

## Cumulative Final Exam Review

### Exam 1 Outline

Intro to Cognitive Psych & Evolution of Cognition: Ch. 1, & 8-28 / 9-4 Lectures

**Key Ideas for understanding Cognitive Psych perspectives**

- Cognitive Psychology studies all of the discrete mental processes that enable any form of “thought” or “behavior.”
  - This can range from very basic processes:  
Reaction Time/ The Sea Squirt
  - To very complex processes:  
Driving & Reading  
Belief Systems & Decision Making  
The thought process of chess experts
- Cognitive Psychology is highly analytical and detail oriented.
 

**Ultimate (why) vs. Proximate (how) Causes**

  - Ultimate Causes are concerned with the Evolutionary reasons to why a cognitive process or phenomenon exists:
    - What adaptive value did it have?
    - How does it function to increase the fitness of an organism?
  - Proximate Causes focus less on the WHY and more on the HOW:
    - How are you able to read and understand this sentence?
  - Proximate explanations in cognitive psychology largely take an Information Processing perspective: Cognitive processes happen in a series of sequential stages. At each stage, something new is added to our understanding of that info. An eventual response is the outcome of this series of stages and operations.

**Mind as a Kluge - Kluge (Gary Markus):**

- A system, especially a computer system, that is constituted of poorly matched elements or of elements originally intended for other applications.
- A clumsy or inelegant solution to a problem.
 

**Adaptations vs. exaptations**

  - Cognitive functions are a mix of adaptations to specific needs and exaptations (new uses) built onto these adaptations
    - Hippocampus & Memory
  - Existing functions can be used in novel ways, but these exaptations may look “glitchy” because of their original use
    - Ex: Stereotyping & Categorization processes
    - Ex: Getting ready for School on a Saturday (proceduralization)

**Localization of function (modularity)**

- The Mind is largely modular (Soft Modularity)
  - Specific adaptively-relevant tasks are handled by specific brain regions/networks
  - Also called “Localization of Function”

**Evolution is stingy**

- Evolution is “stingy” & Neural tissue is very “expensive”
  - Human brains comprise 2% of our body weight but demand 20% of our caloric energy. New neurons & brain regions are expensive.
  - Therefore, evolutionary pressures cause cognitive functions to be just good enough rather than optimal. Newer parts are the first to be de-prioritized.

### **Hierarchical Organization of information processing**

- Within brain regions, different areas process and contribute different pieces of information, which are organized hierarchically into a larger whole.
- We can learn to process and recognize all kinds of things because of association area activity
- The idea that stimuli are processed in multiple stages and brain regions that build from less complex (edges, orientation, lines) to more complex (object recognition, reasoning) illustrates this principle of cognitive neuroscience

Sensation and Perception: Ch. 2 / Supplemental Reading (hallucinations) & 9-9, 9-11, 9-16 Lectures

### **Sensation vs. Perception**

- Two ways for information to enter the mind:
  - Through recall/retrieval (memory)
  - Through sensory systems – vision, hearing, touch, smell, taste, (proprioception)
- Perceiving what the world is like is a multi-stage process (Hierarchical Organization)

#### **Function of sensation & perception**

- Sensation - The detection and basic sensory experience of environmental stimuli, such as sounds, objects, and odors
- Perception - The process of integrating, organizing and interpreting sensations in meaningful ways

#### **Sensation without perception (and vice versa)**

- What's the difference between sensation and perception?
  - Ex: Stroke victim saw pixels, not numbers (Sen. w/o Perc.)
  - Ex: Prosopagnosia or face-blindness (Sen. w/o Perc.)
  - Ex: Phantom Limb pain (Perc. w/o Sen.)
  - Ex: A blind person "seeing" with their hands activates vision centers (Perc. w/o Sen.)

### **Absolute Threshold vs. Just Noticeable difference**

- Our sensory systems seem to be designed to "care" more about relative thresholds, or sensing changes
- Weber's Law - The Just Noticeable Difference between two stimuli depends on the intensity of the original stimuli. In other words, we don't perfectly sense the objective qualities of stimuli - instead, they are sensed in relation to other stimuli. (Ex: Pebble vs. Rock)

#### **Sensory adaptation (aka habituation)**

- The decline in sensitivity to a constant stimulus
  - We adjust to the lights & smells of a room, even though they may be initially sensed as intense.
- Perception is SELECTIVE! Some info gets non-consciously filtered.

### **Transduction**

- The process by which energy from the environment gets sensed & encoded into a neural signal
- Not all energy can be sensed (not all can stimulate sense receptors)
  - We don't sense radio waves, television waves, or ultraviolet light, though they're all around us.
  - We don't hear the full soundwave spectrum (dogs hear higher, elephants lower)
  - \*If these were very survival-relevant, we would.

### **Vision (early perception)**

- Perceiving what the world is like is a multi-stage process
  - 30 different brain regions contribute to vision, each by adding their own piece of info to the bigger mental picture

#### **Hierarchical organization of the visual pathway**

- Front of the eye (lens, cornea, pupil) simply focuses light onto retina

- Bipolar & Ganglion Cells initially organize & encode info from the rods & cones. Ganglion axons = optic nerve
- Thalamus further encodes info & sends it to correct area of visual cortex, where specialized areas handle color, edges, distance, and motion.

#### Encoding of retinal image from sense receptors to V1 cells

- 200 million cells in primary visual cortex (aka V1, striate cortex) create a "neural image"
  - A neurally-encoded representation of the stimuli hitting the retina.
- Different cell columns respond to different stimulus properties: stripes, edges, curves; angles; width; movement, brightness, color
- Respond preferentially to one eye or the other
- Respond preferentially based on where in visual field stimulus is located

#### 3 evolutionary questions for perception to solve

- What is it (object recognition)
- How far is it (from me, especially)
- Where is it going (motion)

\*We figure this out through both Bottom up vs. Top down processing

#### Middle vision

- Loosely defined stage of visual processing; the intersection of Bottom-up & Top-down processes
- After basic features have been extracted from the image (early vision... primary visual cortex); Before object recognition and scene understanding (higher-order perception)
- Goal: to organize elements of a visual scene into groups that we can then recognize as objects.

#### What vs. where pathways

- What: shapes, size, object & facial recognition, color
- Where: orientation in space, depth, motion

#### Bottom-up vs. Top-down processing

- Bottom up processing (direct perception) is the building up of a perception based on the individual features of a stimuli
- Top down processing suggests that our prior experiences and memory guide our perceptual expectations and allow us to see the "whole" without initially processing all the parts individually (constructive perception)

#### Object recognition

Bottom-up theories:

##### Feature analysis - Template Matching

- Object recognition is preceded by a process in which complex stimuli are identified according to simpler features
- Cognitive system is set-up to decompose objects into features and match existing inventory of features to a representation
  - Ex: Dr. Bolte Taylor dialing the phone
- Computers that recognize letters are successful 95% of the time using these principles, even with varied hand writing

##### Geon theory - Recognition by components