COGS 107B

TA: Alexander Johnson
abj009@ucsd.edu

Office Hours: Mondays 1-2pm CSB114 or by appointment
Week 8

Midterm 3 Topics:

Learning
Memory
Motor Control
Prefrontal Cortex & Attention

Learning and memory are dense and incorporate a lot of previous topics
study early

Midterm 3 is non-cumulative 3/13/18 @ lecture time
OR the assigned date for this final
Learning

Key terms:

Strength / Potentiation / Depression (depotentiation) [Presynaptic & Postsynaptic]

What are a few mechanisms for potentiation?

- Boutons moving closer
- Immature -> Mature (change in resistance)
- Receptor density
- NT release changes
FMR gene disruption causes what?

Metabotropic Glutamate Receptor (mGlur) expression increases
Increase in immature spines - increased ‘noise’ & poor communication
Learning

What is STPD and how do neuromodulators set the context for it?

- no ACh, no NE (as in NREM sleep)
- ACh + NE (as in waking)
- NE. no ACh (??)
- ACh, no NE (e.g., REM sleep)

[Diagrams showing different conditions and their effects on synaptic change, spike-timing, and neuromodulation.]
Learning

How is the circuit of the Amygdala set up to allow for associative memory?

How does STDP play a role?
Learning

Why could NE - blockers potential help remedy PTSD?

What word do we use to describe memories that are sensitive to change at the time of their reactivation? Labile
Memory

What are the 4 types of memories discussed in lecture?

What brain regions are they associated with?

- **Associative**
  - L.Amygdala

- **Explicit**
  - (Episodic/Declarative)
  - Hippocampus

- **Implicit / procedural**
  - Basal Ganglia

- **Working**
  - Prefrontal Ctx
Memory Impacts on the Brain

What Neurotransmitter can cause a ‘magnification’ of tone-representation? \( \text{ACh} \)
How can you endogenously (without drugs) cause the same effect? Make that tone salient

Learned Tone

![Control vs Trained Tone maps](image)

Polley et al., JNS, 2006

Tone + ACh

![Dorsal vs Anterior Tone maps](image)

Kilgard et al., Science, 1998
Spatial Navigation to the Rescue

Which neuromodulator predicts the strategy used by the animal? -how?

[ACh] increase in HPC predicts ‘listening to’ episodic place-memory
[ACh] increase in Basal Ganglia predicts ‘listening to’ implicit action-memory

What are Prospective/Retrospective/Generalized place fields?

A
Generalized

B
Retrospective (How did I get here?)

C
Prospective (Where am I going after?)

Subject 4, Unit 524

Subject 4, Unit 326

Subject 1, Unit 563
Prefrontal Cortex and Working Memory

How do cue-responsive and behavior-responsive neurons suggest working memory?

adap. from Chafee and Goldman-Rakic, JNP, 1998
A Note on Neuromodulators

We are seeing different mixes of neurotransmitter being present causing vastly different effects on neuron - neuron communication.

\[ \text{Acetylcholine (ACh)} \]

\[ \text{H}_3\text{C} \]

\[ \text{O} \]

\[ \text{N}^+ \]

\[ \text{CH}_3 \]

\[ \text{H}_3\text{C} \]

\[ \text{O} \]

\[ \text{N}^+ \]

\[ \text{CH}_3 \]

= ??

\[ \text{Acetylcholine (ACh)} \]

\[ \text{H}_3\text{C} \]

\[ \text{O} \]

\[ \text{N}^+ \]

\[ \text{CH}_3 \]

\[ \text{H}_3\text{C} \]

\[ \text{O} \]

\[ \text{N}^+ \]

\[ \text{CH}_3 \]

+ \[
\text{HO}
\]

\[
\text{HO}
\]

Dopamine

= ??

\[ \text{Acetylcholine (ACh)} \]

\[ \text{H}_3\text{C} \]

\[ \text{O} \]

\[ \text{N}^+ \]

\[ \text{CH}_3 \]

\[ \text{H}_3\text{C} \]

\[ \text{O} \]

\[ \text{N}^+ \]

\[ \text{CH}_3 \]

+ \[
\text{HO}
\]

\[
\text{HO}
\]

\[
\text{HO}
\]

Norepinephrine (NE)

\[
\text{OH}
\]

\[
\text{OH}
\]

\[
\text{NH}_2
\]

= ??