pre-synaptic mechanisms**
 - ✓ Habituation (closure of Ca-channels): which means that with constant tactile stimulation there will be depression of withdrawal reflex.
 - ✓ Reverberating circuit: a chain of neurons containing collateral synapses with previous neurons in the chain.

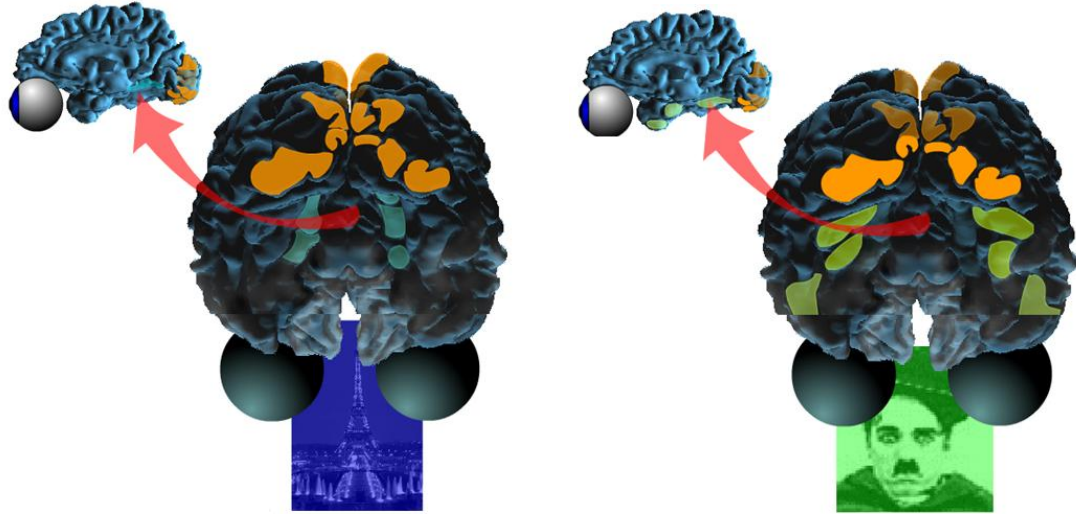


(e) Reverberating circuit

- ✓ Repeated stimulation and role of calcium: a new amount of calcium ions will enter the neuron with the second action potential to be added to those residual calcium ions from the previous first action potential. Therefore, there will be increased neurotransmitter release and more effect.
- **Intermediate-term memory (minutes-days): pre-synaptic mechanisms**
 - ✓ Pre-synaptic facilitation.
 - ✓ Post-tetanic potentiation.
- **Long-term memory (days-years): post-synaptic mechanism**
 - ✓ Long-term potentiation.



- **Vital memory**: extra-fast movies when a person thinks there is a certain probability that he will die in a matter of seconds. The content varies from person to person but usually tends to be a sequence of very symbolic emotive images in chronological order.
- **Memories of faces and places:**
 - **Memory of places**: in medial parts of the temporal lobe.
 - **Memory of faces**: in lateral parts of the temporal lobe (fusiform face area).



- **Comparison between explicit and implicit memories:**

Explicit

- *Late* developed memory
- For facts and events.
- Related to conscious thoughts and language
- Stored with the context in which it was learned.
- Four stages
- Retrieved deliberately
- Easy to store and easy to forget
- A function of the Temporal lobe structures

Implicit memories

- *Early* memory.
- Perceptual and motor skills
- Acquired through practice or reflexes
- Do not retain the context in which they were learned
- Not
- Automatic
- Require much repetition but not easy to forget
- Differs according to the type (fear conditioning in Amygdala/ Operant conditioning in Striatum & Cerebellum).