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Sensation and Perception

What is Sensation?

- **Sensation** = the process by which action potentials that originate from sensory neurons are delivered to the brain
- **Perception** = the process by which sense data is processed and interpreted by the brain
- **Bottom-Up** = term that describes how **sensation** occurs
 - Low-level processing occurs early on in the transmission
 - The more high-level, pattern-recognition processing is done in the brain
- **Top-Down** = term that describes how **perception** occurs
 - Tasks are centrally organized by the brain

Psychophysics

- **Psychophysics** = the study of physical stimuli and how it affects behavior and mental processes
- **Stimuli** = any information that can be detected and interpreted by the brain
 - Light
 - Sound waves
 - Temperature
 - Pressure
- Thresholds
 - **Absolute Threshold** = the amplitude a stimuli must exhibit to be detected **50%** of the time
 - **Difference Threshold** = the difference in amplitude two stimuli must exhibit for people to perceive a **just noticeable difference** between them
 - * **Just Noticeable Difference(JND)** = the perception of a slight difference in magnitude of two stimuli

Signal Detection Theory

- **Signal Detection Theory** = a theory that attempts to explain how stimuli are reliably perceived in the presence of lots of background stimuli

- People’s likelihood of perceiving faint stimuli in noisy backgrounds depends on
 - * Experience
 - * Expectation
 - * Motivation
 - * Fatigue
 - **Subliminal** = a term that describes stimuli that are lower in amplitude than the **absolute threshold** needed to reliably perceive them
 - **Weber’s Law** = a law that states that the **difference threshold** depends on which *type* of stimuli you test
 - Light intensity must vary by 8% to be noticeable
 - Weight must vary by 2% to be noticeable
 - Tone frequency must vary by 0.3%
 - **Sensory Adaptation** = the increased threshold of perception that comes with repeated exposure to a certain stimuli
 - Rather similar to **habituation**
 - **Transduction** = the transformation of one form of energy to another
 - *eg.* Electromagnetic waves turning into action potentials
 - **Sensation** is the process of transduction from various media to action potentials
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Vision

- **Accommodation** = the process of the lens contorting in order to focus the image on the **fovea**
- **Acuity** = the accuracy and sharpness of vision
 - Typically deteriorates with age
- **Nearsightedness** = a condition in which it is easier for objects near to the eyes to be seen
- **Farsightedness** = a condition in which it is easier for objects far from the eyes to be seen

Psychophysics of Vision

- **Hue** = basically the color that the light is
 - Determined by **frequency/wavelength**
- **Intensity** = amplitude of EM wave
 - Associated with how **bright** the color is
- **Wavelength** = distance between the crests of the wave
 - Larger wavelength is associated with lower frequency
- **Frequency** = the amount of oscillations the wave undergoes per second
 - Measured in Hertz(Hz)

Anatomy of the Eye

- **Cornea** = the outer protective layer that covers the eye
- **Pupil** opening of the eye that is adjustable in size when **iris** contracts or relaxes
 - Acts similar to camera shutter
 - * If pupil is open, more light will make its way in
 - Pupil helps to adjust vision to changing light conditions
- **Iris** = a colored ring of muscle that contracts and relaxes to adjust the size of the pupil
- **Lens** = transparent structure that is behind the pupil that contorts to adjust the path of incoming light
 - Lens also inverts the image
 - * We don't see the world as upside down because the brain flips the image
- **Retina** = a layer of light-sensitive cells that start an action potential if hit by certain kinds of light
 - **Rods** = detect the outline of shape
 - * Cannot distinguish color
 - **Cones** = detect the color of objects
 - * Cannot distinguish movement
 - **Transduction** = converting of electromagnetic energy into chemical potential energy
- **Fovea** = area of the **retina** that the lens focuses the image onto
 - Where all fine details are made out

- **Optic Nerve** = a bundle of nerve tissue that conveys action potentials from the retina to the brain
 - Causes a **blind spot**, because there are no **cones** or **rods** on the optic nerve
 - **Blind spot** = a area of the retina that cannot sense light
 - * Caused by **optic nerve** and blood vessels
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Processing Visual Information

- **Ganglion Cells** = cells that connect to **bipolar cells**
 - Axon connects to **optic nerve**
- **Bipolar Cells** = neurons that connect **rods** and **cones** to the **ganglion cells**
- **Optic chiasm** = physical point when optic nerve splits into two distinct nerve tracks
 - Each track leads to one hemisphere
- Process
 1. Transduction occurs on the **cones** and **rods** and an action potential is generated
 2. **Bipolar cells** convey action potential to the **ganglion cells**
 3. **Optic nerve**, made of **ganglion axons**, conveys the action potential to the **optic chiasm**
 4. At the **optic chiasm**, information is segregated onto separate paths to each hemisphere
 5. Each path leads to the **thalamus**
 6. The thalamus directs the action potentials to **visual cortex**
- **Parallel processing** = the simultaneous processing of several different aspects of a problem congruently
 - The brain performs this on
 - * Color
 - * Motion
 - * Form
 - * Depth
- **Trichromatic Theory of Color Vision** = a theory that explains how humans see color

- Researched by **Young** and **Helmholtz**
- Relies on principle that there are *three* **primary colors**
 - * They discovered that using red, green, and blue, they could generate all possible colors
 - * They postulated that there are *three* corresponding photoreceptors
- **Opponent-Process Theory** = a theory that attempts to explain after-image effects
 - Postulates *four* photoreceptors
 - * Red and green = opponents
 - * Blue and yellow = opponents
 - Modern view of vision is a blend of **trichromatic theory** and **opponent-process theory**
- **Color constancy** = the phenomenon of the brain adjusting perception in different lighting conditions so that colors look the same
 - Color is fundamentally a psychological property, not a physical property