Lecture 18 (March 7th): LEARNING & MEMORY #1
Lecture Outline

This Lecture: Psychology of Memory and Brain Areas Involved

Next lecture: Neural Mechanisms for Memory

1) Psychology of Memory

2) Role of Hippocampus in Memory
Psychology of Memory

Memory

STM $\overset{\longrightarrow}{\longrightarrow}$ LTM

Explicit
  - Episodic (events)
  - Semantic (facts)

Implicit
  - Procedural
  - Priming
  - Conditioned Responses
    - Operant
    - Classical
PSYCHOLOGY of Memory

Some Memory Terms:
Encoding: processing new information into a form that can be stored
Storage: maintaining a memory
Recall: to bring back to mind, to retrieve
Recognition: to perceive something as previously known, it is “familiar”

Short Term Memory (STM) vs. Long Term Memory (LTM)
STM: memory for things that just happened
limited storage 7 items (+/- 2)
LTM: memory for things that do not currently occupy your attention;
they must be recalled or recognized

Permanent memories require:
STM -> consolidation -> LTM
How best to consolidate STM -> LTM? i.e., how best to retain?
1) You need GLUCOSE (brain’s energy source)
   a) get it from food
   b) get it from Adrenaline and Cortisol (remember from last lecture?)
   In response to stress….

   **Adrenaline** is released from *Adrenal Medulla*
   **Cortisol** is released from the *Adrenal Cortex*
   … which results in Glycogen -> **Glucose**

   (also, happens when *aroused in general*, from an emotional/meaningful event)
   
   ![Adrenaline Dose vs Memory Retention Graph]

   Do not study when you’re feeling bored!
   Do not study in a panic!
How best to consolidate STM -> LTM (con’t)?

2) Study From Different Angles.
   And, make links with other known things.
   (It’s easier to recall a story as a whole rather
    than a bunch of unrelated facts).
   Don’t “commit to memory”, do “commit to understanding”

3) Sleep / Alcohol / Midazolam
   Stops new memories from being formed, which would otherwise
   interfere with the memory consolidation of items just learned
LTM: Explicit Memory

**Semantic:** facts that can be stated, things that you “know”

**Episodic:** memory for events that you’ve experienced, things that you “remember”
LTM: Implicit Memory

**Procedural memory**: procedures, motor skills, habits

Mirror Drawing

Tower of Hanoi
LTM: Implicit Memory

Primbing: when exposure to a stimulus influences behavior (but you are not consciously aware)

A) Word priming: word or non-word?
   Test = “doctor” vs. “pwnig”
   Prime = “nurse” vs. “car” (… the prime is implicitly put in memory)
LTM: Implicit Memory

**Priming:** when exposure to a stimulus influences behavior (but you are not consciously aware)

B) “Subliminal” Advertising: ALL OVER THE PLACE!
A) Operant Conditioning:
   1) Reward (or “Reinforcement”) -> increase the likelihood of behavior X
      i) positive: “if you do X, I’ll give you candy”
      ii) negative: “if you do X, I’ll stop nagging you”
   2) Punishment -> decrease the likelihood of behavior Y
      i) positive: “if you do Y, I’ll nag you”
      ii) negative: “if you do Y, I’ll stop giving you candy”

“Carrot and Stick”
A) Operant Conditioning: “If you do this, I'll do that”

B) Classical Conditioning: uses “natural”, automatic response
   “When I do this, you'll do that”

Developed by Ivan Pavlov, Nobel Prize 1904
Classical Conditioning

Before
- Unconditioned Stimulus (UCS)
- Unconditioned Response (UCR)
- Neutral Stimulus
- No Conditioned Response

During
- Neutral Stimulus + Unconditioned Stimulus (UCS)
- Unconditioned Response (UCR)

After
- Conditioned Stimulus (CS)
- Conditioned Response (CR)
Watch what I can make Pavlov do. As soon as I drool, he'll smile and write in his little book.
LTM: Implicit Memory

Conditioned Responses

Classical Conditioning
Donald Hebb (1950s): Learning/Training is an increase in connectivity between neurons as a result of simultaneous activity in those neurons ("Hebbian" Mechanisms) (more next next lecture)

So, let’s use Hebbian Mechanisms to explain Pavlov’s Dog!
Role of the Hippocampus in Memory

Human Hippocampal Damage -> Memory Loss ("Amnesia")

First, let’s define different types of Amnesia

- **Retrograde Amnesia**: loss of events *prior to* injury
- **Anterograde Amnesia**: inability to create new memories *after* the injury

Symptoms after Hippocampus Damage (H.M. and others):
- Severe Anterograde amnesia, but only mild Retrograde amnesia
- Anterograde Amnesia for LTM, not STM
- Anterograde Amnesia for explicit LTM, but not implicit LTM (e.g., mirror drawing)

Ok, so ……Role of the Hippocampus
- Not where memories are stored (since only mild retrograde amnesia)
- Consolidates STM -> LTM
- Consolidates Explicit, but not Implicit, LTM

But for SPATIAL memory in RATS (and maybe humans?), it IS where memories are formed and stored.
The Role of the Hippocampus in Spatial Learning (Rats)

First, what is Spatial Memory? Explicit? Implicit?

Hippocampal Lesions in Rats:
- a permanent loss of the learned water maze (Hippocampus necessary for retention, i.e., it is where spatial memories are stored)