

## Introduction to Cognitive Psychology: PSY 200

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### **Study Guide for Exam 1**

*Exam Date: 13 September 2023*

The exam will include 25 multiple choice questions worth 2 points each and 5 short answer questions worth 10 points each. Total points on the exam is 100. This exam makes up 15% of your class grade. The exam is given in class.

Make sure you understand the following topics. The exact nature of the question is what I think up for the exam, but if you understand all of the following topics well, then you should be able to answer a variety of questions on the topics. If a researcher's name is given here, you should be certain that you know the name and the associated experiment or theory.

#### **Lecture 2: Brain parts**

1. Know the difference between the fore-brain and hind-brain. Know the parts of the hind-brain that are related to cognition.
2. Know what contralateral processing refers to in the brain. Be sure to be able to describe contralateral processing of visual perception.
3. Be able to describe the effects of cutting the corpus callosum between the left and right brain hemispheres. Be able to describe both the general behavior and the experiment that reveals the fundamental differences between the hemispheres.
4. Be able to describe the key stimuli, methods, and data from the CogLab Brain Asymmetry experiment. Be able to explain why left-handed and right-handed people were expected to have different data.
5. Know the basic anatomical structure of the cortex. Be able to list the lobes of cortex and describe some of their properties related to cognition.
6. Be able to describe the properties of the primary sensory area.
7. Know what Brodman's areas are.

#### **Lecture 3: Brain scans**

1. Understand the terms spatial and temporal resolution as they relate to brain scans. How does poorer resolution limit the use of a tool? Be able to describe the advantages and disadvantages of EEG and fMRI in terms of spatial and temporal resolution.
2. Be able to describe what is measured with EEG brain scans.

3. Be able to describe (in general terms) how an MRI operates and what information it provides about the brain.
4. Be able to describe (in general terms) how a fMRI operates and what information it provides about the brain and cognition.
5. Know what the BOLD signal is in fMRI (in general terms).
6. Be able to explain why the difference map is important for identifying the function of brain areas. Be to explain why one must contrast the right types of scans.
7. What is the relationship between the colors drawn on a fMRI scan result and brain activation?
8. Be able to describe some of the limitations and misconceptions about brain scanning techniques.
9. Be able to discuss some misconceptions about brain scans that you may hear in the popular press.

#### **Lecture 4: Brain scans**

1. Be able to describe (in general terms) how a brain scan is used to identify the relationship between cognitive events and brain events.
2. Understand how a difference in brain activity (as measured by fMRI, for example), may not actually correspond to cognitive differences.
3. Be able to describe the basic properties of the tongue display unit (TDU) and how it is used. What does a brain scan tell us about its use?
4. Be able to describe (in general terms) the method of reading the mind of someone who adds or subtracts numbers. What are some limitations to this method?
5. Be able to describe (in general terms) the method of thought reconstruction. Be able to describe the limits of all the brain scan mind reading techniques.
6. Be able to describe (in general terms) the difficulties with statistics in brain scans.
7. Know the basic anatomy of a neuron: dendrite, soma, axon, myelin sheath. Know the basic role of each part in the neuron's purpose.

#### **Lecture 5: Neurons and Neurotransmitters**

1. Be able to describe, in general terms, an action potential. Be able to describe the relationship between the chemical (sodium and potassium) and electrical characteristics of an action potential.
2. Be able to explain the difference between excitatory and inhibitory inputs to a neuron. Know how the different types of input affect the likelihood of the neuron having an action potential.
3. Be able to explain (in general terms) why inhibitory cells are necessary in the brain. Reference to epilepsy might be useful here.

4. Be able to describe a synapse: axon, dendrites, synaptic cleft, neurotransmitters, receptors. Be able to explain what happens when an action potential comes to the end of an axon.
5. Understand how a receptor–neurotransmitter pair are linked by molecular shape(s).
6. Understand how the neurotransmitter *dopamine* is related to brain diseases like Tourette’s syndrome and Parkinson’s disease. Understand, in general, how drugs like Haldol and L-DOPA help treat these diseases by affecting dopamine.
7. Be able to explain what Prozac does to the brain at the neurotransmitter level.
8. Know how LSD, curare, cocaine and morphine affect certain neurotransmitters. For curare, cocaine, and morphine be able to explain why this affects behavior like it does.

### **Lecture 6: Receptive fields**

1. Understand the term *firing rate*. Understanding why firing rate is more important than a single action potential.
2. Know the definition of a *receptive field*. Understand why it is defined as *changes*.
3. Be able to describe the CogLab Blind Spot experiment and results.
4. Be able to describe an experiment that would demonstrate the presence of an inhibitory surround for the on-center, off-surround cells.
5. Be able to explain the properties of on-center, off-surround receptive fields of neurons found near the retina of the eye.
6. Understand what kinds of spatial patterns of light will produce a good response for an on-center, off-surround cell.
7. Understand the receptive field of “simple cells”. Understand what kinds of spatial patterns of light will produce a good response for a particular simple cell.
8. Understand, in general, how more complex receptive fields are built up from less complex receptive fields. (e.g. simple cells from center-surround cells, or complex cells from simple cells). This is sometimes called a receptive field hierarchy.
9. Know the properties of complex cells and how they are created by combinations of simple cells.
10. Be able to describe the properties of the receptive field of neurons in the inferior temporal cortex of monkeys.
11. Be able to argue against the idea that there is a *single* cell that exclusively responds to the presence of your grandmother’s face.

### **Lecture 7: Neural networks**

1. Be able to explain the resonance hypothesis. What does it mean in terms of the relationship between neural behavior and cognition?

2. Understand the terms: activation, connection weight, update. Know what they are most closely associated with in real neural systems.
3. Understand the update rule for the network we discussed in class. You do not have to memorize the mathematical equation, but be able to describe the basic mechanisms of the rule.
4. Understand what it means for the network activities to “settle down.”
5. Understand how a network can have “error correction capabilities.”
6. Understand how a network can “tolerate the loss of some cells.”
7. Understand how feedback in the network is related to expectation through the pattern of connection weights.
8. Understand how network behavior creates illusory contours.

### **Lecture 8: Neural learning**

1. Understand that learning in a neural network corresponds to changing connection weights.
2. Understand the concept behind Hebb’s rule for neural learning.
3. Understand how Hebb’s rule is applied to the neural network discussed in class.
4. Be able to explain how a network that learns can *remember* things it has previously experienced.
5. Understand why this type of learning might be important for things like implicit learning or eye-hand coordination.
6. Understand how some aspects of virtual reality may demonstrate this type of learning.