Review for Midterm 1

Study tips and insights to help you understand the material
Exam scope: All of the readings and lectures for weeks 1, 2 and 3.

Read and think about the review questions for each week.

Write out short answers for the questions....

TIP: Try to do it without your notes.
Share your knowledge: Participate on Piazza, call mom, tell your roommate...
When you actively process the information that is when the magic of learning happens.
What does sleep have to do with it anyway?

https://www.berkeley.edu/news/media/releases/2008/01/23_ucues2.shtml
What is Cognitive Science?

Interdisciplinary study of mind and its processes. **Main objective:** Understand how information is acquired, processed, transformed into behavioral output

What are its main disciplines?

- Neuroscience
- Philosophy
- Computer science
- Linguistics
How are these disciplines related?

Neuroscience: How does neural activity represent, store information and how does it translate to behavior?

Computer science: Create systems that simulate cognitive processes and output

Philosophy: Defines key questions: What is reasoning, meaning?

Linguistics: How is meaning/information represented and conveyed?
Effects of sleep deprivation:

**Short term** sleep deprivation leads to:
- Cognitive and behavioral changes
- Decreased ability to concentrate
- Decreased short-term memory
- Paranoia and hallucinations

**Long term** sleep deprivation leads to:
- Cardiovascular stress (elevated heart rate and blood pressure)
- Disruption of the glymphatic system and thus build up of toxins
- Impaired executive functions
- Impaired emotional responses
- Impaired decision making

In children chronic sleep deprivation may lead to hyperactivity and impaired interpretation of social cues
REM-sleep behavior disorder

- Paralysis during REM sleep does not occur → dreams are acted out
- Increased risk for neurodegenerative diseases

Sleep apnea

- Breathing pauses for seconds to minutes during sleep → body briefly jolts to continue breathing
- Cognitive impairments
- Increased risk for diabetes, cardiovascular diseases
Me and you and cyanobacteria:

How are we similar to cyanobacteria?

- Predict rather than respond!
- Anticipate metabolic demands by increasing or suppressing protein expression, hormone, and neurotransmitter release

Why does “When we go to bed affects how long you sleep, no matter how tired you are.”?

How is the functionality of insulin affected by time of day?
Other sleep stuff to make sure that you understand:

Where and what is the master clock? What is the big deal about blue light?

What is the glymphatic system? How does it relate to removal of toxins from the brain?

What is sleep inertia?

What is the cognitive and physical performance of someone who has not slept in a 24 hour period?
<table>
<thead>
<tr>
<th></th>
<th>AD</th>
<th>PD</th>
<th>Huntington’s</th>
<th>ALS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sporadic or inherited?</strong></td>
<td>Mostly sporadic, sleep disruption? Can result from MPTP consumption</td>
<td>Mostly sporadic, sleep disruption?</td>
<td>Genetically inherited, expanded triplet repeat in huntingtin gene</td>
<td>Mostly sporadic</td>
</tr>
<tr>
<td><strong>Symptoms include</strong></td>
<td>Forgetfulness, disorientation, unpredictable behavior, sleep disturbances, depression</td>
<td>Slow movement, muscular rigidity, walking and balance impairment, tremor, changes in non-motor function</td>
<td>Involuntary jerking movements of the limbs, torso and facial muscles, mood swings, depression, irritability, slurred speech, clumsiness</td>
<td>Progressive paralysis starting in hand and feet or in muscles of speech and swallowing</td>
</tr>
<tr>
<td><strong>Pathologies (cellular and molecular)</strong></td>
<td>Plaques (beta-amyloid), Tangles (tau protein)</td>
<td>Loss of dopaminergic cells in substantia nigra pars compacta</td>
<td>Damage to neurons in the basal ganglia and cortex</td>
<td>Damage of motor neurons; loss control of voluntary muscle movements due to high levels of Glu, oxidative stress, environment, autoimmune disease</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>Drugs to regulate ACh and Glu levels</td>
<td>Dopamine enhancing drugs (e.g. levodopa), deep brain stimulation, pallidotomy</td>
<td>Currently no treatment</td>
<td>Anti-glutamate drugs, drugs to ease symptoms</td>
</tr>
</tbody>
</table>
Gotta know the brain!

What does each lobe do?

Where is:
M1
A1
V1
S1
Broca’s area
Wernicke’s area
SCN
Hippocampus
Corpus callosum
Dentate gyrus
CA1, CA2, CA3

What are the different lobes of the brain?
Sensorimotor Cortex

Wada Test

Table A: Hemispheric Control of Speech in Patients with Hemidystonia

<table>
<thead>
<tr>
<th>Handedness</th>
<th>Number of Cases</th>
<th>Left</th>
<th>Right</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>20</td>
<td>8</td>
<td>6</td>
<td>14</td>
</tr>
</tbody>
</table>

Broca's area

Wernicke's area

The 19th-century concept of language cortex:
1. Signers with (LHD) left hemisphere brain damage have sign-language deficits.

2. Wernicke’s area damage → comprehension problems.

3. Broca’s area damage → production problems.

- Leborgne’s brain had damage to the lower rear portion of frontal lobe, lower front portion of parietal lobe, and upper part of the temporal lobe.
- Broca deemed frontal lobe damage most important.
- Aphasia – partial or total loss of ability to articulate ideas due to brain damage.
- Broca’s Area – lower rear portion of frontal lobe, adjacent to motor cortex
  - Inferior frontal gyrus
  - Brodmann’s Areas 44/45

- 1871 Karl Wernicke reported a different sort of language disorder.

- Symptoms
  - Talk fluently, excessively
  - Use made up words
  - Don’t understand, in spite of intact hearing
What happens to signers with right hemisphere damage (RHD)?

Drawings (right) depict maintenance of a spatial framework for an extended discourse in American Sign Language.

(left) Many signers with RHD make mistakes in their spatial organization of a discourse.
Parents, listen next time your baby babbles

August 27, 2014

Parents who try to understand their baby’s babbling let their infants know they can communicate, which leads to children forming complex sounds and using language more quickly. The study’s results showed that children whose mothers attended more closely to their babbling vocalized more complex sounds and developed language skills sooner.

Language at age 3

- Good narrative skills
- Gestures
- [Over]generalizes concepts
  - Obi-Wan is a teacher, garage sale for robots
- Phoneme errors
  - Erratic production of final L sound
    - “well” followed by “wew”
  - sh -> s (siny guy, spacesip)
  - th -> f (He tried to do it without seeing, Darf Vader)
- Verb forms overregularized (“blew up”)
- Frozen phrases (Don’t talk back to Darf Vader, he’ll get ya!)
• Sequential

Speech sounds  Words  Grammar  Social context

• Overlapping

Speech sounds  Words  Grammar  Social context

Producing language

~6-8 months: Babbling onset
10-12 months: say first words
18 months: “word spurt”
This takes quite a while...

Show some word recognition at 6-9 months (Bergelson & Swingley, 2012)
Respond to word order at 17 months, before 2-word stage (Hirsh-Pasek & Golinkoff, 1993)
Show some social (?) responsiveness to language in infancy (Kinzler et al., 2007)
MANY studies showing non-adultlike sensitivity to differences in speech sounds, voices, vocal emotion, word stress patterns in preschool years and beyond

Speech sounds  Words  Grammar  Social context

A caution:
Perception precedes production.
There are two main neurogenic regions

The subgranular zone of the dentate gyrus:

The subventricular zone of the lateral ventricle:

Huart, Rondeaux, and Hummel, 2013


THE CASE OF H.M
New neuron development:
from dividing radial glia to mature granule cell

The dentate gyrus (in the hippocampus) is important for being able to discriminate between similar experiences.

Rats require a dentate gyrus in order to discriminate between a new and old spatial location.

The dentate gyrus (in the hippocampus) is important for being able to discriminate between similar experiences.

Humans show stronger activation of dentate gyrus when presented with an object subtly different from another object seen previously.

The dentate gyrus is important for helping us discriminate between similar experiences.

Neurons in the dentate can detect differences between experiences by demonstrating highly selective and specialized activity.

Adult-born neurons may facilitate the allocation of selective and dedicated activity for new experiences in the dentate gyrus.
Quantifying neuron proliferation (rate of division) and survival

**Measuring Proliferation**

**Control:** BrdU, DCX, Ki67
- No manipulation
- How many cells are dividing or are immature at this time?

**Experimental:** BrdU, DCX, Ki67
- Add manipulation
- How many cells are dividing or are immature at this time?

**Measuring Survival**

**Control:** BrdU
- No manipulation 1 week No manipulation

**Experimental:** BrdU
- No manipulation 1 week Add manipulation
- How many adult-born cells survived 4 weeks later?

**S-bromo-2′-deoxyuridine (BrdU):** A thymidine analog that is incorporated into the DNA of dividing cells during their S-phase.
Adult neurogenesis can be regulated at different stages of neuron development.

Increased proliferation does not necessarily mean that there are more that survive.

### Proliferation (rate of division):

<table>
<thead>
<tr>
<th>Factor</th>
<th>Effect</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress</td>
<td>Decreases</td>
<td>Schoenfeld and Gould, 2012</td>
</tr>
<tr>
<td>Physical Exercise</td>
<td>Increases</td>
<td>van Praag et al., 1999</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>Increases</td>
<td>Bokárt et al., 2009</td>
</tr>
<tr>
<td>Aging</td>
<td>Decreases</td>
<td>Kuhn et al., 1996</td>
</tr>
<tr>
<td>Seizures</td>
<td>Increases</td>
<td>Jessberger and Parent., 2015</td>
</tr>
</tbody>
</table>

### Survival:

Many things can influence adult neurogenesis survival is highly regulated

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<thead>
<tr>
<th>Factor</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Learning</td>
<td>Increases</td>
<td>Dupont et al., 2007</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Decreases</td>
<td>Crews and Nixon, 2004</td>
</tr>
<tr>
<td>Dietary Restriction</td>
<td>Increases</td>
<td>Kitamura et al., 2006</td>
</tr>
<tr>
<td>Enriching Environments</td>
<td>Increases</td>
<td>Tashiro et al., 2007</td>
</tr>
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