Sensation and Perception

• Sensation
  – The process by which our sense organs receive information from the environment

• Perception
  – The sorting out, interpretation, analysis, and integration of stimuli by the sense organs and brain

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Sensing the World Around Us

• Psychophysics
  – The study of the relationship between the physical aspects of stimuli and our psychological experience of them

• Stimulus
  – Energy that produces a response in a sense organ
  – Varies in both type and intensity
Absolute Thresholds

- The smallest intensity of a stimulus that must be present for it to be detected.
Sensing the World Around Us

• Noise
  – Background stimulation that interferes with the perception of other stimuli
Difference Thresholds: Noticing Distinctions Between Stimuli

• Weber’s law
  – A basic law of psychophysics stating that a just noticeable difference is in constant proportion to the intensity of an initial stimulus
Sensory Adaptation

• An adjustment in sensory capacity after prolonged exposure to unchanging stimuli
Structure of the Eye

• Retina

Rods are thin, cylindrical receptor cells highly sensitive to light.

Cones are light-sensitive receptor cells responsible for sharp focus and color perception, particularly in bright light.
Structure of the Eye
A camera’s lens focuses the inverted image on the film in the same way the eye’s lens focuses images on the retina.
Structure of the Eye

• Sending message from the eye to the brain
  – Bipolar cells
    • Receive information directly from the rods and cones and communicate that information to the ganglion cells
  – Ganglion cells
    • Collect and summarize visual information, which is then moved out of the back of the eyeball and sent to the brain via the optic nerve
Structure of the Eye
Structure of the Eye

• Processing the visual message
  – Optic chiasm
    • Junction where the optic nerves of both eyes meet then split
  – Feature detection
    • Some neurons in the cortex are activated only by visual stimuli of a particular shape or pattern
Color Vision and Color Blindness

• Trichromatic theory of color vision
  – There are three kinds of cones in the retina, each of which responds primarily to a specific range of wavelengths
  – Colorblindness is due to one of the three cone systems malfunctioning, and colors covered by that range are misperceived
Color Vision and Color Blindness

• Opponent-process theory of color vision
  – Receptor cells for color are linked in pairs, working in opposition to each other
Hearing: Sensing Sound

- **Sound**
  - The movement of air molecules brought about by a source of vibration
    - **Eardrum**
      - Part of the ear that vibrates when sound hits it
    - **Middle ear**
      - Tiny chamber containing three bones (hammer, anvil, stirrup) that acts as a tiny mechanical amplifier
Hearing: Sensing Sound

• Cochlea
  – Coiled tube in the ear filled with fluid that vibrates in response to sound

• Basilar membrane
  – Structure that runs through the center of the cochlea, dividing it into an upper and lower chambers

• Hair cells
  – Covering the basilar membrane that, when bent by vibrations transmit neural messages
Hearing: Physical Aspects of Sound

• Frequency
  – Number of wave cycles that occur in a second
  – Pitch
  • Characteristic that makes sound seem “high” or “low”
Hearing: Physical Aspects of Sound

• Amplitude
  – Allows us to distinguish between loud and soft sounds
  – Decibels
    • How range of amplitude is measured
<table>
<thead>
<tr>
<th>Sound</th>
<th>Decibel Level</th>
<th>Exposure Time Leading to Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whispering</td>
<td>25 dB</td>
<td></td>
</tr>
<tr>
<td>Library</td>
<td>30 dB</td>
<td></td>
</tr>
<tr>
<td>Average home</td>
<td>50 dB</td>
<td></td>
</tr>
<tr>
<td>Normal conversation</td>
<td>60 dB</td>
<td></td>
</tr>
<tr>
<td>Washing machine</td>
<td>65 dB</td>
<td></td>
</tr>
<tr>
<td>Car</td>
<td>70 dB</td>
<td></td>
</tr>
<tr>
<td>Vacuum cleaner</td>
<td>70 dB</td>
<td></td>
</tr>
<tr>
<td>Busy traffic</td>
<td>75 dB</td>
<td></td>
</tr>
<tr>
<td>Alarm clock</td>
<td>80 dB</td>
<td></td>
</tr>
<tr>
<td>Noisy restaurant</td>
<td>80 dB</td>
<td></td>
</tr>
<tr>
<td>Average factory</td>
<td>85 dB</td>
<td>16 hours</td>
</tr>
<tr>
<td>Live rock music (moderately loud)</td>
<td>90 dB</td>
<td>8 hours</td>
</tr>
<tr>
<td>Screaming child</td>
<td>90 dB</td>
<td>8 hours</td>
</tr>
<tr>
<td>Subway train</td>
<td>100 dB</td>
<td>2 hours</td>
</tr>
<tr>
<td>Jackhammer</td>
<td>100 dB</td>
<td>2 hours</td>
</tr>
<tr>
<td>Loud song played through earphones</td>
<td>100 dB</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Helicopter</td>
<td>105 dB</td>
<td>1 hour</td>
</tr>
<tr>
<td>Sandblasting</td>
<td>110 dB</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Auto horn</td>
<td>120 dB</td>
<td>7.5 minutes</td>
</tr>
<tr>
<td>Live rock music (loud)</td>
<td>130 dB</td>
<td>3.75 minutes</td>
</tr>
<tr>
<td>Air raid siren</td>
<td>130 dB</td>
<td>3.75 minutes</td>
</tr>
<tr>
<td><strong>THRESHOLD OF PAIN</strong></td>
<td><strong>140 dB</strong></td>
<td><strong>Immediate damage</strong></td>
</tr>
<tr>
<td>Jet engine</td>
<td>140 dB</td>
<td><strong>Immediate damage</strong></td>
</tr>
<tr>
<td>Rocket launching</td>
<td>180 dB</td>
<td><strong>Immediate damage</strong></td>
</tr>
</tbody>
</table>

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Hearing: Sorting Out Theories of Sound

• Place Theory of Hearing
  – Different areas of the basilar membrane respond to different frequencies

• Frequency Theory of Hearing
  – The entire basilar membrane acts like a microphone, vibrating as a whole in response to sound
Balance

• Semicircular canals
  – Three tubelike structures of the inner ear containing fluid that sloshes through them when the head moves, signaling rotational or angular movement to the brain

• Otoliths
  – Tiny, motion-sensitive crystals within the semicircular canals that sense body acceleration
Smell

• Olfaction
  – Can detect more than 10,000 different smells
  – Can identify gender by smell
  – Can evoke memories

• Olfactory cells
  – Receptor cells of the nose

• Pheromones
  – Pollen-like chemicals that are released by non-humans that have an effect on other’s behavior
Taste: Gustation

• Taste buds
  – Receptor cells located within the tongue, as well as other parts of the mouth and throat
  – Constantly reproduce every 10 days
  – “Supertasters” vs. “Nontasters”
  – Umami taste
Take a Taste Test

1. Taste Bud Count
   Punch a hole with a standard hole punch in a square of wax paper. Paint the front of your tongue with a cotton swab dipped in blue food coloring. Put wax paper on the tip of your tongue, just to the right of center. With a flashlight and magnifying glass, count the number of pink, unstained circles. They contain taste buds.

2. Sweet Taste
   Rinse your mouth with water before tasting each sample. Put 1/2 cup sugar in a measuring cup, and then add enough water to make 1 cup. Mix. Coat front half of your tongue, including the tip, with a cotton swab dipped in the solution. Wait a few moments. Rate the sweetness according to the scale shown below.

3. Salt Taste
   Put 2 teaspoons of salt in a measuring cup and add enough water to make 1 cup. Repeat the steps listed above, rating how salty the solution is.

4. Spicy Taste
   Add 1 teaspoon of Tabasco sauce to 1 cup of water. Apply with a cotton swab to first half inch of the tongue, including the tip. Keep your tongue out of your mouth until the burn reaches a peak, then rate the burn according to the scale.

TASTE SCALE

<table>
<thead>
<tr>
<th>Barely Detectable</th>
<th>Moderate</th>
<th>Strong</th>
<th>Very Strong</th>
<th>Strongest Imaginable Sensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>50</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of taste buds</th>
<th>SUPERTASTERS</th>
<th>NONTASTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet rating</td>
<td>25 on Average</td>
<td>10</td>
</tr>
<tr>
<td>Tabasco</td>
<td>64 on Average</td>
<td>31</td>
</tr>
</tbody>
</table>

Average tasters lie in between supertasters and nontasters. Bartoshuk and Lucchina lack the data at this time to rate salt reliably, but you can compare your results with others taking the test.
The Skin Senses

- Touch, temperature, pressure, and pain
- **Gate-Control Theory** of pain
  - Particular nerve receptors in the spinal cord lead to specific areas of the brain related to pain
  - Psychological factors can close the “gate”
The Skin Senses

- Women experience painful stimuli more intensely than men.
- Pain is a perceptual response that depends heavily on our emotions and thoughts.
- Genetics also play a part in sensitivity.
The Skin Senses

• How our senses interact
  – Synesthesia
    • Rare condition in which exposure to one sensation (such as a sound) evokes an additional one (such as vision)
Perceptual Organization

- **Figure**
  - The object being perceived

- **Ground**
  - The background or spaces within the object
Perceptual Organization: The Gestalt Laws of Organization
Perceptual Organization: The Gestalt Laws of Organization

Proximity

Closure

Simplicity

Similarity

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Perceptual Organization

• Feature analysis
  – An approach that considers how we perceive a shape, a pattern, object, or scene by reacting first to the individual elements that make it up
Perceptual Organization

• Top-Down processing
  – Perception that is guided by higher-level knowledge, experience, expectations, and motivations

• Bottom-Up processing
  – Perception that consists of the progression of recognizing and processing information from individual components of a stimuli and moving to the perception of the whole
Perceptual Organization

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Perceptual Organization

• Perceptual constancy
  – Phenomenon in which physical objects are perceived a unvarying and consistent despite changes in their appearance or in the physical environment
Perceptual Organization: Depth Perception

• Binocular disparity
  – The ability of the brain to integrate the two images received from the eyes into one composite view

• Monocular cues
  – Cues that allow us to obtain a sense of depth and distance with just one eye
Poggendorf Illusion

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Müller-Lyer Illusion

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“Devil’s Tuning Fork”

- Can you reproduce this on a piece of paper?
Subliminal Perception

• Subliminal Perception
  – The perception of messages about which we have no awareness

• Extrasensory Perception
  – ESP