Textbook: Chapter 6 (page 216-263)

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Definitions

- Absolute threshold: the minimum stimulation needed to detect a particular stimulus 50 percent of the time
- Accommodation: the process by which the eye's lens changes shape to focus near or far objects on the retina
- Audition: the sense or act of hearing
- Binocular cues: depth cues, such as retinal disparity, that depend on the use of two eyes
- Blind spot: the point at which the optic nerve leaves the eye, creating a "blind" spot because no receptor cells are located there
- Bottom-up processing: analysis that begins with the sensory receptors and works up to the brain's integration of sensory information
- Cochlea: a coiled, bony, fluid-filled tube in the inner ear; sound waves traveling through the cochlear fluid trigger nerve impulses
- Cochlear implant: a device for converting sounds into electrical signals and stimulating the auditory nerve through electrodes threaded into the cochlea
- Color constancy: perceiving familiar objects as having consistent color, even is changing illumination alters the wavelengths reflected by the object
- Conducting hearing loss: hearing loss caused by damage to the mechanical system that conducts sound waves to the cochlea
- Cones: retinal receptor cells that are concentrated near the center of the retina and that function in daylight or in well-lit conditions. The cones detect fine detail and give rise to color sensations
- Depth perception: the ability to see objects in three dimensions although the images that strike the retina are two-dimensional; allows us to judge distance
- Difference threshold: the minimum difference between two stimuli required for detection 50 percent of the time. We experience the difference threshold as a just noticeable difference
- Embodied cognition: in psychological science, the influence of bodily sensations, gestures and other states on cognitive preferences and judgments
- Extrasensory perception: the controversial claim that perception can occur apart from the input; includes telepathy, clairvoyance and precognition
- Feature detectors: nerve cells in the brain that respond to specific features of the stimulus, such as shape, angle or movement
- Figure-ground: the organization of the visual field into objects (the figures) that stand out from their surroundings (the ground)
- Fovea: the central focal point in the retina, around which the eye's cones cluster
- Frequency: the number of complete wavelengths that pass a point in a given time (for example, per second)
- Frequency theory: in hearing, the theory that the rate of nerve impulses traveling up to the auditory nerve matches the frequency of a tone, thus enabling us to sense its pitch
- Gate-control theory: the theory that the spinal cord contains a neurological "gate" that blocks pain signals or allows them to pass on to the brain. The "gate" is opened by the activity of pain signals traveling up small nerve fibers and is closed by the activity in larger fibers or by information coming from the brain
- Gestalt: an organized whole. Gestalt psychologists emphasize our tendency to integrate pieces of information into meaningful wholes.
- Grouping: the perceptual tendency to organize stimuli into coherent groups
- Hue: the dimension of color that is determined by the wavelength of light; what we know as the color names blue, green and so forth
- Inner ear: the innermost part of the ear, containing the cochlea, semicircular canals and vestibular sacs
- Intensity: the amount of energy in a light or sound wave, which we perceive as brightness or

loudness, as determined by the wave's amplitude
- Iris: a ring of muscle tissue that forms the colored portion of the eye around the pupil and controls the size of the pupil opening
- Kinesthesis: the system for sensing the position and movement of individual body parts
- Lens: the transparent structure behind the pupil that changed shape to help focus images on the retina
- Middle ear: the chamber between the eardrum and cochlea containing three tiny bones (hammer, anvil and stirrup) that concentrate the vibrations of the eardrum on the cochlea's oval window
- Monocular cues: depth cues, such as interposition and linear perspective, available to either eye alone
- Opponent-processing theory: the theory that opposing retinal processes (red-green, yellow-blue, white-black) enable color vision. For example, some cells are stimulated by green and inhibited by red, others are stimulated by red and inhibited by green.
- Optic nerve: the nerve that carries neural impulses from the eye to the brain
- Parallel processing: the processing of many aspects of a problem simultaneously; the brain's natural mode of information processing for many functions, including vision. Contrasts with the step-by-step (serial) processing of most computers and of conscious problem solving.
- Parapsychology: the study of paranormal phenomena, including ESP and psychokinesis
- Perception: the process of organizing and interpreting sensory information, enabling us to recognize meaningful objects and events
- Perceptual adaptation: in vision, the ability to adjust to an artificially displaced or even inverted visual field
- Perceptual constancy: perceiving objects as unchanging (having consistent shapes, size, brightness and color) even as illumination alters the wavelengths reflected by the object
- Perceptual set: a mental predisposition to perceive one thing and not another
- Phi phenomenon: an illusion of movement created when two or more adjacent lights blink on and off in quick succession
- Pitch: a tone's experienced highness or lowness; depends on frequency
- Place theory: in hearing, the theory that links the pitch we hear with the place where the cochlea's membrane is stimulated
- Priming: the activation, often unconsciously, of certain associations, thus predisposing one's perceptions, memory or response
- Prosopagnosia: inability to recognize faces
- Psychophysics: the study of relationships between the physical characteristics of stimuli, such as their intensity and our psychological experience of them
- Pupil: the adjustable opening in the center of the eye through which light enters
- Retina: the light-sensitive inner surface of the eye, containing the receptor rods and cones plus layers of neurons that begin the processing of visual information
- Retinal disparity: a binocular due for perceiving depth: by comparing images from the retinas in the two eyes, the brain computes distance- the greater the disparity (difference) between the two images, the closer the object
- Rods: retinal receptors that detect black, white and gray; necessary for peripheral and twilight vision, when cones don't respond
- Sensation: the process by which our sensory receptors and nervous system receive and represent stimulus energies from our environment
- Sensorineural hearing loss: hearing loss caused by damage to the cochlea's receptor cells or to the auditory nerves (aka nerve deafness)
- Sensory adaptation: diminished sensitivity as a consequence of constant stimulation
- Sensory interaction: the principle that one sense may influence another, as when the smell of food influences its taste
- Signal detection theory: a theory predicting how and when we detect the presence of a faint stimulus (signal) amid background stimulation (noise). Assumes there is no signal absolute threshold and that detection depends partly on a person's experience, expectations, motivations and alertness
- Subliminal: below one's absolute threshold for conscious awareness
- Top-down processing: information processing guided by higher-level mental processes, as

when we construct perceptions drawing on our experience and expectations
- Transduction: conversion of one form of energy into another. In sensation, the transforming of stimulus energies, such as sights, sounds, and smells, into neural impulses our brain can interpret
- Vestibular sense: the sense of body movement and position, including the sense of balance
- Visual cliff: a laboratory device for testing depth perception in infants and young animals
- Wavelength: the distance from the peak of one light or sound wave to the peak of the next. Electromagnetic wavelengths vary from the short blips of cosmic rays to the long pulses of radio transmission.
- Weber's Law: the principle that, to be perceived as different, two stimuli must differ by a constant minimum percentage (rather than a constant amount)
- Young-Helmholtz trichromatic (three-color) theory: the theory that the retina contains three different color receptors- one most sensitive to red, one to green, one to blue- which, when stimulated in combination, can produce the perception of any color

Basic Principles of Sensation and Perception

- Sensation: the process by which our sensory receptors and nervous system receive and represent stimulus energies from our environment
- Perception: the process of organizing and interpreting sensory information, enabling us to recognize meaningful objects and events
- Bottom-up processing: analysis that begins with the sensory receptors and works up to the brain's integration of sensory information
- Top-down processing: information processing guided by higher-level mental processes, as when we construct perceptions drawing on our experience and expectations
- Transduction: conversion of one form of energy into another. In sensation, the transforming of stimulus energies, such as sights, sounds, and smells, into neural impulses our brain can interpret
    - Receive sensory stimulation, often using specialized receptor cells
    - Transform that stimulation into neural impulses
    - Deliver the neural information to your brain
    - Psychophysics: the study of relationships between the physical characteristics of stimuli, such as their intensity and our psychological experience of them
- Thresholds
    - Absolute threshold: the minimum stimulation needed to detect a particular stimulus 50 percent of the time
        - Detecting a weak stimulus depends on signal's strength and your psychological state (experience, expectations, motivation, alertness)
        - Signal detection theory: a theory predicting how and when we detect the presence of a faint stimulus (signal) amid background stimulation (noise). Assumes there is no signal absolute threshold and that detection depends partly on a person's experience, expectations, motivations and alertness
            - Measured as a ratio of hits to false alarms
        - 50% of stimuli are subliminal (below one's absolute threshold for conscious awareness)
        - Sometimes, you can be affected by stimuli so weak that you aren't even conscious of it
        - Priming: the activation, often unconsciously, of certain associations, thus predisposing one's perceptions, memory or response
        - We can evaluate a stimulus even if we are not aware of it
        - Only when a stimulus triggers synchronized activity in several brain areas foes it reach consciousness
    - Difference Threshold: the minimum difference between two stimuli required for detection 50 percent of the time. We experience the difference threshold as a just noticeable difference
        - The difference threshold increases with the size of the stimulus
        - Weber's Law: the principle that, to be perceived as different, two stimuli must differ by a constant minimum percentage/ratio (rather than a constant amount)

        - The exact proportion varies depending on the stimulus
            - Example: two lights by 8%, two masses by 2%, two tones must different in frequency by 0.3%
- Sensory Adaptation: diminished sensitivity as a consequence of constant stimulation
    - True with odors, etc.
    - However not the same with visuals, since our eyes are always moving (there is change)
    - Allows for the mind to concentrate on changes in stimuli
- Perceptual Set: a set of mental tendencies and assumptions that greatly affect what we perceive
    - Can affect what we hear, see, taste and feel
    - Through experience we form concepts that organize and interpret unfamiliar information
    - Top-down processing
- Context Effects
    - A given stimulus may trigger different perceptions based on context
    - The brain can work backwards in time to allow a later stimulus to determine how we perceive an earlier one
- Emotion and Motivation
    - Perceptions are also influences by emotion and motivation
    - Desired objects seem closer
    - This perceptual bias energizes our going for it
    - Motives direct perception of ambiguous images

Vision

- Our eyes receive light energy and transduce it into neural messages that our brain then processes into what we consciously see
- The Stimulus Input: Light Energy
    - Humans can only see a small portion of the electromagnetic spectrum (400-700 nm)
    - Two characteristics of light determine our sensory experience of them
        - Wavelength: the distance from the peak of one light or sound wave to the peak of the next. Electromagnetic wavelengths vary from the short blips of cosmic rays to the long pulses of radio transmission.
            - Determines its hue (the dimension of color that is determined by the wavelength of light; what we know as the color names blue, green and so forth)
        - Intensity: the amount of energy in a light or sound wave, which we perceive as brightness or loudness, as determined by the wave's amplitude
- The Eye
    - Light enter through the cornea, which protects the eye and bends light to provide focus
    - Pupil: the adjustable opening in the center of the eye through which light enters (dilates in darkness, contracts in bright light)
    - Iris: a ring of muscle tissue that forms the colored portion of the eye around the pupil and controls the size of the pupil opening (dilates or constricts in response to light intensity and emotions)
    - Lens: the transparent structure behind the pupil that changed shape to help focus images on the retina
    - Accommodation: the process by which the eye's lens changes shape to focus near or far objects on the retina
    - Cones: retinal receptor cells that are concentrated near the center of the retina and that function in daylight or in well-lit conditions. The cones detect fine detail and give rise to color sensations (cluster around the fovea)
        - Each transmits to a single bipolar cell
        - The direct connection preserve's the cones precise information (better to detect fine details)
    - Fovea: the central focal point in the retina, around which the eye's cones cluster
    - Rods: retinal receptors that detect black, white and gray; necessary for peripheral and twilight vision, when cones don't respond

        - Share bipolar cells with other rods, sending combined messages
        - Sensitive in dime light
        - Several rods funnel their faint energy output into a bipolar cell> more sensitive in dim light
    - Optic nerve: the nerve that carries neural impulses from the eye to the brain
    - The Retina: the light-sensitive inner surface of the eye, containing the receptor rods and cones plus layers of neurons that begin the processing of visual information
        - The retina's reaction to light
            1. Light entering the eye triggers photochemical reactions in the rods and cones at the back of the retina
            2. Chemical reaction in turn activates bipolar cells
            3. Bipolar cells then activate the ganglion cells, the axons of which converge to form the optic nerve. This nerve transmits information to the visual cortex (via the thalamus) in the brain
        - Blind spot: the point at which the optic nerve leaves the eye, creating a "blind" spot because no receptor cells are located there. However, the brain fills in the hole automatically
- Visual Information Processing
    - Entry level: visual processing begins in the retina's neural layers (rods and cones)
        - They pass along electrical impulses and encode/analyze sensory input
    - Information travels to the bipolar cells, and then ganglion cells, through their axons, through the optic nerve to the brain (occipital lobe)
    - Light and pressure trigger retinal cells, both of which will be interpreted as light
    - Feature Detection
        - Feature detectors: nerve cells in the brain (occipital lobe's visual cortex) that respond to specific features of the stimulus, such as shape, angle or movement
            - Nerve cells receive information from the ganglion cells
            - Nerve cells pass the information to other cortical areas where supercell clusters respond to more complex patterns (integrate the information)
                - Temporal lobe= ability to recognize faces
            - Different areas of the brain are responsible for recognizing different objects
        - Parallel Processing: the processing of many aspects of a problem simultaneously; the brain's natural mode of information processing for many functions, including vision. Contrasts with the step-by-step (serial) processing of most computers and of conscious problem solving
    - Summary of Visual Information Processing
        - Retinal processing: receptor rods and cones > bipolar cells > ganglion ells
        - Feature detection: brain's detector cells respond to specific features (edges, lines, angles)
        - Parallel processing: brain cells teams process combined information about color, movement, form and depth
        - Recognition: brain interprets the constructed image based on information from stored images
- Color Vision
    - Color is a mental construction
    - We have a very low difference threshold for color, allowing for the detection of thousands of shades
    - Color deficient is genetically sex-linked for males
    - Young-Helmholtz trichromatic (three-color) theory: the theory that the retina contains three different color receptors- one most sensitive to red, one to green, one to blue- which, when stimulated in combination, can produce the perception of any color
        - Example: yellow = green + red
    - Color-deficient vision
        - Lack functioning red or green sensitive cones (or both)> can't distinguish between red and green
    - Opponent-processing theory: the theory that opposing retinal processes (red-green, yellow-blue, white-black) enable color vision. For example, some cells are stimulated by

green and inhibited by red, others are stimulated by red and inhibited by green.
        - Explains why we cannot see a reddish-green
- Visual Organization
    - Gestalt: an organized whole. Gestalt psychologists emphasize our tendency to integrate pieces of information into meaningful wholes.
    - In perception, the whole may exceed the sum of its parts
    - Form Perception
        - Figure-ground: the organization of the visual field into objects (the figures) that stand out from their surroundings (the ground)
        - Grouping: the perceptual tendency to organize stimuli into coherent groups
            - Example: proximity, continuity, closure
    - Depth Perception: the ability to see objects in three dimensions although the images that strike the retina are two-dimensional; allows us to judge distance
        - Visual cliff: a laboratory device for testing depth perception in infants and young animals
            - Most infants wouldn't go over the cliff, suggesting that infants do perceive depth
            - Seems to be an inherited skill
        - Binocular cues: depth cues, such as retinal disparity, that depend on the use of two eyes
            - Retinal disparity: a binocular cue for perceiving depth: by comparing images from the retinas in the two eyes, the brain computes distance- the greater the disparity (difference) between the two images, the closer the object
        - Monocular cues: depth cues, such as interposition and linear perspective, available to either eye alone
            - Used with objects that are very far away (too far for retinal disparity to be of use)
    - Motion Perception
        - Phi phenomenon: an illusion of movement created when two or more adjacent lights blind on and off in quick succession
        - Brain assumes that shrinking objects are retreating (not shrinking) and growing objects are approaching (not growing)
    - Perceptual Constancy: perceiving objects as unchanging (having consistent shapes, size, brightness and color) even as illumination alters the wavelengths reflected by the object (changes in angle, distance, light)
        - Color and brightness constancies
            - Color constancy: perceiving familiar objects as having consistent color, even in changing illumination alters the wavelengths reflected by the object
            - Brightness constancy: perceive objects to have a consistent brightness even when illumination varies
            - Perception of constancy depends on relative luminance- the amount of light an objects reflects relative to its surroundings
        - Shape and Size constancies
            - Shape constancy: perceive objects are unchanging when retinas receive changing images of them (viewed from different angles)
                - Cortex learns to associate different views with the same object
            - Size constancy: perceive objects to have a constant size even when viewed from different distances
                - Perceiving an objects size gives cues to its distance and vice versa
- Visual Interpretation
    - Experience and Visual Perception
        - Restored Vision and Sensory Restriction
            - Innate (genetic): distinguish figure from ground, sense color
            - Learned: recognizing object
            - Cannot lose abilities once they have been learned
            - There is a critical period for normal sensory and perceptual development
        - Perceptual adaptation: the ability to adjust to an artificially displaced or even

inverted visual field (humans, cats and monkeys)

Hearing

- Audition: the sense or act of hearing
- The Stimulus Input: Sound Waves
    - Ears detect changes in air pressure
    - Amplitude of sound waves determines loudness
    - Frequency: the number of complete wavelengths that pass a point in a given time, determines the pitch
    - Pitch: a ton's experienced highness or lowness (depends on the frequency)
        - Low frequency = low pitch and vice versa
    - Decibels
        - Measure of sound
        - Logarithmic: 10 decibels correspond to a tenfold increase in sound intensity
- The Ear
    - Sound waves go through the outer ear, through the auditory canal, to the eardrum (a tight membrane) which will vibrate
    - Middle ear: the chamber between the eardrum and cochlea containing three tiny bones (hammer anvil, stirrup) that concentrate the vibrations of the eardrum on the cochlea's oval window
    - Cochlea: a coiled, body, fluid-filled tube in the inner ear
    - Inner ear: the innermost part of the ear, containing the cochlea, semicircular canals and vestibular sacs
    - Sensorineural hearing loss: hearing loss cause by damage to the cochlea's receptor cells or to the auditory serves (nerve deafness)
        - Caused by heredity, aging, prolonged exposure to loud noise, occasionally disease
        - Ringing in the ears alerts us to the possibility of hearing damage
    - Conduction hearing loss: hearing loss caused by damage to the mechanical system that conducts sound waves to the cochlea
        - Less common
    - How we transform sound waves into nerve impulses
        - The outer ear funnels sound waves to the ear drum
        - The boned of the middle ear amplify and relay the eardrum's vibrations through the oval window into the fluid-filled cochlea
        - The resulting pressure changes in the cochlear fluid cause the basilar membrane to ripple, bending the hair cells on its surface
        - Hair cell movements trigger impulses at the base of the nerve cells, who's fibers converge to form the auditory nerve
        - The nerve sends neural messages to the thalamus and on to the auditory cortex (temporal lobe)
    - Cochlear implant: a device for converting sounds into electrical signals and stimulating the auditory nerve through electrodes threaded into the cochlea
        - Used in cases of sensorineural hearing loss (nerve deafness)
    - Perceiving Loudness
        - Brain interprets loudness from the number of activated hair cells
        - If a hair cell loses sensitivity to soft sounds, it may still be sensitive to loud sounds
        - Quiet sounds are amplified more than loud sounds
    - Perceiving Pitch- how we distinguish low and high pitch
        - Place Theory: the theory that links the pitch we hear with the place of where the cochlea's basilar membrane is stimulated
            - Problem: does not explain how we hear low pitches; low pitch sounds result in a general vibration of the basilar membrane (not localized)
        - Frequency Theory: the theory that the rate of nerve impulses traveling up to the auditory nerve matches the frequency of a tone, thus enabling us to sense its pitch
            - Sound makes the whole basilar membrane vibrate
            - Problem: neurons cannot fire faster than 1000 Hz, but we can hear sounds with higher frequencies

        - Volley Principle: by firing in rapid succession, they can achieve a combined frequency above 1000 Hz
    - Locating Sounds
        - Sound waves strike one ear sooner and more intensely than the other
        - Our brain computes the sound's location

Touch

- Contact with the mother results in happier and faster growing infants
- Sense of touch: mixture of pressure, temperature and pain
    - Stroking adjacent pressure spots = tickle
    - Stroking of a pain spot = itching sensation
    - Cold and pressure spots = wetness
    - Stimulating cold and warm spots = hot

Pain

- Draws the brains attention to something wrong
- Understanding Pain
    - Pain sensitivity varies from individuals depending on gender, physiology, experience, attention, culture
    - Top-down and bottom-up processing
    - Biological Influences
        - Have different nociceptors: sensory receptors that detect hurtful temperatures, pressures or chemicals
        - Gate-control theory: the theory that the spinal cord contains a neurological "gate" that blocks pain signals or allows them to pass on to the brain. The "gate" is opened by the activity of pain signals traveling up small nerve fibers and is closed by the activity in larger fibers or by information coming from the brain
            - Therefore, a way to treat chronic pain is to stimulate (massage, electric stimulation, acupuncture) gate-closing activity in the large neural fibers
        - Pain diminishes when distracted from the pain and by the release of naturally painkilling endorphins
        - Factors that affect how people experience pain (genetics)
            - Larger production of endorphins = less bothered by pain
            - Mutated gene that disrupts pain circuit neurotransmissions = experience less pain
        - Phantom limb sensations: the brain misinterprets the spontaneous central nervous system activity that occurs in the absence of normal sensory input
            - Feel pain or movement in missing limb
            - Example: loss of limb, scent, sight, hearing, etc.
    - Psychological Influences
        - Distraction can minimize pain
        - We seem to edit our memories of pain
        - People overlook a pain's duration
        - The memory records the pain's peak (when it was most painful) and how much pain was felt at the end
        - Expectations
    - Social-Cultural Influences
        - We tend to perceive more pain when others also seem to be in pain
        - Empathy for other's pain
        - Cultural expectations
- Controlling Pain
    - Possible treatments for pain (depending on the symptoms): drugs, surgery, acupuncture, electrical stimulation, massage, exercise, hypnosis, relaxation training, thought distraction, placebo, immersion in computer-generated 3D world

Taste

- used to think all tastes were either sweet, sour, salty, bitter, or a combination of those 4

- Fifth receptor: umami- flavor enhancer monosodium glutamate (meaty taste)
- The survival functions of basic tastes
    - Sweet indicates energy source
    - Salty indicated sodium essential to physiological processes
    - Sour indicates potentially toxic acid
    - Bitter indicates potential poisons
    - Umami indicates proteins to grow and repair tissue
- Taste bud: each contain a pore that catches food chemicals, contains 50-100 taste receptor cells (hairs)
    - Different receptors respond to different taste
    - Tongue produces taste buds constantly (in case they get damage aka burned)
- Taste sensitivity decreases with age (accelerated with alcohol and smoking)
- Sensory interaction: the principle that one sense may influence another, as when the smell of food influences its taste (brain blends inputs from different senses together)
    - Smell + texture + taste = flavor
    - McGurk effect: people who watched videos of spoken phenomena could be fooled into misperceiving what they heard if the mouthing was actually different from what was being spoken
    - Embodies cognition: the influence of bodily sensations, gestures and other sates on cognitive preferences and judgments
    - Synaesthesia: when one sort of sensation produces another
        - Example: hearing a sound results in seeing a color

Smell

- A chemical sense
    - Odorant molecules bind to olfactory receptors in the nasal cavity
    - Olfactory receptor cells are activate and send electric signals
    - The signals are relayed via converges axons
    - The signals are transmitted to olfactory bulb >temporal lobes' smell cortex > parts of limbic system involved in memory and emotion
- Odor molecules trigger a combination of receptors, in patterns that are interpreted by the olfactory cortex
- Women have a better sense of smell then men
- Attractiveness off smells depends on learned associations
- Odors can evoke feelings and memories

Body Position and Movement

- Kinesthesis: the system of sensing the position and movement of individual body parts
    - Due to sensors in joints, tendons, bones and ears
- Vestibular sense: the sense of body movement and position, including the sense of balance
    - In the inner ear, the semicircular canals and vestibular sacs contain fluid that moves when your rotates or tilts
    - This movement stimulates hair-like receptors which send messages to the cerebellum, enabling you to sense your body position and to maintain balance

Perception: our version of reality

- Biological influences
    - Sensory analysis
    - Unlearned visual phenomena
    - Critical period for sensory development
- Psychological influences
    - Selective attention
    - Learned schemas
    - Gestalt principles
    - Context effects
    - Perceptual set

- Social-Cultural influences
    - Cultural assumptions and expectations

Extrasensory Perception (ESP)

- Extrasensory perception: the controversial claim that perception can occur apart from sensory input
    - Telepathy: mind-to-mind communication
    - Clairvoyance: perceiving remote events, such as a house on fire in another state
    - Precognition: perceiving future events
- Psychokinesis: moving objects with your mind
- Parapsychology: the study of paranormal phenomena, including ESP and psychokinesis