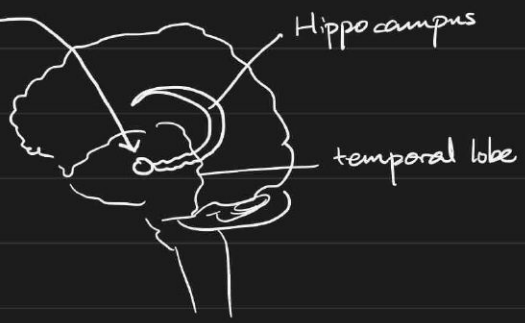
Lecture 9 Neural Basis of Memory and Learning

* Our brains are plastic!
- Memory problems:
  - Retrograde amnesia: can't remember past
  - Anterograde amnesia: can't learn new things
  → Rare case of both — Clive Wearing

#1 Long-term potentiation

* NMDA Receptors — protein responsible for learning
  - Works if post synaptic cell already partially depolarised
  - Things attached, calcium goes in, and:
    - Make more non-NMDA receptors
    - Make non-NMDA receptors more responsive
    - Maybe make more dendrite
  * If two neurons fire together, NMDA bonds & connection builds

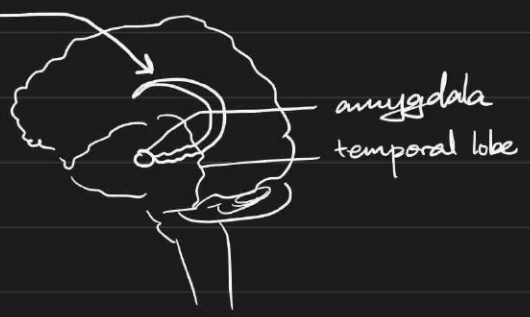
#2 Fear conditioning (Amygdala) — this thing



- (from greek word for almond)
- Activates when scared
  → Angry person looking at you
  → Scared person looking at behind you
- Fear conditioning
  → Play tone and shock mouse (classical conditioning) → mouse freezes upon hearing tone; remove amygdala → no longer freezes
  → Iowa gambling task: Ppl without amygdala no longer fear even when losing money when gambling.

- Fear extinction.
  - New learning ("hey don't be afraid") → override amygdala response (the prefrontal cortex inhibits amygdala)
  → PTSD — extreme traumatic event → prefrontal cortex no longer inhibits amygdala → intrusive thoughts.

#3 Long-term Memory (Hippocampus) — this thing



- (name means sea horse)

* Awareness and memory
  - Implicit memory — memory not aware of
    "first time eating egg plant"
  - Explicit memory — involves awareness
    "your mum's name"

↖ Hippocampus works with this

→ H.M. case — Hippocampus removed to stop epileptic. Outcome:
  - Normal IQ & reasoning
  - Can't make new long-term memory. Can learn information
  - "Every day is alone in itself, whatever enjoyment I've had, and whatever sorrow I've had" — H.M.
  - But H.M. can have implicit learning
    → mirror tracing task
    → negative condition: shake hand — get shocked — a few times later refuses to shake hand.

* Hippocampus for navigation
  → Mouse learns to find platform in water; no hippocampus mouse does not learn.

→ fMRI. Watch hippocampus when ppl learn → turns out ppl better recall things they learnt when hippocampus lighted up

#4 Sleep, Caffeine, and Memory

→ Experiment: ppl do better if they (nap + REM) than (nap) than (no nap)

* Sleep helps to consolidate memory!
  - Maybe cuz hippocampus is not encoding new memory