Cheat Sheet: Sensation and Perception

Essential Concepts

Sensation and Perception

- Sensation occurs when sensory receptors detect sensory stimuli.
- Perception involves the organization, interpretation, and conscious experience of those sensations.
- All sensory systems have both absolute and difference thresholds, which refer to the minimum amount of stimulus energy or the minimum amount of difference in stimulus energy required to be detected about 50% of the time, respectively.
- Sensory adaptation, selective attention, and signal detection theory can help explain what is perceived and what is not. In addition, our perceptions are affected by a number of factors, including beliefs, values, prejudices, culture, and life experiences.

The Visual System

- Light can be described in terms of waveforms with physical characteristics like amplitude, frequency, and wavelength. A light wave's wavelength is generally associated with color, and its amplitude is associated with brightness.
- Light waves cross the cornea and enter the eye at the pupil. The eye's lens focuses this light so that the image is focused on a region of the retina known as the fovea. The fovea contains cones that possess high levels of visual acuity and operate best in bright light conditions. Rods are located throughout the retina and operate best under dim light conditions. Visual information leaves the eye via the optic nerve. Information from each visual field is sent to the opposite side of the brain at the optic chiasm. Visual information then moves through a number of brain sites before reaching the occipital lobe, where it is processed.
- Two theories explain color perception. The trichromatic theory asserts that three distinct cone groups are tuned to slightly different wavelengths of light, and it is the combination of activity across these cone types that results in our perception of all the colors we see.

The opponent-process theory of color vision asserts that color is processed in opponent pairs and accounts for the interesting phenomenon of a negative afterimage.

- We perceive depth through a combination of monocular and binocular depth cues.

The Auditory System

- Sound can be described in terms of waveforms with physical characteristics like amplitude wavelength, frequency, and timbre.
    - Wavelength and frequency are inversely related so that longer waves have lower frequencies, and shorter waves have higher frequencies.
    - A sound's frequency is associated with pitch, and its amplitude is associated with loudness.
- Sound waves are funneled into the auditory canal and cause vibrations of the eardrum; these vibrations move the ossicles. As the ossicles move, the stapes presses against the oval window of the cochlea, which causes fluid inside the cochlea to move. As a result, hair cells embedded in the basilar membrane become enlarged, which sends neural impulses to the brain via the auditory nerve.
- Pitch perception and sound localization are important aspects of hearing.
    - Our ability to perceive pitch relies on both the firing rate of the hair cells in the basilar membrane as well as their location within the membrane.
    - In sound localization, both monaural and binaural cues are used to locate where sounds originate in our environment.
- Individuals can be born deaf, or they can develop deafness as a result of age, genetic predisposition, and/or environmental causes.
    - Hearing loss that results from a failure of the vibration of the eardrum or the resultant movement of the ossicles is called conductive hearing loss.
    - Hearing loss that involves a failure of the transmission of auditory nerve impulses to the brain is called sensorineural hearing loss.

The Other Senses

- Taste (gustation) and smell (olfaction) are chemical senses that employ receptors on the tongue and in the nose that bind directly with taste and odor molecules in order to transmit information to the brain for processing.

- Our ability to perceive touch, temperature, and pain is mediated by a number of receptors and free nerve endings that are distributed throughout the skin and various tissues of the body.
- The vestibular sense helps us maintain a sense of balance through the response of hair cells in the utricle, saccule, and semi-circular canals that respond to changes in head position and gravity.
- Our proprioceptive and kinesthetic systems provide information about body position and body movement through receptors that detect stretch and tension in the muscles, joints, tendons, and skin of the body.
- Perception and Illusions
- Gestalt theorists have been incredibly influential in the areas of sensation and perception. Gestalt principles such as figure-ground relationship, grouping by proximity or similarity, the law of good continuation, and closure are all used to help explain how we organize sensory information.
- Our perceptions are not infallible, and they can be influenced by bias, prejudice, and other factors.

Glossary

absolute threshold

minimum amount of stimulus energy that must be present for the stimulus to be detected 50% of the time

afterimage

continuation of a visual sensation after removal of the stimulus

amplitude

height of a wave

basilar membrane

thin strip of tissue within the cochlea that contains the hair cells which serve as the sensory receptors for the auditory system

binaural cue

two-eared cue to localize sound

binocular cue

cue that relies on the use of both eyes

binocular disparity

slightly different view of the world that each eye receives

blind spot

point where we cannot respond to visual information in that portion of the visual field

bottom-up processing

system in which perceptions are built from sensory input

chemoreceptors

respond to certain types of chemicals either applied externally or released within the skin (such as histamine from an inflammation)

closure

organizing our perceptions into complete objects rather than as a series of parts

cochlea

a fluid-filled, snail-shaped structure that contains the sensory receptor cells (hair cells) of the auditory system

cochlear implant

electronic device that consists of a microphone, a speech processor, and an electrode array to directly stimulate the auditory nerve to transmit information to the brain

conductive hearing loss

failure in the vibration of the eardrum and/or movement of the ossicles

cone

specialized photoreceptor that works best in bright light conditions and detects color

congenital deafness

deafness from birth

congenital insensitivity to pain (congenital analgesia)

genetic disorder that results in the inability to experience pain

cornea

transparent covering over the eye

crossmodal phenomena

effects that concern the influence of the perception of one sensory modality on the perception of another

deafness

partial or complete inability to hear

decibels (dB)

a logarithmic unit of sound intensity

depth perception

ability to perceive depth

double flash illusion

the false perception of two visual flashes when a single flash is accompanied by two auditory beeps

electromagnetic spectrum

all the electromagnetic radiation that occurs in our environment

figure-ground relationship

segmenting our visual world into figure and ground

fovea

small indentation in the retina that contains cones

frequency

number of waves that pass a given point in a given time period

Gestalt psychology

field of psychology based on the idea that the whole is different from the sum of its parts

good continuation (continuity)

we are more likely to perceive continuous, smooth flowing lines rather than jagged, broken lines

hair cell

auditory receptor cell of the inner ear

hertz (Hz)

cycles per second; measure of frequency

inattentional blindness

failure to notice something that is completely visible because of a lack of attention

incus

middle ear ossicle; also known as the anvil

inflammatory pain

signal that some type of tissue damage has occurred

integrated

the process by which the perceptual system combines information arising from more than one modality

interaural level difference

sound coming from one side of the body is more intense at the closest ear because of the attenuation of the sound wave as it passes through the head

interaural timing difference

small difference in the time at which a given sound wave arrives at each ear

iris

colored portion of the eye

just noticeable difference

difference in stimuli required to detect a difference between the stimuli

kinesthesia

perception of the body's movement through space

law of continuity

suggests that we are more likely to perceive continuous, smooth flowing lines rather than jagged, broken lines

lens

curved, transparent structure that provides additional focus for light entering the eye

loudness

associated with the amplitude of the sound wave

malleus

middle ear ossicle; also known as the hammer

McGurk effect

an effect in which conflicting visual and auditory components of a speech stimulus result in an illusory perception

mechanoreceptors

respond to mechanical stimuli, such as stroking, stretching, or vibration of the skin

Meissner’s corpuscle

touch receptor that responds to pressure and lower frequency vibrations

Ménière's disease

results in a degeneration of inner ear structures that can lead to hearing loss, tinnitus, vertigo, and an increase in pressure within the inner ear

mere-exposure effects

the result of developing a more positive attitude towards a stimulus after repeated instances of mere exposure to it

Merkel’s disk

touch receptor that responds to light touch

monaural cue

one-eared cue to localize sound

monocular cue

cue that requires only one eye

Müller-Lyer illusion

a visual illusion where a pair of lines may appear to be different lengths, but they are actually the same length

multimodal

of or pertaining to multiple sensory modalities

multimodal perception

the effects that concurrent stimulation in more than one sensory modality has on the perception of events and objects in the world

multimodal phenomena

effects that concern the binding of inputs from multiple sensory modalities

neuropathic pain

pain from damage to neurons of either the peripheral or central nervous system

nociception

sensory signal indicating potential harm and maybe pain

olfactory bulb

bulb-like structure at the tip of the frontal lobe, where the olfactory nerves begin

olfactory receptor

sensory cell for the olfactory system

opponent-process theory of color perception

color is coded in opponent pairs: black-white, yellow-blue, and red-green

optic chiasm

X-shaped structure that sits just below the brain's ventral surface; represents the merging of the optic nerves from the two eyes and the separation of information from the two sides of the visual field to the opposite side of the brain

optic nerve

carries visual information from the retina to the brain

Pacinian corpuscle

touch receptor that detects transient pressure and higher frequency vibrations

pattern perception

ability to discriminate among different figures and shapes

peak (crest)

highest point of a wave

perceptual hypothesis

educated guess used to interpret sensory information

perception

way that sensory information is interpreted and consciously experienced

pheromone

chemical message sent by another individual

photoreceptor

light-detecting cell

pinna

visible part of the ear that protrudes from the head

pitch

the frequency of a sound wave that is associated with our perception of that sound

place theory of pitch perception

different portions of the basilar membrane are sensitive to sounds of different frequencies

priming

the process by which recent experiences increase a trait's accessibility

proprioception

perception of body position

proximity

things that are close to one another tend to be grouped together

pupil

small opening in the eye through which light passes

retina

light-sensitive lining of the eye

rod

specialized photoreceptor that works well in low light conditions

rubber hand illusion

the false perception of a fake hand as belonging to a perceiver, due to multimodal sensory information

Ruffini corpuscle

touch receptor that detects stretch

sensation

what happens when sensory information is detected by a sensory receptor

sensorineural hearing loss

failure to transmit neural signals from the cochlea to the brain

sensory adaptation

the reduction in sensitivity after prolonged exposure to a stimulus

sensory modalities

a type of sense; for example, vision or audition

signal detection theory

change in stimulus detection as a function of current mental state; the ability to identify a stimulus when it is embedded in a distracting background

similarity

things that are alike tend to be grouped together

stapes

middle ear ossicle; also known as the stirrup

subliminal message

message presented below the threshold of conscious awareness

synesthesia

the blending of two or more sensory experiences

taste bud

grouping of taste receptor cells with hair-like extensions that protrude into the central pore of the taste bud

temporal theory of pitch perception

sound's frequency is coded by the activity level of a sensory neuron

thermoreceptors

respond to cold or hot temperatures

timbre

a sound's purity, affected by the complex interplay of frequency, amplitude, and timing of sound waves

top-down processing

interpretation of sensations is influenced by available knowledge, experiences, and thoughts

transduction

conversion from sensory stimulus energy to action potential

trichromatic theory of color perception

color vision is mediated by the activity across the three groups of cones

trough

lowest point of a wave

tympanic membrane

eardrum

umami

taste for monosodium glutamate

unimodal

of or pertaining to a single sensory modality

vertigo

spinning sensation

vestibular sense

contributes to our ability to maintain balance and body posture

vestibulo-ocular reflex

coordination of motion information with visual information that allows you to maintain your gaze on an object while you move

visible spectrum

portion of the electromagnetic spectrum that we can see

wavelength

length of a wave from one peak to the next peak

Weber’s law

Ernst Weber's discovery that the difference threshold is a constant fraction of the original stimulus and bigger stimuli require larger differences to be noticed