

Sensation and Perception

Chapter 4

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- Sensation and Perception**
- I. How Are Stimulation and Perception Linked?
  - II. How Do We See the World?
  - III. How Do We Perceive Form and Substance?
  - IV. How Do We Perceive Sounds?
  - V. Which Senses are the Least Understood?
  - VI. What is the Relationship Between Touch and Pain?
  - VII. Does Extrasensory Perception Exist?

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I. How Are Stimulation and Perception Linked?

**Sensation** (stimulation of the sensory system)

- The process in which information is transmitted from the environment to the brain
- The oldest field in psychology (1879)

**Perception** (selection, organization, & interpretation of sensations)

- The process by which an organism selects and interprets sensory input so it acquires meaning

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## Psychophysics

- The study of the relationship between physical stimuli and people's conscious experience of them
- Studies **sensory thresholds**
  - The point at which a difference is detected
  - Two types:
    - Absolute thresholds
    - Difference thresholds

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## Absolute Thresholds

Minimal amount of energy that can produce a sensation  
Varies from person to person  
Perception that takes place below this threshold is **subliminal**

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## Difference Thresholds

The amount of change necessary to be noticed

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## Methods of Studying Thresholds

### ■ Signal Detection Theory

Perception depends on:

- Intensity of the stimulus
- The observer's motivation
- The criteria set by the observer
- Background noise

Feature Detectors: Neurons in the sensory cortex that respond to the lines or edges of objects

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## Sensory Adaptation

The process of being more sensitive when not stimulated and less sensitive after repeated stimulation

- Sensitization: We become more sensitive to stimuli that are low in magnitude
- Desensitization: We become less sensitive to constant stimuli

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## II. How do we see the world?

### ■ Theories of Color Vision

Trichromatic Theory

- Young–Helmholtz theory
- All colors are made by mixing three different colors: red, green, and blue
- Different types of cones are each responsive to one of these wavelengths of light

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### Opponent Process Theory (Herring, 1887)

Assumes there are six colors and three types of receptors:

- Red–green
- Blue–yellow
- Black–white

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### Theories of Color Vision

- Both theories have received support
  - There are three classes of cones
    - The trichromatic theory explains color coding in the photoreceptors of the retina
  - Cells in the lateral geniculate nucleus do respond in an opponent-process way
    - The opponent-process theory explains color coding in the neurons (ganglion cells)

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### Vision

Normal Vision: Image is focused on the retina



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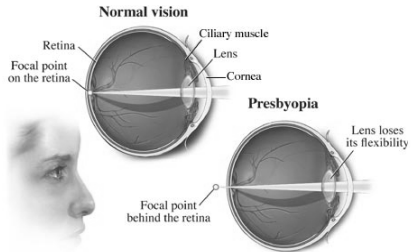
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## Presbyopia

Normal worsening of vision with age, especially near vision.



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## Visual Problems

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## Nearsightedness (Myopia)

- A common cause of blurred vision.
- Objects in the distance appear blurry and out of focus.
- Some may squint or frown when trying to see distant objects clearly.
- Image is focused in front of the retina

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## Farsightedness (Hyperopia)

- The inability of the eye to focus on nearby objects and sometimes on distant objects as well.
- Image is focused behind the retina instead of directly on it.
- Occurs when an eye is too short lengthwise, the cornea is not curved enough, or the lens sits farther back in the eye than normal.

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## Color Blindness

Most people are **Trichromats: Normal color vision**

- People who can perceive all three primary colors and can see any hue

Less than 1% of the population are **Monochromats: Total color blindness**

- They cannot see any hue
- They often lack cones in the retina

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## Color Blindness

- Most people with color blindness are **Dichromats: Partial Color Blindness**
  - People who can distinguish only two of the three basic colors
  - Usually have trouble distinguishing red from green
  - 8% of men and 1% of women
    - Often transmitted genetically from mothers to sons
      - Transmitted on the X chromosome

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## Cataracts

- Dullness (clouding) of the lens causing visual problems (partial or total blindness)

Cataract



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## Cataracts

- More than half of all Americans age 65 and older have cataracts in their eyes
- Occur when there is a buildup of protein in the lens that makes it cloudy.
- Buildup prevents light from passing through a normally clear lens, causing some loss of vision.
- Cause: Unknown.

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## Types of Cataracts

- Age-related: Develops as a result of aging.
- Congenital: Babies are sometimes born with cataracts as a result of an infection they had before they were born, or they may develop during childhood.
- Secondary: May develop as a result of other diseases, like diabetes, or long-term exposure to toxic substances, certain medications (such as corticosteroids or diuretics), ultraviolet light, and radiation.
- Traumatic: Can form after injury to the eye.
- Prevention: None

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### Tx: Near & Farsightedness

- Eyeglasses and Contact lenses are the treatment of choice. Both are safe and effective and are less risky and less expensive than surgery.
- Corrective lenses refocus light entering the eye on the retina.
- Surgery changes the shape of the cornea. Surgery to correct nearsightedness is a relatively new technique. Several procedures are available, such as LASIK, photorefractive keratectomy, corneal ring implants, and intraocular lens implants (IOLs).
- Prevention: None

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### Diabetic Retinopathy

- Diabetes damages the small blood vessels in the retina.
- Retina: Is the part of the eye that captures images and sends the information to your brain.
- Can lead to poor vision and even blindness.
- Progressive condition.
- During the early stage, the tiny blood vessels in the eye weaken. The blood vessels develop small bulges that may burst and leak into the retina and into the gel-like fluid inside the eye called the vitreous gel.

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### Diabetic Retinopathy

- As the condition progresses, new fragile blood vessels grow on the surface of the retina. These abnormal blood vessels may break easily, bleeding into the middle of the eye and clouding vision. This bleeding can also cause scar tissue to form, which can pull on the retina and cause the retina to detach from the wall of the eye (retinal detachment).
- Prevention: Keep blood sugar and blood pressure levels near normal. Have yearly eye exams.

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## Glaucoma

- **Damage to the nerve located in the back of the eye (optic nerve) results in loss of eyesight.**
- **First, side (peripheral) vision is lost.**
- **If not treated, vision loss may continue, leading to total blindness over time.**

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## Types of Glaucoma

Open-angle glaucoma (OAG): **Most common in the US.**

- **The optic nerve is slowly damaged, usually causing gradual loss of vision.**
- **Both eyes can be affected at the same time, although one may be affected more than the other.**
- **Sometimes much of your eyesight can be affected before you notice a change.**

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## Types of Glaucoma

Closed-angle glaucoma (CAG): **Less common, accounting for 10% of the cases in US.**

- **The colored part of the eye (iris) and the lens block the movement of fluid between the chambers of the eye, causing pressure to build up and the iris to press on the drainage system.**
- **It may cause sudden blurred vision with pain and redness, usually in one eye first; symptoms may also include nausea and vomiting.**
- **May need immediate medical attention.**

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## Types of Glaucoma

Congenital glaucoma: Rare. Present in some infants at birth. Glaucoma that

- Develops during the first few years of life is called infantile glaucoma.
- Infants with congenital or infantile glaucoma usually have cloudy eyes that are sensitive to light and have excessive tearing.
- Symptoms may not develop until 6 months to 1 year after birth.
- If the problem is not detected early and treated, the child may have severe vision loss and may go blind.
- People between the age of 3 years and young adulthood can develop a similar type of glaucoma called juvenile glaucoma.

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## Prevention

- Risk factors (age, race, and family history) are beyond your control.
- Over age 20: eye examination that includes tests for glaucoma every 3 to 5 years.
- These tests may be done by an optometrist or an ophthalmologist.

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## Treatment

- Medications, laser treatments, and surgery to lower pressure in the eyes.
- Studies indicate that treatment with medication or surgery are both effective, but the risks and benefits may differ depending on the type of glaucoma, age, race, and other factors.

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### III. How Do We Perceive Form and Substance?

Illusions: An illusion is a perception of a physical stimulus differing from measurable reality

The Muller-Lyer Illusion

The Ponzo Illusion

The Hering-Helmholtz Illusion

The Corridor Illusion

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### Illusions

■ Why are our brains and eyes fooled by such illusions?

- Recent theories account for illusions in terms of the backgrounds against which they are seen
- Assume previous experience with the particular stimulus
- Also assume well-developed perceptual constancies

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### Gestalt Laws of Organization

Gestalt psychologists suggest that conscious experience is more than the sum of its parts

The mind organizes the elements of experience to create something unique

The **Law of Prägnanz**

- Stimuli that can be grouped together as a whole will be seen that way
- We see the simplest shape possible

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## Gestalt Laws of Organization

■ Principles of organization helps us perceive figures and contours

They define the figure-ground relationship

- Figures (the object of attention) are perceived as distinct from the grounds (background)
- There are five laws of perceptual grouping

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## Gestalt Laws of Organization

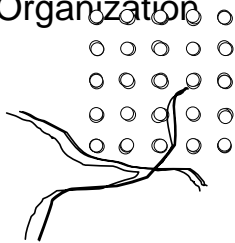
1. Law of proximity

2. Law of similarity

3. Law of continuity

4. Common fate principle

5. Law of closure



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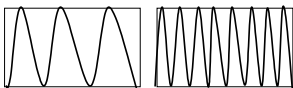
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## IV. How Do We Perceive Sounds?

■ What is Sound?

- Occurs when changes in air pressure affect the receptive organ for hearing
- Sound waves vary in frequency and amplitude

■ Frequency: number of sound waves during a unit of time



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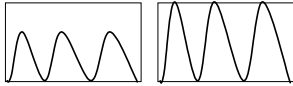
## What is Sound?

### ■ Frequency

- Determines the pitch, or tone, of a sound
- High-pitched tones have high frequency
- Measured in hertz (cycles per second)

### Amplitude or intensity

- Total energy of a sound wave



- Determines loudness
- Measured in decibels (unit expressing the loudness of sound)

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## Hearing



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## Structural Components of the Ear

**Hearing loss occurs because of damage to one of the ear's three main structural components:**

- **External ear canal** (the cavity seen when looking in one's ear)
- **Middle ear:** Separated from the ear canal by the eardrum
- **Inner ear:** Contains the main organ that allows you to hear (the cochlea) and nerve pathways to the brain that help interpret sound.

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## 2 Main Types of Hearing Loss

Sensorineural and Conductive.

- **Sensorineural:** Nerve deafness. No cure. Affects 17 million Americans. With sensorineural hearing loss, sound can reach the inner ear, but there's damage in that part of the ear or to the nerve pathways from the inner ear to the brain.
- **Conductive hearing loss:** occurs when sound is not transferred from the outer and middle ear to the inner ear. Conductive hearing loss can result from a punctured eardrum, severely impacted ear wax, head trauma, birth defects, or heredity.

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## Hearing Loss/Impairment

- The third most common long-term (chronic) health problem in older Americans.
- It affects up to 40% of people age 65 and older and up to 80% of people older than 85.
- Hearing loss can affect what and how much you do in the workplace, at home, personal safety, social interaction.
- May contribute to loneliness, depression, and loss of independence.

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## Types of Hearing Loss

**Presbycusis (prez-bee-KYOO-sis):** Age-related hearing loss. Results from damage to parts of the inner ear, the auditory nerve, or hearing pathways in the brain.

- **Causes: Sensorineural Deafness-damage to the cochlea, auditory nerve, or auditory processing areas of the brain.**
  - Most common cause is chronic exposure to high-intensity sound
  - Even 15 minutes a day of loud music can cause permanent hearing loss.
  - Aging, loud noise, heredity, head injury, infection, illness, certain prescription drugs, and circulation problems such as high blood pressure.
- **Treatment: Hearing Aids**

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## Types of Hearing Loss

**Tinnitus** (tih-NIE-tuhs): Ringing, roaring, or some other noise inside their ears.

- Causes: Loud noise, hearing loss, certain medicines, and other health problems, such as allergies and problems in the heart and blood vessels. Often it is unclear why the ringing happens.
- Treatment: Music also can be soothing and can sometimes mask the sounds caused by the condition. Avoid smoking, alcohol, and loud noises.

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## Types of Hearing Loss

**Conductive Deafness**: Interference with the transmission of sound to the inner ear

- Causes: Ear wax buildup, fluid in the middle ear, abnormal bone growth, a punctured eardrum, or a middle ear infection.
- Treatment: Mineral oil, baby oil, glycerin, or commercial ear drops to soften ear wax.

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## Hearing Aids

Four basic styles of hearing aids for people with sensorineural hearing loss:

**In-the-Ear (ITE)**: Fit completely in the outer ear and are used for mild to severe hearing loss.

- The case, which holds the components, is made of hard plastic.
- They are not usually worn by children because the casings need to be replaced as the ear grows.

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## Hearing Aids

Behind-the-Ear (BTE): Worn behind the ear and are connected to a plastic earmold that fits inside the outer ear.

- The components are held in a case behind the ear.
- Sound travels through the earmold into the ear.
- BTE aids are used by people of all ages for mild to profound hearing loss.

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## Hearing Aids

Canal Aids (fit into the ear)

In-the-Canal (ITC): Customized to fit the size and shape of the ear canal and is used for mild or moderately severe hearing loss.

Completely-in-Canal (CIC): Largely concealed in the ear canal and is used for mild to moderately severe hearing loss.

- Because of their small size, canal aids may be difficult for the user to adjust and remove.
- They are not typically recommended for children.

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## Hearing Aids

Body Aids: Used by people with profound hearing loss.

- The aid is attached to a belt or a pocket and connected to the ear by a wire.
- Because of its large size, it is able to incorporate many signal processing options, but it is usually used only when other types of aids cannot be used.

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## V. Which senses are least understood?

- Taste: Chemical sense
- Four basic tastes
  - Sweet
  - Salty
  - Sour
  - Bitter

Some regions of the tongue are more sensitive to certain taste stimuli than others

- Example: The tip is particularly sensitive to sweet

Taste sensitivity seems to be genetically determined

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## Smell

Also called **olfaction**

- Like taste, smell is a chemical sense
- The stimuli for smell are chemicals in the air
  - They are absorbed into the mucus that covers the olfactory receptor cells
  - Contained in the olfactory epithelium

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## Smell and Communication

Animals secrete **pheromones**

- Chemicals detected as scents by other animals
- Act as a means of communication
- May influence the physiology of another animal
- Widely recognized as initiators of sexual activity among animals

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## VI. What is the relationship between touch & pain?

- Touch
- There are specialized receptors for touch, pain, and temperature
  - Some parts of the body are more sensitive than others
  - The receptors appear to interact with one another
  - Women have greater sensitivity to pain
  - However, how something feels is relative

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## Pain

- The perception of pain is both physical and psychological
  - Athletes often report not feeling pain until a competition has ended
  - Some cultures teach that pain is to be endured without complaint
  - Boys and girls within Western culture may be taught to respond to pain differently

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## Neuromatrix Theory

- Useful in explaining “phantom limb pain”

Neuromatrix means the brain is “prewired” to assume the body has a left and right arm

- Even if an arm is amputated, the brain still assumes it is there

Since the limb is not there, the brain receives no feedback and increases the strength of stimulation

The increase in stimulation then causes phantom pain

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## Pain

### ■ Endorphins

#### Natural painkillers

- Produced in the brain and pituitary gland
- Bind to receptor sites in the brain and spinal cord
- Same receptors activated by morphine
- Prevent pain signals from passing to higher levels of the nervous system
  - Some increase pain tolerance
  - Others reduce pain sensations

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## Pain

### ■ Acupuncture

- A technique used to relieve particular kinds of pain
- Developed in China thousands of years ago
- Long, slender needles are inserted into the body at specific locations
- Contrary to traditional views, it helps when needles are inserted near the site of the pain

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## Acupuncture

### ■ How it works

- May stimulate a release of endorphins
- May alter serotonin levels

#### It may be effective with

- Migraines
- Arthritis
- Postoperative pain from dental surgery

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## Pain

### ■ Pain Management

- Treating chronic pain is challenging
  - Drug treatment may be ineffective or dangerous
    - High doses
    - Risk of addiction
- Pain may be maintained by non-physical causes
  - May elicit attention
  - May distract the sufferer from other problems

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## Pain Management

### ■ Hypnosis is one alternative

- Estimated to be effective in 15–20% of cases
- Anxiety and worry can worsen pain
  - Biofeedback, which teaches relaxation, can help
- Negative attitude can worsen pain
  - Cognitive coping strategies can help

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## VII. Extrasensory Perception

### ■ ESP includes four phenomenon:

- Telepathy
    - Alleged transfer of thoughts from one person to another
  - Clairvoyance
    - Alleged ability to perceive objects or events not present
  - Precognition
    - Alleged ability to perceive future events
  - Psychokinesis
    - Alleged ability to move objects with mental powers
- Experimental evidence for ESP is generally weak

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