**Sensation**

**Objectives:**
1. Contrast the processes of sensation and perception.
2. Distinguish between absolute and difference thresholds, and discuss research findings on subliminal stimulation.
3. Describe the phenomenon of sensory adaptation and explain its functional value.

**Sensation**
- **process of detecting physical energy from the environment and encoding it into neural signals**
  - done by our sensory organs

**Perception**
- **process of selecting, organizing, and interpreting our sensations**
  - done by our brains

**Bottom-Up Processing**
- processing that begins with the sense 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

**Sensation- Basic Principles**
- as humans we exist in a sea of energy
- some we are aware of, some we aren't

**psychophysics** - the study of how this physical energy around us relates to our psychological experience

**<EARY SCHOLL OF PSYCHOLOGY>**

**Sensation-Thresholds**
- **Absolute Threshold**
  - minimum stimulation needed to detect a particular stimulus 50% of the time

**Sensation-Thresholds**
- vision - we can see a candle flame from 30 miles on a clear, dark night (granted there are no physical obstructions)
- hearing - we can hear a watch ticking in a silent room from 20 feet away
- touch - we can feel the wing of a fly falling on our face from a very close distance
- smell - we can smell a single drop of perfume in a 3 room apartment
- taste - we can taste a teaspoon of sugar diluted in 2 or 3 gallons of water
- ex. Hearing tests
**Sensation-Thresholds**

- **Signal Detection Theory**
  - predicts how and when we detect the presence of a faint stimulus (signal) amid background stimulation (noise)
  - assumes that there is no single absolute threshold
  - detection depends partly on person's
    - Experience/ expectations/ motivation/ level of fatigue
  - seeks to explain why people respond differently to the same stimuli, and why the same person’s reactions vary as circumstances change

- **Difference Threshold**
  - minimum difference between two stimuli required for detection 50% of the time
  - aka the just noticeable difference (jnd)
  - the difference threshold increases with the magnitude of the stimulus

- **Weber's Law**
  - to perceive as different, two stimuli must differ by a constant minimum percentage (rather than in quantity)
  - light intensity: 8%
  - weight: 2%
  - tone frequency: 0.3%

- **Sensory adaptation**
  - diminished sensitivity as a consequence of constant stimulation

- **Why??**

- **Subliminal Stimulation**
  - subliminal message: stimulus that lies below one's absolute threshold for conscious awareness
  - We can detect some subliminal messages
  - How is that?
    - because absolute thresholds involve detecting the stimulus 50% of the time
  - Does this mean we can be subliminally persuaded?
    - <<NO>>

- **CBC Sunday night Study..”Telephone Now”**
- **subliminal tape study**
- **John Krosnick 1992**

**Vision**

4. Explain the visual process, including the stimulus input, the structure of the eye, and the transduction of light energy.
5. Describe the 2 major theories of color vision.
6. Explain issues with visual acuity and examine the afterimage effect in the context of opponent process theory.
Vision - Physical Properties of Waves

- Short wavelength = high frequency
- Long wavelength = low frequency
- Great amplitude
- Small amplitude

Vision - The Eye

- Light enters through the cornea (a transparent protector - bends light)
- Pupil - small adjustable opening of the eye determines the amount of light let in (black part of eye)
- Iris - muscle that controls the amount of light that enters the pupil (colored part of eye)
- Lens - behind the pupil
  - It focuses light rays by adjusting its curvature – process known as accommodation
  - Lens focus light onto the retina - the light sensitive inner surface of our eyes

Vision - The Eye

- Retina contains photoreceptors (rods and cones) which convert light energy into neural impulses
  - These impulses carried by optic nerve to the brain where they are constructed into full images
- Rods - detect black, white, and gray necessary for peripheral and twilight vision
- Cones - detect fine detail and give rise to color sensations
  - Concentrated around center of retina (fovea – central point of focus)

Vision - The Eye

- >>exp why the pupil must open to see in dark - because rods are on the periphery of retina

Vision - Receptors

<table>
<thead>
<tr>
<th>Cones</th>
<th>Rods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>6 million</td>
</tr>
<tr>
<td>Location in retina</td>
<td>Center</td>
</tr>
<tr>
<td>Sensitivity in dim light</td>
<td>Low</td>
</tr>
<tr>
<td>Color sensitive?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Vision - Pathways from the Eyes to the Visual Cortex

1. Light entering eye triggers photochemical reaction in rods and cones at back of 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 in the brain's occipital lobe.
Vision

- **Acuity** - the sharpness of vision
- **Nearsightedness** - nearby objects seen more clearly than distant objects because distant objects in front of retina
- **Farsightedness** - faraway objects seen more clearly than near objects because the image of near objects is focused behind retina

Vision

- Far (Short eyeball)
- Nearsighted (Long eyeball)
- Normal

Visual Information Processing

- **Feature Detectors** (David Hubel & Torsten Wiesel, 1979)
  - nerve cells in the brain that respond to specific features
  - shape
  - angle
  - Movement
  - Facial Recognition - 30% of cortex
  - Temporal Lobe involved in facial recog (see p. 205)

Visual Information Processing

- **Parallel Processing**
  - simultaneous processing of several aspects of a problem simultaneously
  - Brain divides visual scene into subdivisions
  - They are all processed in parallel and combined into a whole.

Visual Information Processing

- **Ewald Hering’s Opponent-Process Theory** - opposing retinal processes enable color vision
  - “ON” cells - sensitive to one color
  - “OFF” cells - sensitive to the opposite color

- **Color-Deficient Vision**
  - People who suffer red-green blindness lack functioning red or green sensitive cones
  - Well if Yellow is a mix of green & red, then how can c.b. see yellow?
  - Enter Ewald Hering’s Opponent Process Theory

Visual Information Processing

- **Afterimage Effect**
  - explained by Opp Proc Th

Visual Information Processing

- **Color Constancy**
  - Perceiving familiar objects as having consistent color, even if changing illumination alters the wavelengths reflected by the object

- **Color Sensation is a Subjective experience** – context plays a role in the process
  - Ex. apple in fruit bowl – color remains constant as lighting shifts
Unit 4-Sec 2 The other Senses

- Explain the auditory process, including the stimulus input and the structure and function of the ear.
- Explain the place and frequency theories of pitch perception, and describe how we locate sounds.
- Discuss the nature and causes of hearing loss, and describe the effects of noise on hearing and behavior.
- Describe the sense of touch, and explain the basis of pain.
- Describe the senses of taste and smell, and comment on the nature of sensory interaction.
- Distinguish between kinesthesia and the vestibular sense.

Audition

- **Audition**: sense of hearing
  - **Sound Waves**
    - Our ears detect changes in air pressure caused by sound waves and transform them into neural impulses that our brains decode as sounds.
    - Amplitude/height determines the loudness (measured in decibels).
    - Abs Threshold: defined as 0 dB
    - Every 10 decibel increase represents a tenfold increase in sound.
    - Prolonged exposure > 85 decibels = hearing loss (sensorineural) -- Rock Concerts = 140 dB

The Intensity of Some Common Sounds

- The intensity of some common sounds is shown in the table.

Audition- The Ear

- **Outer Ear**
  - The visible part -- channels sound waves through the auditory canal to the eardrum (gateway to the middle ear).

- **Middle Ear**
  - Conducts eardrum’s vibrations through the hammer, anvil, and stirrup (smallest bone in body), which in turn stimulate the cochlea.
  - Contains the **cochlea**: a coiled, bony, fluid-filled tube, which triggers nerve impulses.
  - Cochlea contains the **basilar membrane**, which is lined with tiny hair cells (16k x 130 mil rods/cones).
  - When the fluid in the cochlea vibrates, it stimulates these hair cells, which trigger impulses in adjacent nerve fibers, which connect to the auditory nerve (TRANSDUCTION).

Pitch Perception

- **Place Theory (Herman von Helmholtz)**
  - Pitch we hear is determined by place where the cochlea’s membrane is stimulated (place of vib-det pitch).
  - High frequency waves produce large vibrations near the beginning of the cochlea’s membrane, lower near the end.
  - Brain can detect pitch by recog place on membrane from which it receives neural signals.
  - Problem: Low pitched sounds don’t neatly localize on basilar membrane.

- **Frequency Theory**
  - The theory that the rate of nerve impulses traveling up the auditory nerve matches the frequency of a tone, thus enabling us to sense its pitch.

Pitch Perception Cont’d

- Brain reads pitch from frequency of neural impulses because neural impulses are triggered at the same rate as sound waves (100 waves/sec = 100 pulses/sec).
  - Note: Humans detect sounds 20-20k Hz.
  - Problem: Neurons can only fire 1000x/sec (Freq Th doesn’t explain how high pitch is det).

- **Volley Principle**: workgroups of neural cells synchronize alternate firing & reloading.
  - Remember refractory period/resting pause from Ch 2.
Sound Localization

Sound travels at 750 miles per hour

Hearing Loss

- **Conduction Hearing Loss**
  - Inability to conduct vibrations due to eardrum puncture or damage to middle ear bones (digital hearing aids amp vib)

- **Sensorineural / Nerve Hearing Loss**
  - damage to the cochlea's receptor cells or to the auditory nerve, aging, loud noise/music, disease
  - Coch implant (translates sound into neural imp)
  - Won't work in deaf adults who've spent a life w/o hearing? WHY NOT??????

Deaf Culture

- Deaf Culture – Nat'l Assoc of Deaf – "deafness isn't a disability"
  - >>objects to using cochlear implants in children who were deafened before learning to speak
  - >>deafness could be considered "visual enhancement" v "hearing impairment"

  - Auditory Cortex in deaf is sensitive to touch and visual input
  - Helen Keller – visual + aud cort sensitive to touch.
  - FYI - Older adults have more trouble hearing high pitched sounds but are okay w/' low pitch... Why?
  - Degeneration near beginning of basilar membrane
  - Place Theory

Touch

- **4 Separate Skin Senses**
  - pressure
    - only skin sensation with identifiable receptors
  - warmth
  - cold
  - Pain
  - Relationship b/w warmth, cold, pain and receptors that respond to them remains a mystery.

- Other skin sensations are variations of the basic 4
  - Stroking adjacent pressure spots = tickle
  - Gentle stroking of pain spot = itching sensation

- Pain is way of telling us that something is wrong
  >>people born w/o ability to feel pain die young (excess joint strain, infections from not shifting)

- Pain is a sense, but the brain has a big effect on it as well
  - Ex. Phantom limb- 7 out of 10 amputees report pain or movement in their nonexistent limbs
  - Ex. Placebo effect
  - Fyi-no single stimulus that triggers pain & no special receptors
    >>low pain stimuli can produce other sensations
    - warmth, coolness, smoothness, roughness

- **Gate-Control Theory (Ronald Melzack & Patrick Wall)**
  - theory that the spinal cord contains a neurological "gate" that blocks pain signals or allows them to pass on to the brain
  - "gate" opened by the activity of pain signals traveling up small nerve fibers
  - "gate" closed by activity in larger fibers or by information coming from the brain (ie. endorphins)
  - in theory you can treat pain by stimulating larger nerve fibers (massage, muscle stim, acupuncture)
  - >>cause "gate closing" activity in large neural fibers
  - Lamaze method of Pain Control combines relaxation, counterstimulation & distraction

- Pain's role in pain cont'd—
  - Pain gate closed by endorphins
    - eg. 1979-Ohio St B-Ball player finishing game w/ broken neck
  - Brain can also produce pain when no physical ailment is observed
  - Brain's Recording of Pain (exp memories of pain)
    - Brain records peak moment of pain and how much is felt at end of experience
    - Daniel Kahneman 1993
      >>2 trials— trial 1 - put hand in cold H2O for 60 sec
      trial 2 - put hand in cold H2O for 60 sec + then immediately switch to slightly less cold for 30 sec
    - Subjects said they'd rather rep T 2
  - Implications for med procedures (ie. Colon exams)

- More on Brain's Role
  - Roger Ulrich 1994-
    - Surgery patients assigned to rooms looking out on trees – less pain med & faster discharge than patients in identical rooms w/ a view of brick wall
### Taste

- **Did u know?-alc & smk dec taste sens**

- **Sensory Interaction** one sense influences another especially true with taste and smell

  >>people who’ve lost sense of smell think they’ve lost taste

  >>can’t taste when have a cold

  - Best eg of S.I.:

    >>SMELL + TASTE + TEXTURE = FLAVOR

- **Age, Sex and Sense of Smell**

  ![](image)

  - **Women and young adults have best sense of smell**

- **Body Position and Movement**

  - **Kinesthesia** system for sensing the position and movement of individual body parts

    - Receptors located in muscles, tendons, and joints

    - Athletes-strong kinesthetic sense

  - **Vestibular Sense** the sense of body movement and position, including the sense of balance

    - Based in the inner ear (semi-circular canals, vestibular sacs)

    - Head movement triggers fluid to stimulate hair-like receptors in these organs which sends signal to cerebellum (rem balance & voluntary movement)

    - Exp why if head is off balance, whole body is off

    - After spinning, neither fluid nor kinesth receptors immediately return to neutral ----

- **Perception**

  - **Selective Attention** focus of conscious awareness on a particular stimulus

    - Eg. Cocktail party effect/phenomenon

    - Ability to follow one conversation despite distraction of other conversations

- **Change Blindness**

  Illustrates selective attention-focusing awareness on a limited aspect of what we experience

### Smell

- **Did u know?-alc & smk dec taste sens**

- **Taste & Smell: “chemical senses”**

- **Age, Sex and Sense of Smell**

  - **Women and young adults have best sense of smell**

- **Body Position and Movement**

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### Unit 4 Sec 3 Perception

1. Describe how the process of perception is directed and limited by selective attention.
2. Explain how illusions help us to understand perception.
3. Discuss Gestalt psychology’s contribution to our understanding of perception.
4. Explain the figure-ground relationship, and identify principles of perceptual grouping in form perception.
5. Discuss research on depth perception involving the use of the visual cliff, and describe the binocular and monocular cues in depth perception.
6. Describe stroboscopic movement and the phi phenomenon.
7. Describe the perceptual constancies, and show how the perceived size-distance relationship operates in visual illusions.
8. Describe the perceptual constancies, and show how the perceived size-distance relationship operates in depth perception.
9. Describe the debate over the role of nature and nurture in perception, and discuss what research findings on sensory deprivation and restored vision have contributed to this debate.
Perceptual Illusions

Perceptual illusions can help us learn about how we normally interpret and organize our sensations. For example, which line segment is longer?

- Segment AB is 1/3 longer than BC.

Cross Cultural Research shows us that some perceptual sets come from experience—noncarpentered cultures not tricked.

Why do the girls change sizes when they switch places? -puzzles most people because they assume the girls are the same distance away.

Summary: Perceptual Organization

How do we organize the visual experience?
1. Form Perception – figure/ground, Gestalt Principles
2. Depth Perception – binocular/monocular cues
3. Motion Perception – brain computes motion as image moves across retina
4. Perceptual Constancy – size, shape and lightness constancy helps us recognize it despite the variance of the image on our retina

Perceptual Organization: Gestalt

- Visual Capture
  - tendency for vision to dominate the other senses (movie theater ex.)
- Gestalt – an organized whole (Max Wertheimer)
  - tendency to integrate pieces of information into meaningful wholes
- German Gestalt psychologists, we organize perceptions into a gestalt (an organized whole)
  - they would say we put pieces of information into meaningful wholes

Perceptual Organization: Grouping Principles

- Grouping
  - the perceptual tendency to organize stimuli into coherent groups
- Gestalt Grouping Principles
  - proximity – group nearby figures together
  - similarity – group figures that are similar
  - continuity – perceive continuous patterns
  - closure – fill in gaps
  - connectedness – spots, lines, and areas are seen as unit when connected

Perceptual Organization: Closure

- Proximity
- Similarity
- Continuity
- Connectedness
Perceptual Organization: Illusory Contours

- Figure-ground: organization of the visual field into objects against a background, also applies to other senses (e.g., hearing-conversation with friends in a crowd)
- Ex. Clouds vs. sky, Pictures vs. wall

Perceptual Organization: Depth Perception

- Depth Perception
  - Ability to see objects in three dimensions
  - Allows us to judge distance

Perceptual Organization: Visual Cliff Study

- Richard Gibson & Eleanor Walk
- Depth perception shown at 6-14 mos. – depth perception partly innate

Depth Perception

- How do we transform 2-dimensional retinal images into three-dimensional perceptions?
  - With Binocular and Monocular Cues
- Binocular Cues
  - Retinal disparity
  - Images from the two eyes differ
  - Closer the object, the larger the disparity
- Convergence
  - Neuromuscular cue
  - Two eyes move inward for near objects
  - Closer the object, the more the convergence

Perceptual Organization: Depth Perception

- Monocular Cues
  - Relative size
    - Smaller image is more distant
  - Interposition/ Superposition
    - Closer object blocks distant object
  - Relative clarity
    - Hazy object seen as more distant
  - Texture gradient
    - Coarse --> close
    - Fine --> distant

Perceptual Illusions

- Relative size
  - Light from distant objects passes through more atmosphere, we perceive hazy objects as farther away

Perceptual Illusions

- Perceived distance in meters
  - Morning fog
  - Midday sunshine
  - True distance in meters

Graph showing perceived vs. true distance under different lighting conditions.
Perceptual Organization: Depth Perception

- Monocular Cues (cont.)
  - relative height
  - higher objects seen as more distant
  - relative motion
  - closer objects seem to move faster
  - linear perspective
  - parallel lines converge with distance
  - Light and shadow

Motion Perception

- brain knows that shrinking objects are moving away from us, and that enlarging objects are getting closer
- brain also interprets a rapid series of slightly varying retinal images as movement
  - this is called stroboscopic motion
- how we view movies as moving
  - 24 still pictures are flashed per second creating perceived movement (like a super fast slide show)
- phi phenomenon: another illusion of movement
  - created when two or more adjacent lights blink on and off in succession
    (eg. lighted sign creating impression of a moving arrow)

Perception (cont.)

- Illusory Depth
  - Explanation – Walter Vick cuts out paper shaped to imitate stair patterns and colored them to stimulate light and shadow – (Monocular Cue) – nearby objects reflect more light to our eyes – thus given two identical objects – dimmer seems further
**Perceptual Constancy**

- Perceptual Constancy
  - perceiving objects as unchanging even as illumination, angle of vision and retinal image change (i.e. still see door as rect even though ret im is trap)
  - Color
  - shape
  - size

**Perceptual Constancy**

- Perceptual Constancy
  - Lightness Constancy:
    - AS light changes, red apple in fruit bowl retains its redness, b/c brain computes the light reflected by any object relative to its surrounding objects.
  - Perceived lightness stays roughly constant given unchanging context, but what if context changes?

**Brightness Constancy**

- Perceived lightness changes with context

**Other Size-Distance Illusions**

- In each of these examples, the top and bottom lines are actually the same length.
- In each case the top line looks longer.
- Why?

**Ponzo Illusion**

- Converging lines indicate that top line is farther away than bottom line. Experience tells us that a more distant obj can create the same-sized image as a nearer one only if it is larger.

**Perceptual Organization**

- Muller-Lyer Illusion

**Perceptual Organization: Muller-Lyer Illusion**

- Perceptual psychologists have hypothesized that the top horizontal line looks longer because it also looks farther away.
- Specifically, the inward pointing arrows signify that the horizontal line is closest to you, and the outward pointing arrows signify the opposite case.
Perceptual Illusions

Perceptual Organization: Size-Distance Relationship– Ames Room

1. The Ames room is designed so that the monocular depth cues give the illusion that the two people are equally far away.

Perceptual Organization: Grouping Principles

- Gestalt grouping principles are at work here.

Perceptual Organization: Grouping Principles

- Impossible doghouse

Sensory Restriction: Blakemore & Cooper, 1970

- Kant-Ger Phil-nature; knowledge comes from inborn ways of organizing sensory experiences.
- Kittens raised without exposure to horizontal lines later had difficulty perceiving horizontal bars. Illustrates nurture component of feature detection.
- *There is a Critical period for normal sensory and perceptual development*

Critical Period Con’td

- People who gain sight for the first time as adults report vision problems most people do not have.
- Many cannot recognize items by sight that they could by touch.
- However, if vision is corrected as an infant areas of the brain associated with vision develop rapidly to catch up.

Unit 4- Sec. 4 Perception

3. Discuss the effects of assumptions, expectations, and contexts on our perceptions.
4. State the claims of ESP, and explain why most research psychologists remain skeptical.

Perceptual Interpretation

- Perceptual Adaptation
  - (vision) ability to adjust to an artificially displaced visual field
  - Prism glasses (football player in video)
  - Disc by George Stratton (1896)- glasses made L-R, Down-Up, took 8 days to adjust, readjusted quickly when took off glasses
- Perceptual Set
  - A mental predisposition to perceive one thing and not another
  - 1972 British newspaper published these photographs lochness monster or tree trunk, clouds or ufo (p291)
Perceptual Set: Schemas

- What you see in the center is influenced by perceptual set <<what u expect to see>>

Perceptual Set: Schemas

![Image](image)

Perception and the Human Factor

- Human Factors Psychology
  - explores how people and machines interact
  - explores how machine and physical environments can be adapted to human behaviors

Perceptual Set: Human Factors

Is There Extrasensory Perception?

- ESP - Extrasensory Perception
  - controversial claim that perception can occur apart from sensory input
  - 3 Types
    - Telepathy - mind-to-mind communication
    - Clairvoyance - perceiving remote events
    - Precognition - perceiving future events
      - ex. Nostradamus

- Parapsychology
  - the study of paranormal phenomena
  - ESP
  - Psychokinesis - mind over matter being able to move or physically change objects with your mind