Ch. 4: Sensation and Perception

compiled by Cetin

I. Sensation and Perceptions
- a. Sensation
  - 1. Stimulation of sense organs
- b. perception
  - 1. Selection, organization, and interpretation of sensory input
- c. Determine reality for an organism
  - 1. Sum of sensation through the various sense organs of the organism
  - 2. formations of perceptions through neural processing of sensory info by central nervous system of the organism
  - 3. Different species have different perceptions of the environment because of the difference in sense organs and central neural processing mechanisms

II. Psychophysics
- a. Study of how physical stimuli are translated into psychological experience
- b. Thresholds
  - 1. are dividing points between energy levels of physical stimuli that can and can't be detected by an organism
  - 2. stimulus: any detectable input from the environment
  - 3. absolute thresholds for a specific stimulus is the minimum amount of stimulus intensity an organism can detect (ex. The minimum intensity of sound needed for a person to detect the presence of sound)
- c. Just Noticeable Difference (JND)
  - 1. A JND is the smallest different. in the amount of stimulation that a specific sense can detect
  - 2. Varies with the size of the initial stimulus. The JND increases with an increase in the size of the initial stimulus.
  - 3. Weber's law: states that the size of a JND is a constant proportion of the size of the initial stimulus
    - A. This constant proportion is called the Webber Fraction (ex. Webber fraction for lifting weights is about 1/30)
- d. Psychophysical Scaling
  - 1. Scaling: the subject makes a perceptual judgment on the magnitude of stimulus
  - 2. Fechner's law: magnitude of a sensory experience is proportional to the # of JNDs that the stimulus causing experience is above absolute threshold.
    - A. Indicates that the constant increments of increases in stimulus intensity result in progressively smaller perceptions of changes in the magnitude of the stimulus
  - 3. Magnitude Estimation
    - A. Subjects are asked to assign numbers to stimuli on the basis of the intensity they appeared to be
  - 4. All measurements of perceptual magnitude show that sensory experiences are not simple linear function of the physical intensity of the stimuli.
- e. Signal Detection Theory
  - 1. Proposes that the detection of a stimulus depends on decision-making processes as well as sensory processes
    - A. Decision-making processes and sensory processes are influenced by a variety of factors other than stimulus intensity
  - f. Subliminal Perception
  - 1. The perception of sensory input without conscious awareness
  - 2. Research studies have suggested the existence of subliminal perception
  - 3. Appears to generally produce weak effects on the subjects
  - 4. Subliminal stimulation have been used in advertising and other media
- g. Sensory Adaptation
  - 1. Is a gradual decline in sensitivity to prolonged stimulation
  - 2. Organisms tend to be more aware of the changes rather than the constants in their

sensory input

III. Sense of Sight: The Visual System
- a. Light is a stimulus for vision
  1. Light is a form of electromagnetic radiation that travels as a wave but also acts as a particle (photon)
  2. 3 Major Properties
     - A. Amplitude: affects perception of brightness
     - B. Wavelength: affects perception of color
     - C. Purity (how varied the mix of wavelength is): affects perception of the saturation or richness of color
- b. The eye is the sensory organ for vision
  1. Eye contains the sensory receptors and channels light onto the receptors
  2. Light passes through the cornea, pupil, and lens and falls on the light sensitive surface area of the retina
  3. The lens is the transparent eye structure that focuses the light rays falling on the retina
  4. Accommodation occurs when the curvature of the lens adjusts to the alter visual success
     - A. Focus on a close object (active process): lens of the eye gets fatter (rounder)
     - B. Focus on a distant object: lens flattens
  5. Nearsightedness: close objects are seen clearly but distant objects blurry because the focus of light from distant objects falls short of the retina
  6. Farsightedness: distant objects are seen clearly but close objects appear blurry because the focus of light from close objects falls behind the retina
  7. The pupil is the opening in the center of the iris that helps regulate the amount of light passing into the rear chamber of the eye
- c. The retina is the neural tissue lining the inside back surface of the eye; it absorbs light, processes images, and sends visual info to the brain
  1. Contains five major cell types: photoreceptors, bipolar cells, ganglion cells (sensory neurons), horizontal cells, and amacrine cells
  2. There are neural circuits in the retina which process visual info
  3. Optic Disk: a hole in the retina where the optic nerve fibers exit the eye
     - A. This hole creates a blind spot in the visual field
- d. There are 2 major types of photoreceptors: the rods and cones
  1. A human retina has about 100-125 million rods, but only 5-6.4 million cones
  2. Light from the center of the visual field falls on a part of the retina called the fovea, which contains only cones
  3. Parts of the retina that serve the periphery of the visual field is mostly rods
  4. Rods are more sensitive to low light intensity levels than cones
  5. Cone vision has better resolution than rod vision since there is a greater degree of convergence of rods onto ganglion cells than that for cones
  6. Rods provide black and white vision and cones provide color vision
- e. Dark & Light Adaptation
  1. Dark: the process in which eyes become more sensitive to light in low illumination
  2. Light: process in where by the eyes become less sensitive to light in high illumination
- f. Information processing in the retina
  1. The receptive field of a visual cell is the retinal are that, when stimulated, affects the firing of that cell
  2. Types of receptive fields of ganglion cells coming from the retina
     - A. On center-off surround: spot of light in center results in increase rate of action potentials, while spot of light in surround results in decrease rate of action potentials
     - B. off center- on surround: dark spot in center results in increase in rate of action potentials, while dark spot in surround results in decrease in rate of action potentials

3. Lateral Antagonism (Lateral inhibition)
    A. Occurs when neural activity in a cell opposes the activity in surrounding cells

g. Visual Pathway to the Brain
1. Optic Chiasm: where the optic nerve from the inside half of each eye cross over and then project to the opposite half of the brain
    A. Therefore info from both eyes goes to both the right and left hemispheres
2. Lateral geniculate nucleus (LGN) of the thalamus
    A. 90% of the axons from retina synapse in this nucleus
    B. Axons from the LGN synapse w/ the primary visual cortex in the occipital love
3. Superior Colliculus
    A. 10% of axons from the retina synapse here before going to the thalamus and then to the occipital lobe
    B. Pathway is used for coordination of visual info w/ other sensory info such as audition
4. Visual pathways show parallel processing, which involves simultaneous extracting of different kinds of info from the same input

h. Info Processing in the Visual Cortex
1. Feature directors: neurons that selectively to very specific features of more complex stimuli
2. Types
    A. Simple cells: respond to a line in a particular angle and position in visual field
    B. Complex: Respond to line at specific angle at various positions within its receptive field
    C. Cells in the temporal lobe respond best to focus

i. Color Perception
1. Subtractive color mixing works by removing some wavelengths of light leaving less light than what was originally there
    A. Pigments absorb some wavelengths and reflect others
    B. Subtractive primaries: magenta, cyan, and yellow
2. Additive color mixing (adding lights together)
    A. Additive primary colors: red, green, blue
    B. Complementary colors: any two colors that combine to produce white. Ex. yellow + blue, magenta + green, cyan + red
3. Trichromatic Theory of Color Vision
    A. States that human eyes have three types of receptors w/ different sensitivities to different light wavelengths
    B. Research has found three types of cones that absorb light best at blue, green, and red
    C. Color perception depends in part on the relative activity of the three classes of cones
4. Opponent Process Theory of Color Vision
    A. States that color perception depends on activity of cells that make antagonistic responses to three pairs of colors
    B. Three pairs are red V. green, yellow V. blue, black V white
    C. Ex. cells in LGN show excitation to red but inhibition to green
    D. After image: a visual image that persists after a stimulus is removed

IV. Sense of Hearing: The Auditory System
a. The stimulus is a sound wave in which a vibration in a medium such as air. Sound is a pressure wave
1. The major properties of sound
    A. Wavelength: affects pitch perception
    B. Amplitude: affects loudness
    C. Purity: affect perception of timbre

b. Humans hearing capacities

1. Frequency is inversely proportional to wavelength and is measures in cycles per second or hertz (Hz)
2. Frequency range is 20 Hz to 20,000 Hz
3. Amplitude is measured in decibels (dB) SPL
4. Loudness range is 0-120 db SPL

c. Sensory Processing in the Ear

1. External Ear
    - A. Pienna: collects sound waves, various degrees of directional collection depending on species
    - B. Auditory canal: conveys sound to middle ear
2. Middle Ear
    - A. Eardrum and Middle ear ossicles (hammer, anvil, and stirrup)
    - B. Function is to amplify sound wave. Compensates for impedance mismatch between air and fluid of inner ear
3. Inner Ear
    - A. Cochlea: fluid filled, coiled tunnel that contains the receptors for hearing
    - B. Sound vibrates oval window, the fluid of cochlea, and finally the basilar membrane
    - C. The Basiliar membrane runs the length of the spiraled cochlea and contains the auditory receptors which are called hair cells
    - D. Hair cells have cilia that protrude from them. Bending of the cilia stimulates the hair cells
    - E. Sound waves vibrate the basiliar membrane which in turn causes a bending of cilia of the hair cells which stimulates the hair cells