Sensation and Perception

Chapter 6

Basic Principles

(Reading 1)

Basic Principles

- Sensation- how sensory receptors and your nervous system receive stimuli
  - I hear, I see…
- Perception- the process of organizing and interpreting incoming information
  - I hear a fire truck, I see a cat…
- Psychophysics- relationship between physical stimuli and our experience of it.

Perception…

Perception is hard! Your brain is taking in so much information and trying to make sense of it all…

Sometimes, perception is not reality

Processing

Bottom-Up Processing

- Beginning with stimulation of our senses, we interpret sensory information with our brains
- I see a furry, 4-legged creature with a tail and identify this as a dog

Top-Down Processing

- Using our schemas and past experiences, we interpret sensory information to construct deeper meaning
- The dog is growling and foaming at the mouth and I realize it may have rabies so I will not approach it

Examples:

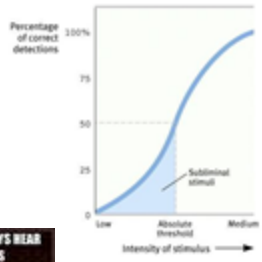
Transduction

Converting one form of energy into another.

- All sensation:
  - RECEIVES information
  - TRANSFORMS information into neural impulses
  - DELIVERS information to the brain

In this order, would this be considered top-down or bottom-up processing?

Threshold



Absolute threshold- (Gustav Fetchner) The minimum amount of energy that can be detected 50% of the time

Signal Detection Theory

Detection of a stimulus depends on both the intensity of the stimulus and the physical and psychological state of the individual.

What changes your ability to detect signal?

- How intense the signal is (loud)
- Internal and external noise
- Your willingness to respond
- How motivated you are

WEBER'S LAW AND THE JND

Weber's Law:

- Minimum amount of change you can detect
  - Did that TV just get louder?

Just Noticeable Difference:

- Increases in proportion, not set amount
  - Hearing a change between volume 2 and 3 is easier than 72 and 73

Weber's Law

Weber's Law is related to the Just Noticeable Difference (also known as the difference threshold), which is the minimum difference in stimulation that a person can detect 50 percent of the time. But Ernst Weber noted that for people to really perceive a difference, the stimuli must differ by a constant "proportion" not a constant "amount".

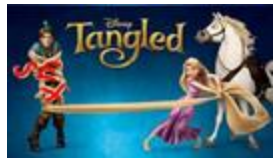
For example, if you are buying a new computer that costs $1,000 and you want to add more memory that increases the price $200 (a 20% increase), you might consider this too much additional money to spend. However, if you were buying a $300,000 house a $200 feature may seem like nothing. It might take an additional $10,000 to make you stop and think if it's too much to spend. In this example, the amount stays the same ($200), but the proportion changes and that's what makes the perceptual difference.

Subliminal Perception?

Subliminal- stimuli that comes in below absolute threshold

- Subliminal Advertising Experiment

Priming: unconscious activation that predisposes you to think or respond a certain way



Sensory Adaptation

- Nose Blind

Constant exposure to a stimuli means we become less aware of it

- *Our sensory receptors are programed to respond to novelty!*
- *"We perceive the world not as it is but how it is useful to us to perceive it!"*

Perceptual Set

- What do you see?

- Our readiness to perceive one thing and not another
- Perception is influenced by our expectations!

Context Effect

- We take in the world through perceptual sets but also in context.
  - If you hear someone say:
    - "Eel the orange" you will hear Peel
- Our perception is also colored by our emotions
  - Do you hear pain or pane? Mourning or morning?

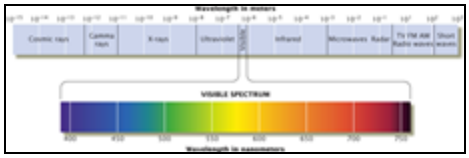
EYE see you!

Vision

Reading 2

Transduction and Light Energy

- **Transduction**: Our eyes have the ability to convert one form of energy – in this case LIGHT – into messages that our brain can interpret as a visual experience
- We can only see a small part of the electromagnetic spectrum

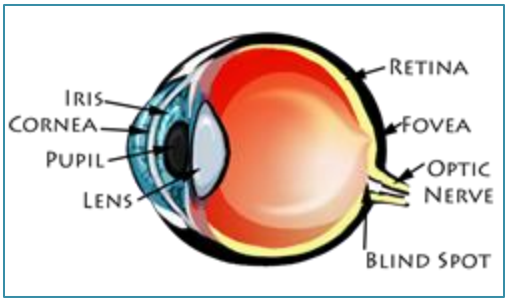


DNEWS- Color

What Animals See

Properties of Color and Light Energy

- **Hue**
  - Colors we see such as red and green
  - Determined by wavelength
  - Shorter wavelength results in blue-violet; longer results in red
- **Intensity**
  - "loudness" or brightness of a color
  - Determined by amplitude
- **Saturation**
  - Vividness of a hue



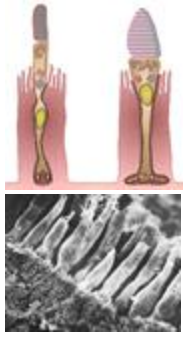
The Eye

The Visual System

- **Cornea:** Transparent protective coating over the front of the eye
- **Pupil**: Small opening in the iris through which light enters the eye
- **Iris:** Colored part of the eye
- **Lens:** Focuses light onto the retina. Changes shape through accommodation to help focus image on retina
- **Retina:** Lining of the eye containing receptor cells that are sensitive to light
- **Fovea:** Center of the visual field
- **Optic Nerve:** nerve that carries neural impulses to the brain
- **Blind Spot:** Point at which the optic nerve leaves the eye, creating a blind spot because no receptor cells are there.

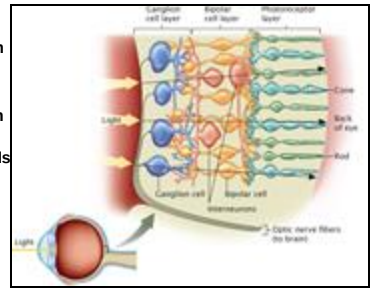
Receptor Cells

- Cells in the retina that are sensitive to light
- Rods- periphery of retina
  - About 120 million rods
  - Respond to light and dark
  - Very sensitive to light
  - Provide our night vision
- Cones- center of retina
  - About 8 million cones
  - Respond to color as well as light and dark
  - Work best in bright light
  - Found mainly in the fovea



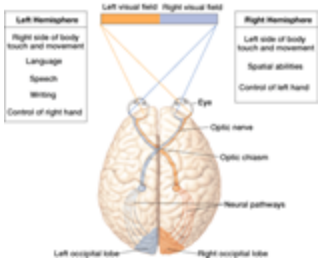
Receptor Cells

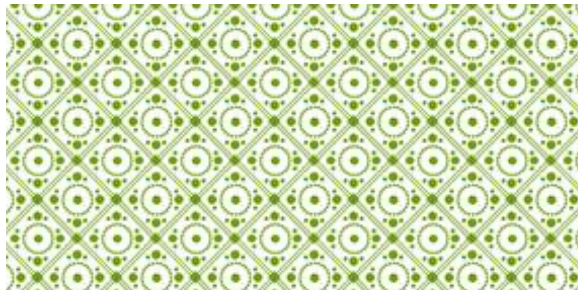
- Bipolar cells
  - **Receive input from receptor cells**
- Ganglion cells
  - **Receive input from bipolar cells**
  - **Axons of these cells form optic nerve**
- Blind spot
  - **Area where axons of ganglion cells leave the eye**



From Eye to Brain

- Optic nerve
  - Made up of axons of ganglion cells
  - carries neural messages from each eye to brain
- Optic chiasm
  - Point where part of each optic nerve crosses to the other side of the brain
- Thalamus relays sensory info to visual cortex in occipital lobes





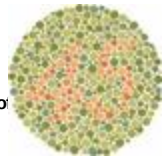
Perception

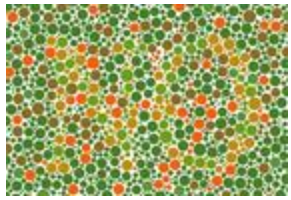
Reading 3

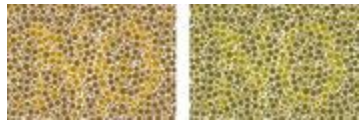
Is Your Red the Same as My Red?

Theories of Color Vision

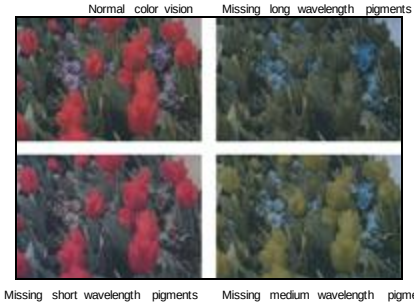
- Trichromatic theory (Young-Helmholtz)
  - Three different types of cones
    - **Red**
    - **Green**
    - **Blue**
  - Experience of color is the result of mixing of the signals from these receptors
  - Can account for some types of colorblindness
    - **Approximately 10% of men and 1% of women have some form of "colorblindness"**

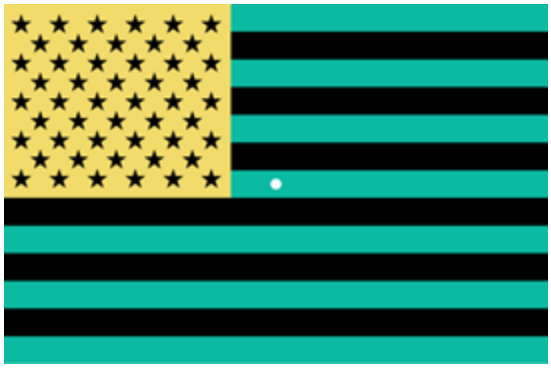






COLOR VISION





Theories of Color Vision

- Trichromatic theory cannot explain all aspects of color vision
  - People with normal vision cannot see "reddish-green" or "yellowish-blue"
  - Red-Green colorblind people can see yellow, which Helmholtz argues is a result of red and green cones firing – if Helmholtz is correct, how could this be?
  - Color afterimages?

Theories of Color Vision

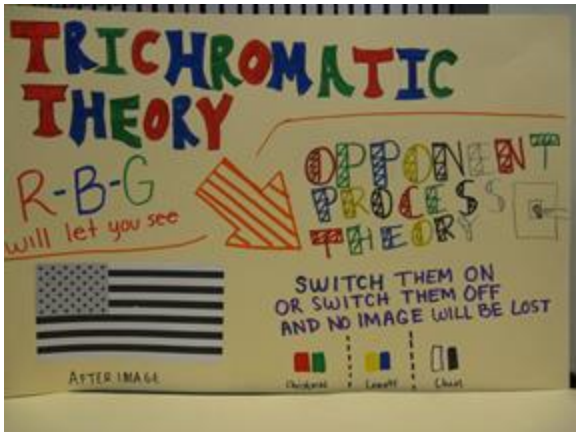
Opponent-process theory (Ewald Hering)

- Three pairs of color receptors
  - **Yellow-blue**
  - **Red-green**
  - **Black-white**
- Members of each pair work in opposition
- Can explain color afterimages

Both theories of color vision are valid

Are your colors my colors?

- DNEWS: https://www.youtube.com/watch?v=nAbxfKPKorc
- VSAUCE: https://www.youtube.com/watch?v=evQsOFQju08

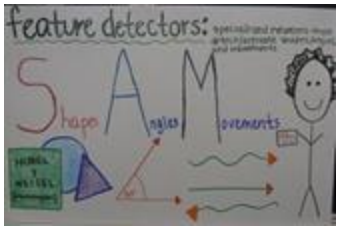


Adaptation

- Dark adaptation
  - Increased sensitivity of rods and cones in darkness
- Light adaptation
  - Decreased sensitivity of rods and cones in bright light
- Afterimage
  - Sensory experience that occurs after a visual stimulus has been removed in response to overstimulation of receptors

Feature Detection (Hubel and Wiesel)

- Feature detectors are neurons in the brain that respond to specific aspects of a stimulus: edges, lines, movements, angles



Visual Illusions

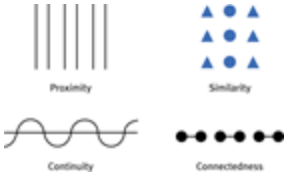
- Occur because of misleading cues in the stimulus
- Gives rise to false perceptions

Optical Illusions Website

Perceptual Organization: Figure Ground

- We perceive a foreground object (figure) against a background (ground)

Perceptual Organization: Grouping



Proximity: We group nearby things together

Similarity: We group together objects that look alike

Continuity: We tend to perceive smooth and continuous patterns over separate pieces

Connectedness: We group together things that are connected as one unit

Closure (above) : We fill in gaps to complete a whole object and assume there are three circles and two triangles in this picture.

Perception of Distance and Depth

- Visual Cliff
- Binocular cues – those that require both eyes
  - Stereoscopic vision
  - Retinal disparity
  - Angle of Convergence

Perception of Distance and Depth

- Monocular cues – those that require only one eye
  - Relative height
  - Relative size
  - Interposition
  - Linear perspective
  - Relative motion
  - Light and shadow

Perception of Movement

- Apparent movement
  - Illusion that still objects are moving
- Stroboscopic motion
  - Created by a rapid series of still pictures
- Phi phenomenon
  - Apparent motion created by lights flashing in sequence

Perception of Movement

- Spiral Illusion
  - Stare into the middle of the spiral
  - After a minute, then look at a still object
  - What happens?
  - How can sensory adaptation explain this?
  - This is often explained in terms of "fatigue" of the class of neurons encoding one motion direction. It is probably more accurate to interpret this in terms of adaptation

Perceptual Organization

- Perceptual Constancy
  - Our tendency to perceive objects as stable and unchanging despite changing sensory information
- Size constancy
- Shape constancy
- Lightness constancy
- Color constancy
  - The Dress ☹

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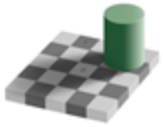


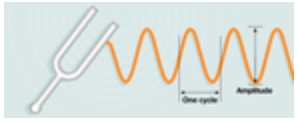
Perceptual Interpretation

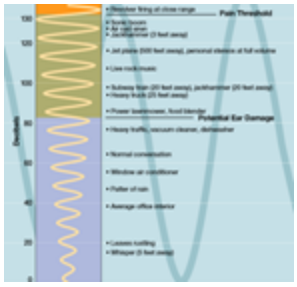
- Perceptual Adaptation
  - Our ability to adjust to distorted perceptual circumstances
  - Drunk goggles?
  - Rotating Face Mask
- Optical Illusions Website

Hearing

Sound

- We hear by transduction of sound waves into nerve impulses.
- Sound waves
  - Changes in pressure caused by molecules of air moving
- Frequency
  - Number of cycles per second in a wave, measured in **Hertz** (Hz)
  - Frequency determines **pitch**
- Amplitude
  - Magnitude (height) of sound wave
  - Determines **loudness**, measured in **decibels** (dB)

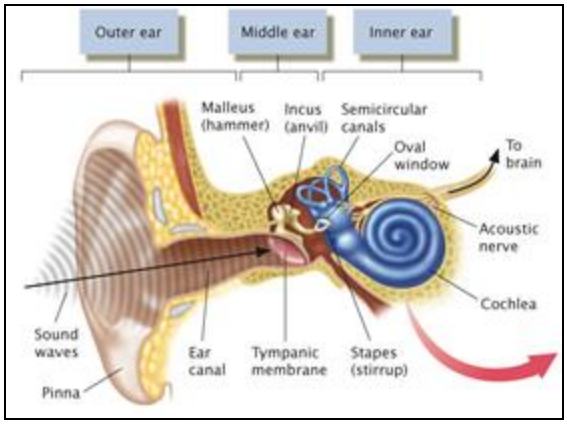




The Ear

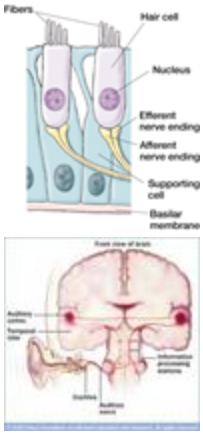
- Outer Ear
  - **Pinna**
  - **Tympanic Membrane (eardrum)**
- Middle Ear
  - **Contains three auditory ossicles (bones)**
    - **Malleus (Hammer)**
    - **Incus (Anvil)**
    - **Stapes (Stirrup)**
  - **These bones relay and amplify the incoming sound waves**

- Inner Ear
  - **Oval Window set in motion by ossicles**
  - **Fluid-filled Cochlea**
  - **Basilar membrane set in motion by the rippling fluid**
  - **Organ of Corti sits atop the basilar membrane and contains with cilia (hair cells) which bend as basilar membrane vibrates**



Ear to Brain

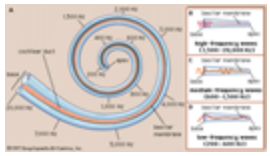
- Cilia send nerve impulses through the auditory nerve to the brain
- Auditory nerve
  - Connection from ear to brain
  - Provides information to both sides of brain
  - Information processed in auditory cortex in temporal lobe



How do we hear?

Place Theory: where in the basilar membrane the waves hit– the PLACE, like keys on a keyboard (high frequencies)

Volley/ Frequency Theory:
Firing rate of neurons in the acoustic nerve match the frequency of sound waves (low/moderate frequencies)



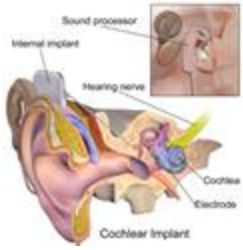
Hearing Disorders

- About 28 million people have some form of hearing damage in the U.S.
- Can be caused by: Injury, Infections, Explosions, Long-term exposure to loud noises
- Conduction hearing loss results from damage to parts of the ear itself
- Sensorineural hearing loss results when there is damage to hair cells or auditory nerve

Cochlear Implants

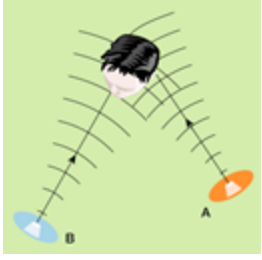
Cochlear implants can replace damaged hair cells and transduce sounds into electrical signals sent to the auditory nerve

- Use of the implants is debated
- Many advocates for the deaf argue that deafness is NOT a disability, but rather an enhancement of other senses



Localizing Sounds

- We use both monaural and binaural cues
- Loudness
  - Louder sounds are perceived as being closer
- Time of arrival
  - Sounds will arrive at one ear sooner than the other (ITD)
  - This helps determine direction of the sound
- McGurk Effect



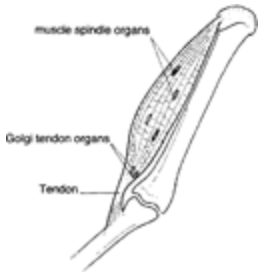
The Other Senses

The Skin Senses

- Skin is the largest sense organ
- There are receptors for pressure, temperature (cold and warm), and pain
- Touch appears to be important not just as a source of information, but as a way to bond with others
- Homunculus Man
  - Proportional representation of skin receptor concentration
  - The larger the part, the more receptors/the more sensitive

Kinesthetic Senses

- Kinesthetic senses provide information about the position and movement of body parts
  - Stretch receptors sense muscle stretch
  - Golgi tendon organs sense movement of tendons when muscle contracts and send impulses to CNS



Vestibular Senses

- Vestibular senses provide information about equilibrium and head and body position
  - **Fluid moves in two vestibular sacs and the semicircular canals**
  - **These vestibular organs are lined with hair cells that bend when fluid moves over them**
- Vestibular organs are also responsible for motion sickness
- Motion sickness may be caused by discrepancies between visual information and vestibular sensation

Proprioception

How your kinesthetic and vestibular senses work together, to keep you moving and balanced.

Pain

Tells your brain damage is happening…

Different nerves carry different types of pain

Gate Control Theory: "gate" in the spine blocks extreme pain

Endorphins help

Social aspect of pain- who's watching???

Chemical Senses

Olfaction (smell)
- Molecules come in contact with our nose

Gustation (taste)
- Molecules come in contact with our tongue

Taste

- Five Basic Tastes
- Traditionally, taste sensations consisted of sweet, salty, sour, and bitter tastes. Recently, receptors for a fifth taste have been discovered called "Umami" (pleasant savory taste imparted by glutamate)


Sweet


Sour

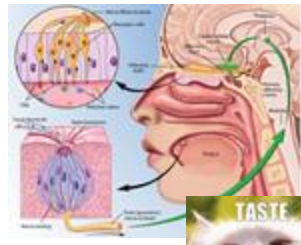

Salty

Bitter


Umami (Fresh [dead?] Chicken)

Taste

- Receptor cells are located in taste buds
- Taste buds are located in papillae ("pa-PILL-ee") on the tongue
- Chemicals dissolve in saliva and activate taste receptors inside the taste buds
- Taste is processed in the parietal lobe



Taste

- Why do we have receptors for the tastes we do?
- Evolutionary perspective on how taste receptors developed?
- Other aspects of taste result from the interaction of taste and smell together, such as flavors.
- Without a sense of smell, our vanishes!
- Super Tasters? Women are more likely to be supertasters as are those from Asia, South America and Africa

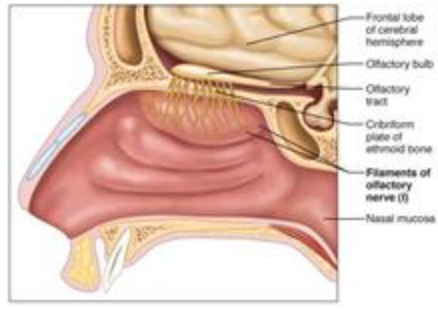
TABLE 6.2

The Survival Functions of Basic Tastes

Taste	Indicates
Sweet	Energy source
Salty	Sodium essential to physiological processes
Sour	Potentially toxic acid
Bitter	Potential poisons
Umami	Proteins to grow and repair tissue

(Adapted from Cowart, 2005.)

Olfaction



Olfaction

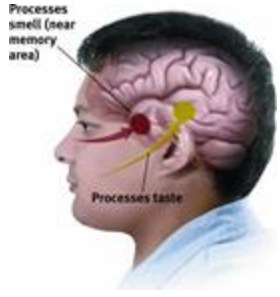
Signals are sent from the olfactory bulb to the brain- SMELL DOES NOT GO THROUGH THE THALAMUS!

Pheromones: odors from an animal that change the behavior of another animal

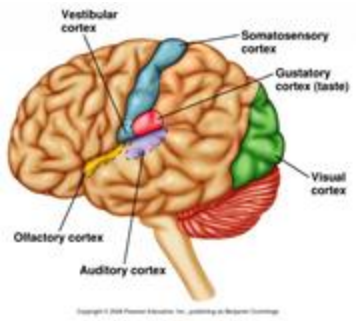
Tee Shirt Test

Smell, Taste and Memory

- The brain region for smell (in red) is closely connected with the brain regions involved with memory (limbic system). That is why strong memories are made through the sense of smell.
  - Smell does not go through the thalamus!



Sensory Receptors in the Brain



Extrasensory Perception

- Refers to extraordinary perception such as
  - **Clairvoyance** – awareness of an unknown object or event
  - **Telepathy** – knowledge of someone else's thoughts or feelings
  - **Precognition** – foreknowledge of future events
- **Psychokinesis** – "Mind over matter"
- Research has been unable to conclusively demonstrate the existence of ESP or psychokinesis