

# The Brain and Music 3

Cathrine Blom

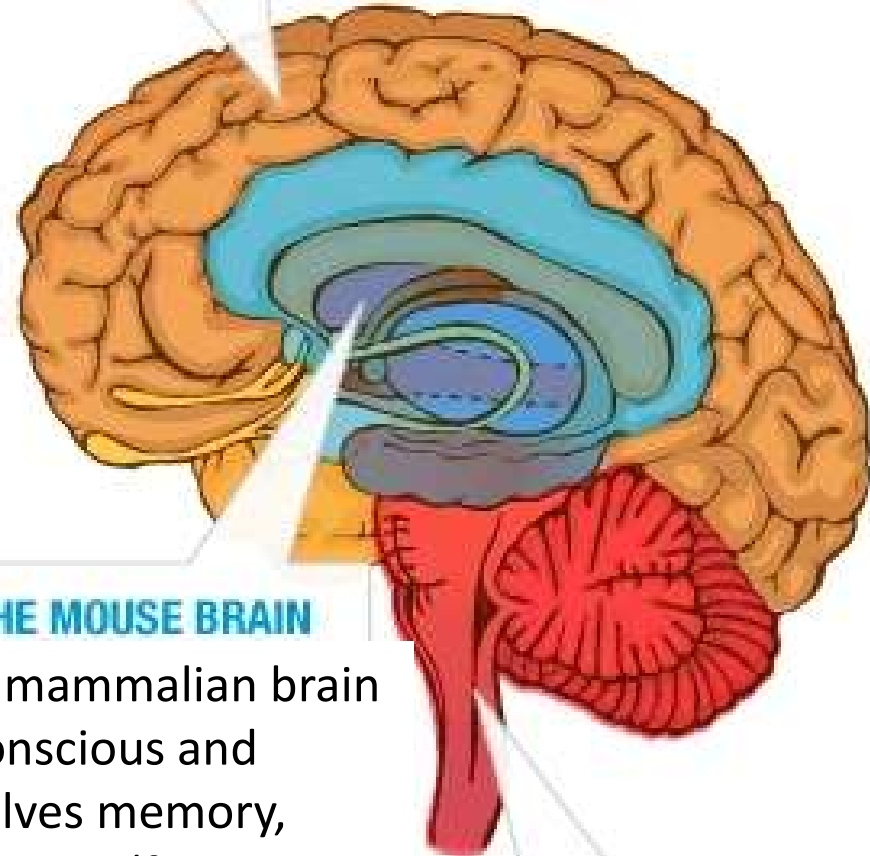
OLLI Fall 2023

## Summary of Lecture 2

### THE HUMAN BRAIN

The neocortex is involved in all human higher functions like problem solving, attention, thought, perception, memory, and social interaction. It is the seat of our personality traits.

The brain's neural network consists of 100 billion cells (neurons) and 500 trillion connections



### THE MOUSE BRAIN

The mammalian brain is conscious and involves memory, emotions (fear, anger, pleasure), the ability to learn from experiences and anticipate danger.

### THE LIZARD BRAIN

The ancient brain, mainly about survival. Automatic. Controls basic bodily functions, hunger, sex, "fight or flight."

## The neocortex is divided into four lobes

Frontal lobe

**Interestingly,** the frontal lobe is not fully developed until age 25. Children cannot think in abstract terms; teenagers don't have the rational brains of adults.

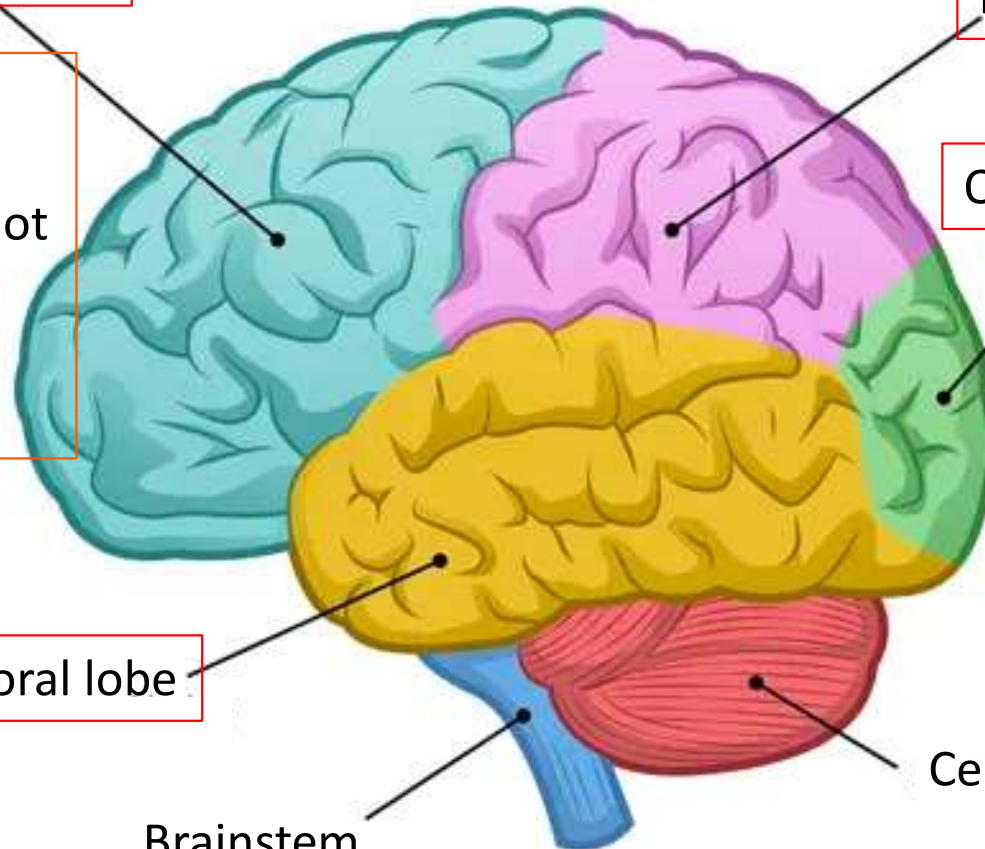
Parietal lobe

Occipital lobe

Temporal lobe

Brainstem

Cerebellum



The brain is divided into two identical parts which process music differently

## Left hemisphere:

Processing rapid changes in frequency and intensity, both in music and words. Music analysis and musical structure

Rhythm \*\*\*



## Right hemisphere:

Pitch, harmony, timbre and melody

Rhythm (figuring out the rhythm)

In musicians, 25% of music perception is done by the left hemisphere

Music is sound. How do we perceive sound?



A musical instrument starts the air vibrating – a sound wave.

The wave travels through air, and starts a response in the ear.

The ear send signals to the brain, which the brain interprets as music.



\***Range:** the overall shape of the music, e.g., the distance between the lowest and highest note

\***Form:** The shape of a musical composition

strophic form A, A, A

binary form A,B

ternary form A,B,A

song form A,B,A,B (verse, chorus)

rondo A,B,A,C,A (refrain with contrasting sections)

- \*The whole brain is involved in music -- **no musical center**
- \*Difference in brain structure between musicians and non-musicians
- \*The brain “jumps” if a chord is “wrong”
- \*Have we grown dependent on music? Is it noise, pleasure, or both?

# Music and Memory

How the brain identifies and stores music and the different brain structures involved in this task



# Memory

- \* **D**eclarative **m**emory: memory of specific people, places, and events (episodic and semantic memory) **C**onscious

The hippocampus (relay station), frontal lobes (and amygdala) are involved in storage of declarative memories. If the hippocampus is destroyed, you can not store memories.

- \* **P**rocedural **m**emory: biking, driving a car, playing an instrument, things you can do without thinking (motor skill memory) **U**nconscious

The cerebellum and motor cortex are involved in storage of procedural memories.

# Storage of declarative long-term (episodic and semantic) memories

## The Frontal lobe

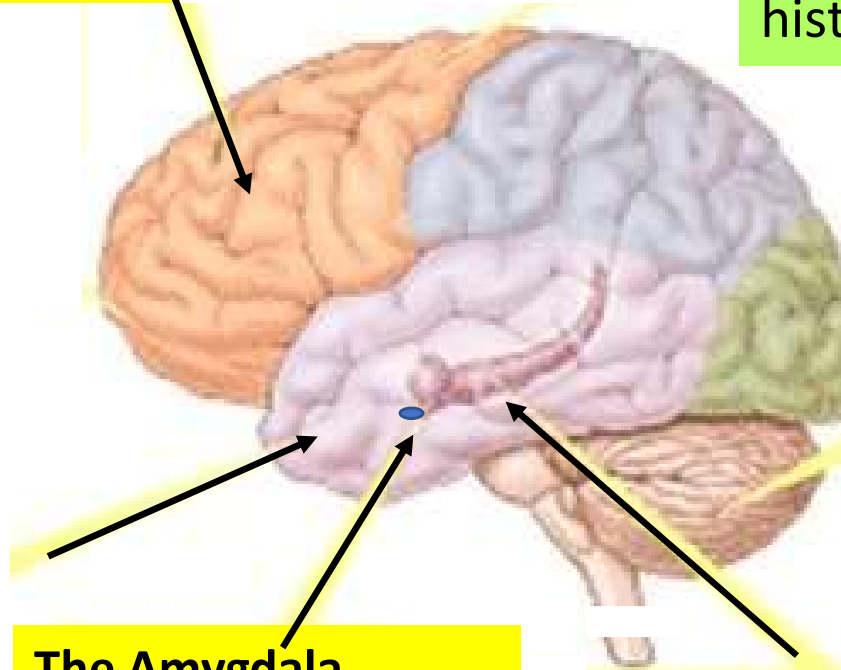
stores memories of specific people, places, and events (declarative memories)

## Episodic memory:

things that have happened **to you** over a lifetime

## Semantic memory:

**general worldly knowledge** that you have assembled over a lifetime, historical, political events



## The Temporal lobe

stores memories of specific people, places, and events (declarative memories) and contributes to the processing of new material in short-term memory

## The Amygdala

is vital to the formation of new emotional memories, mainly in response to fear, but also to love, grief, joy

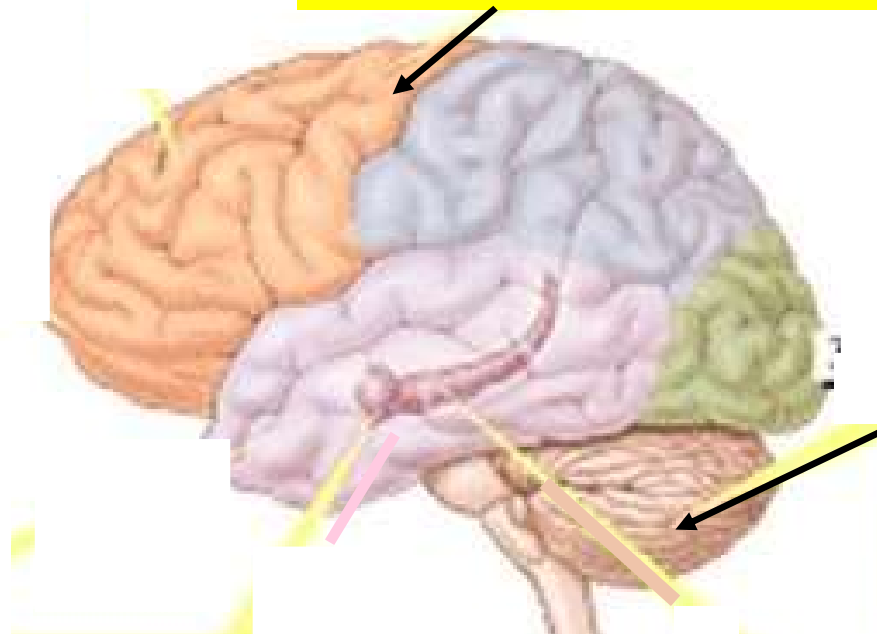
## The Hippocampus

plays a pivotal role in the formation of new long-term memories of specific people, places, and events

## Storage of procedural (motor skill) memories

### **The Motor cortex**

is involved in storing motor skill memories like playing an instrument (procedural memories)

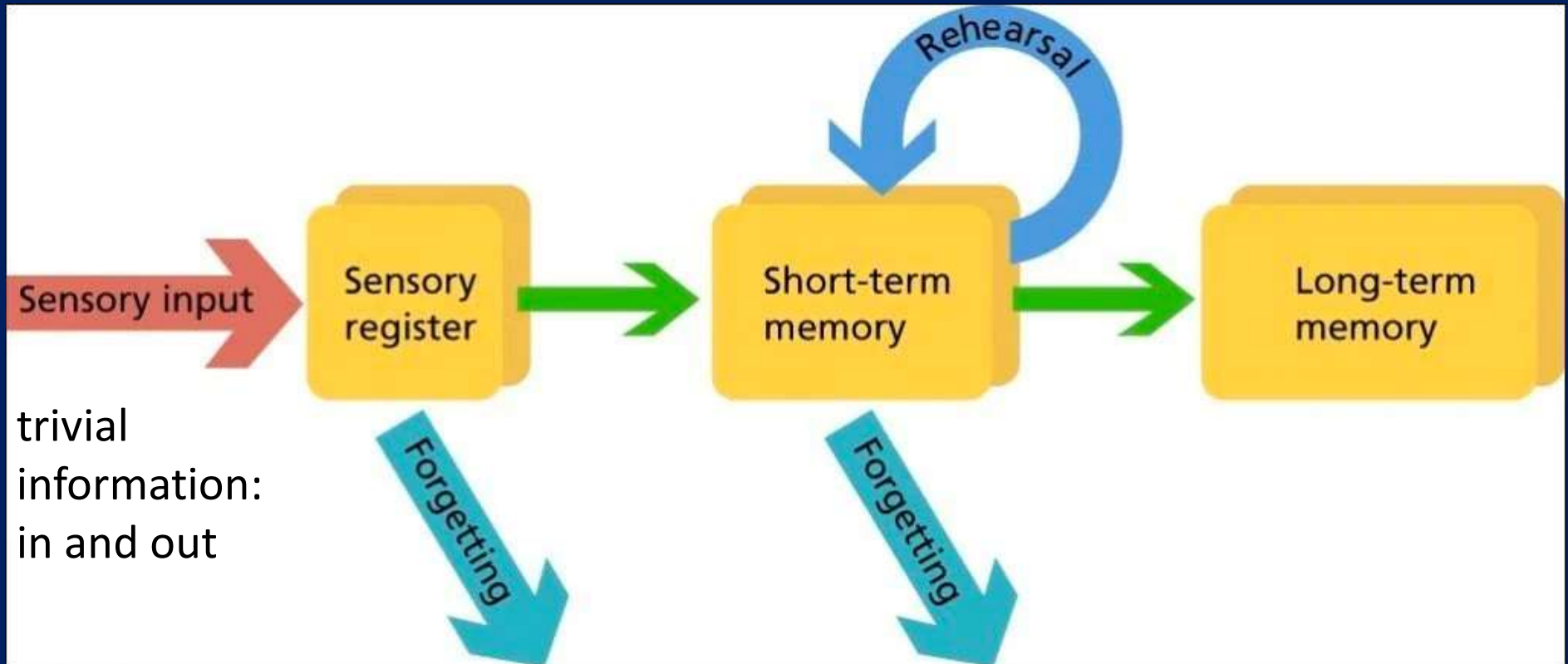


### **The Cerebellum**

plays an important role in the storage of motor skill memories (procedural memories)

## Short-term memory

Reading a phone no. -> store in short term memory -> dial and forget it  
Doing homework -> practice over and over -> store in long-term memory



After holding a phone number in short term memory long enough to dial it, you usually forget it. If strong emotions are involved and the amygdala is drawn in, the telephone number could be burned into your long-term memory.

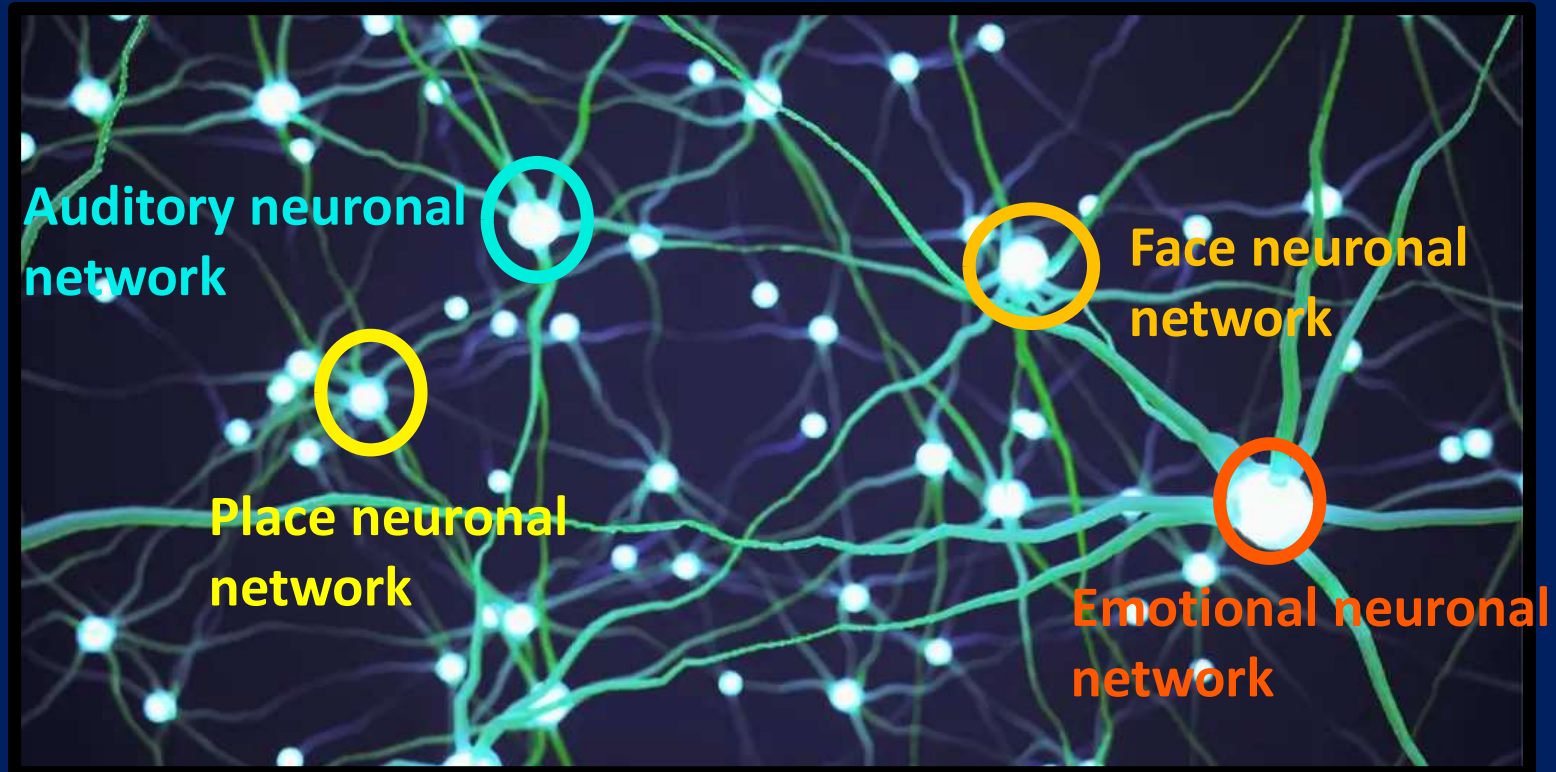
## Music and Emotions

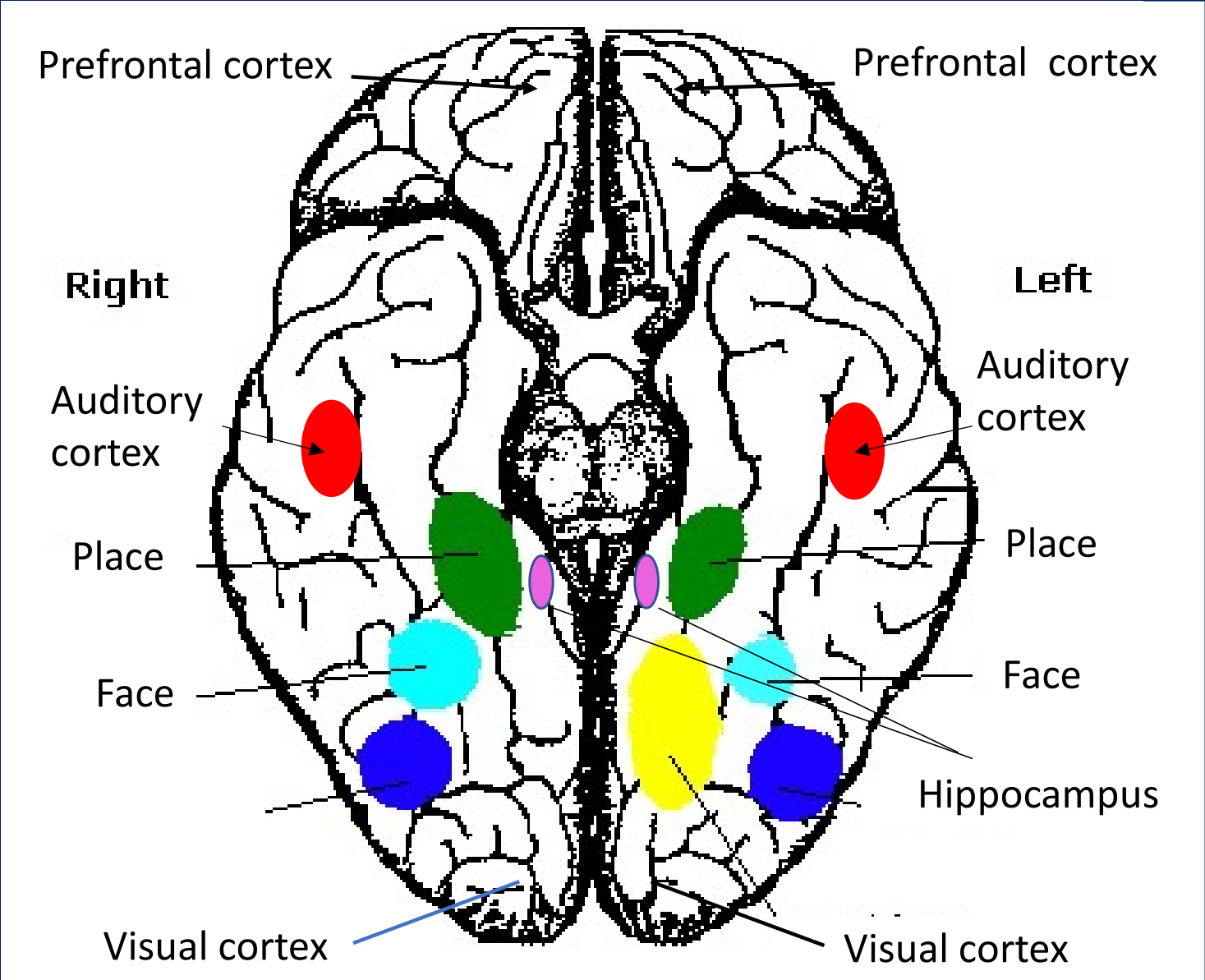
Listening to one's favorite/beautiful music makes the brain release dopamine, which makes one relax and less stressed, lowering blood pressure and heart rate.

Being angry, some may enjoy listening to aggressive music which matches their state of mind. Others find that aggressive music makes them angrier. Being sad, some find that sad music makes them feel better, while others find that it only makes the pain worse and seek out happy music instead.

Studies show that music without lyrics induces emotions faster than music with lyrics; music goes straight to the emotional parts of our brains. Sometimes we don't need more than the title, e.g., *None but the Lonely Hearts*, to be flooded with feelings.

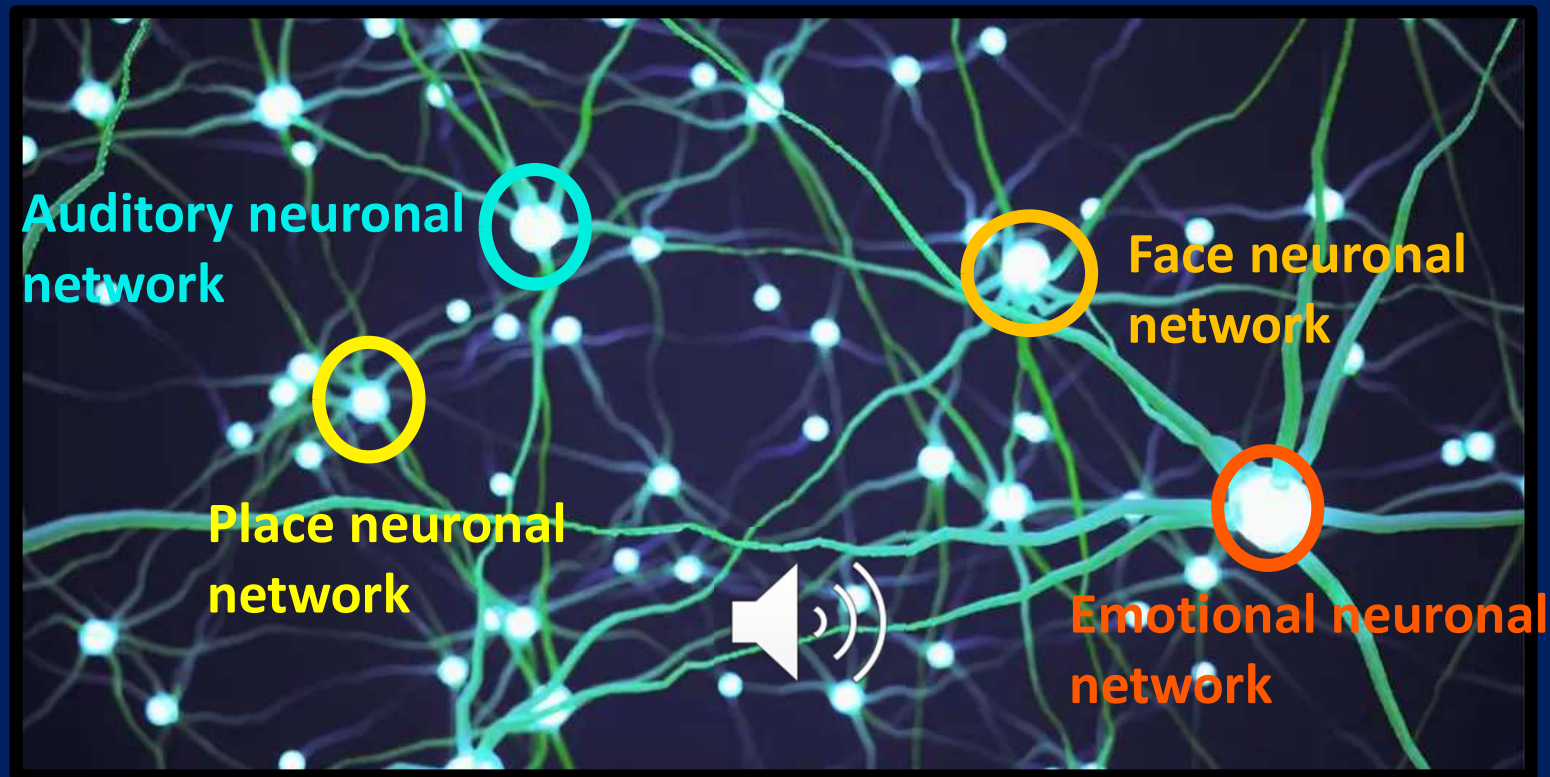
## Storing and retrieval of memories: an example





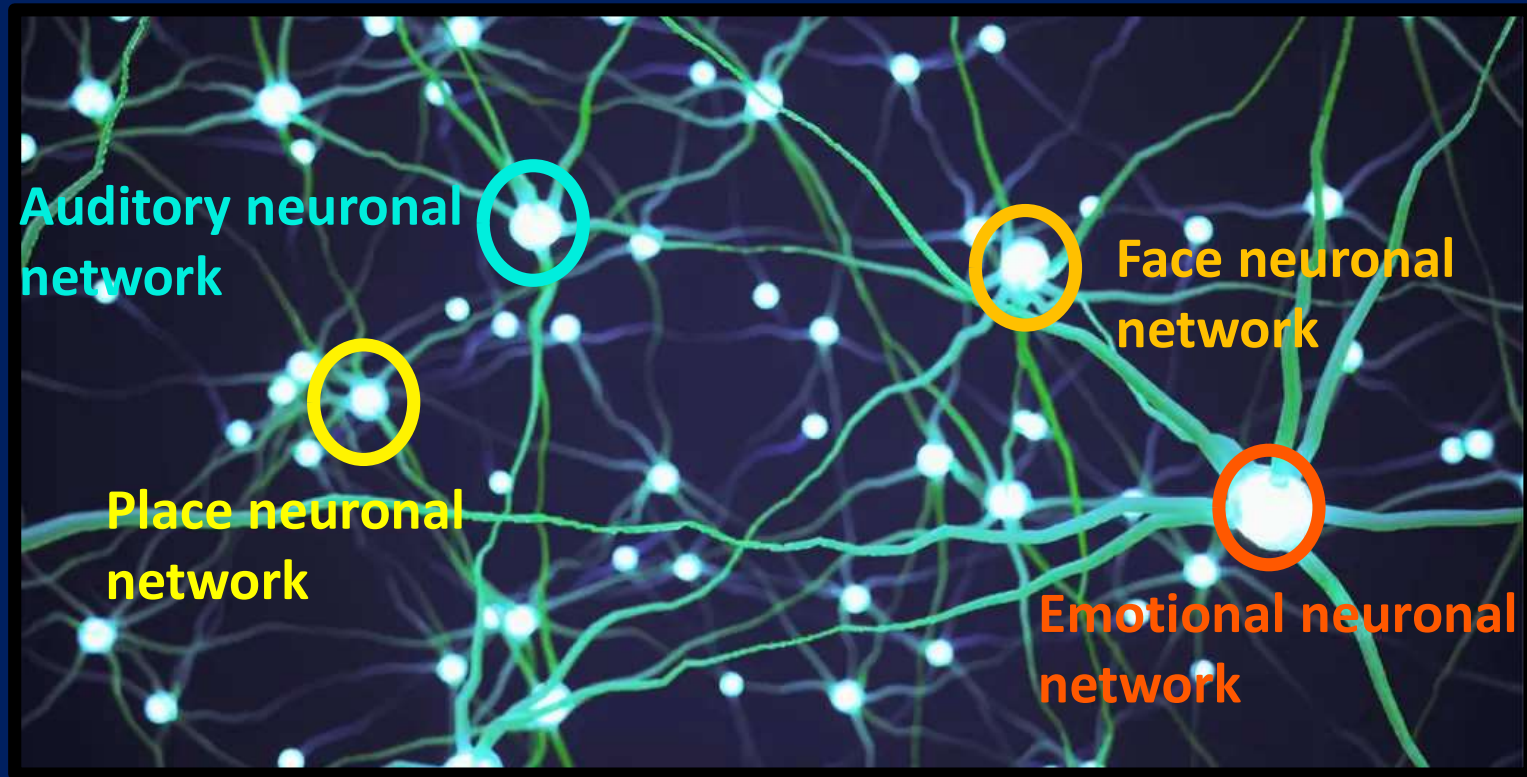


## Storing and retrieval of memories: an example



**Storing of memories:** You are at a concert and meet the **person of your dreams**. The orchestra plays “None but the Lonely Hearts.” The short term memory and the amygdala send a strong signal to the hippocampal memory system that this is an important event. The hippocampus binds the inputs together and sends the memory to the prefrontal cortex for storage, forever tying the person to this particular piece of music.



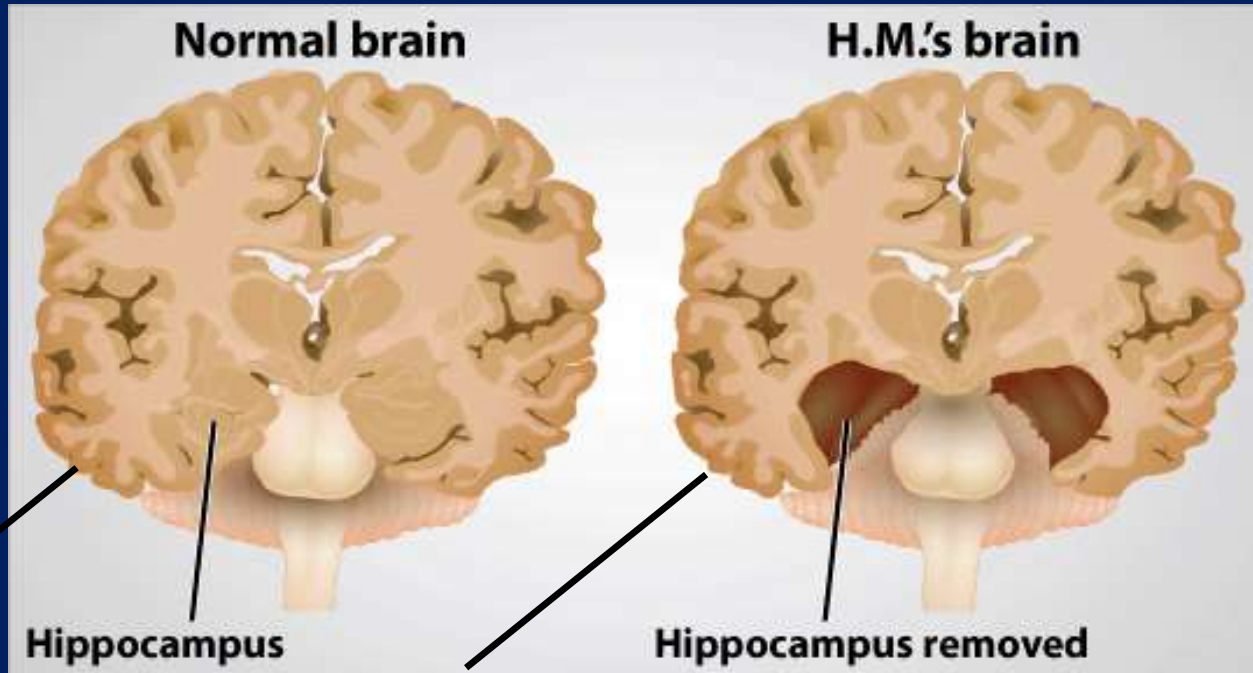


**Retrieval** of that special memory occurs when the prefrontal cortex receives a cue, e.g., hearing “None but the Lonely Hearts” again. Everything comes back in a flash: How you dated, how much you loved the person, the sad break up, which still fills your eyes with tears, particularly when you hear that (damned) “None but the Lonely Hearts.” After all, it was all his/her fault!

**WARNING: your memories could be distorted....**

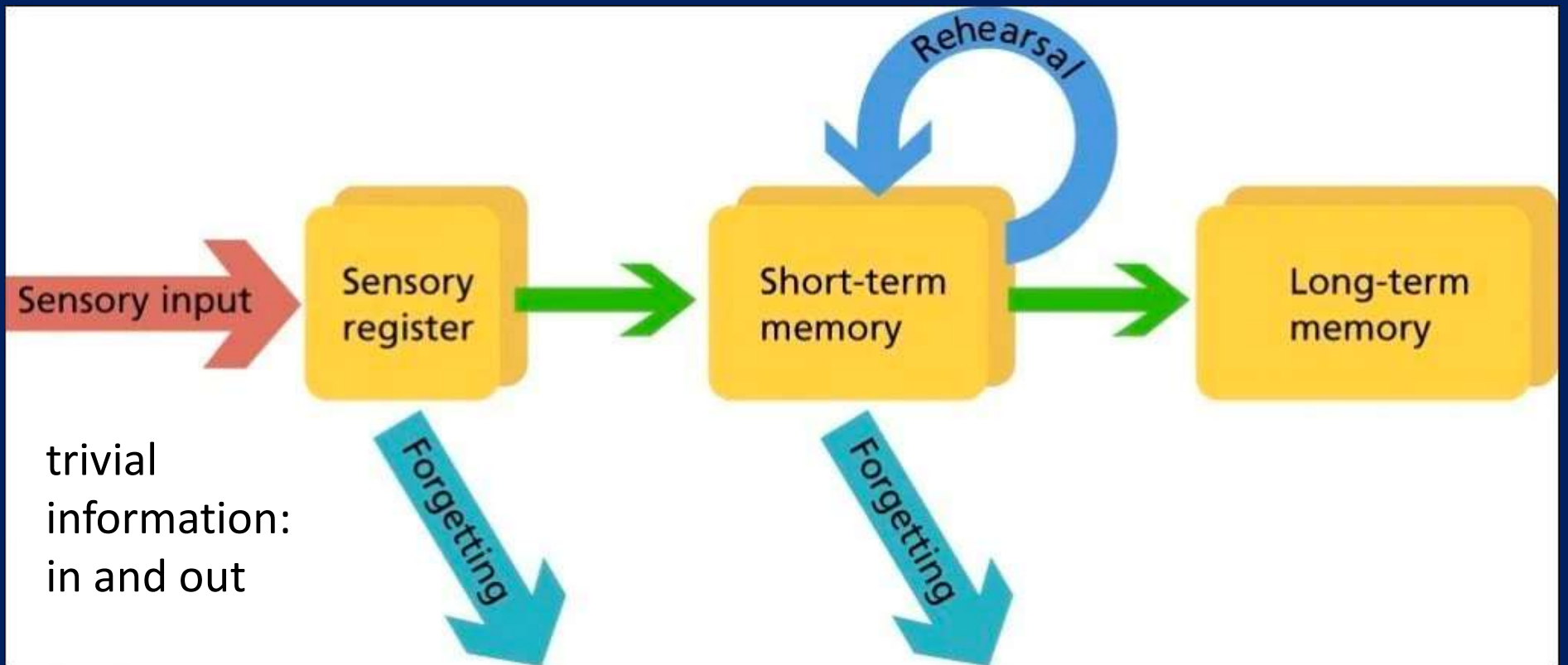


## What happens if the hippocampus is destroyed?

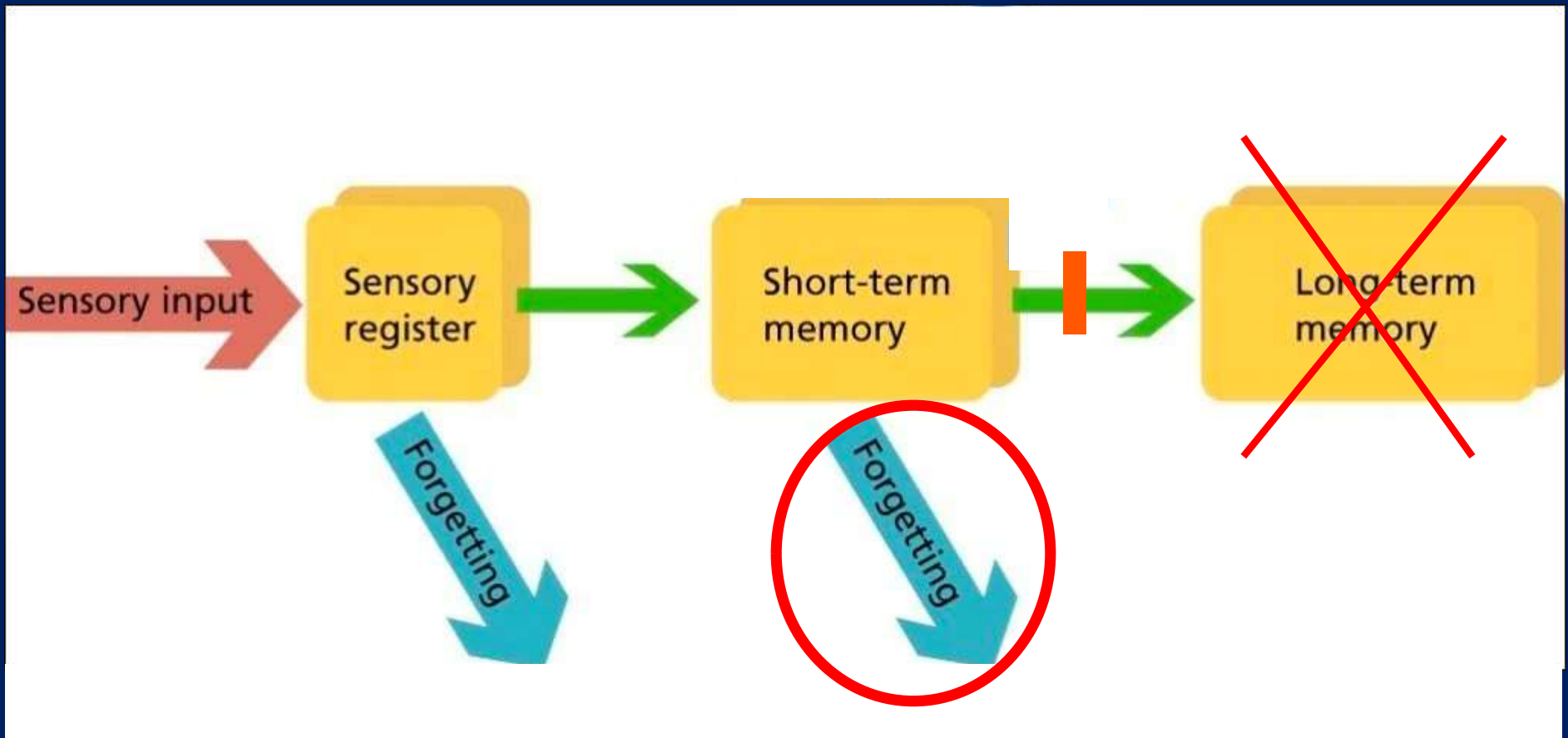


### The famous case of H.M. (Henry Molaison (1926-2008))

H.M. had debilitating epilepsy. In 1953, at age 27, he had both hippocampi surgically removed. Afterwards he became unable to form new memories and could only remember parts of his past and historical events from before his surgery. The first evidence that the hippocampus is vital for storage of memories.



## Memory storage in people without a hippocampus



They have normal short term memory, but nothing gets stored anywhere; everything gets dumped and is lost forever

## The amazing case of Clive Wearing

**Clive Wearing's brain**



**Hippocampi destroyed**

Clive's temporal lobes, as well as parts of his inferior frontal lobes, were destroyed by herpes encephalitis in 1985. He has no recollection of the past and cannot store new memories.

**While his declarative (semantic and episodic) memory is dead, his unconscious procedural (motor skill) memory is intact**

## The amazing case of Cliff Wearing

- \* musicologist, renowned conductor, and choral master
- \* not been able to form new memories since his illness in 1985
- \* no conscious memories of the past except for his wife Dorothy and that he is a musician
- \* lives in increments of up to 30 seconds (short term memory)
- \* feels like a living dead

### Yet:

- \* his professional skills are unimpaired
- \* he can conduct an orchestra without incident, play the piano, and sing

# Clive's story





Clive, music, and consciousness



Clive's sister Adele has just left. Clive talks about his situation.



