

Chapter 3

Sensation and Perception

Outline

I. A Preliminary Distinction

- A. **Sensation** is the process of detecting external stimuli and changing those stimuli into nervous system activity.
 - 1. Sense receptors are specialized neural cells that change physical energy into neural impulses.
 - 2. Each sense receptor is a **transducer**, a mechanism that converts energy from one form to another.
- B. **Perception** is a cognitive process that involves the selection, organization and interpretation of stimuli.
- C. We say that our senses present us with information about the world, whereas perception represents that information and is affected by motivation, expectations and past experiences.

II. Concepts Related to All Sensory Processes

- A. A **sensory threshold** is the minimum intensity of a stimulus that will cause sense organs to operate.
- B. **Psychophysics** is the study of relationships between the physical attributes of stimuli and the psychological experiences they produce.
- C. An **absolute threshold** is the physical intensity of a stimulus that a person reports detecting 50% of the time.
 - 1. Absolute threshold levels are used to determine if one's senses are operating properly.
 - 2. These psychophysical questions are relevant to everyday experiences outside of the classroom.
- D. **Signal detection theory** states that stimulus detection is a decision-making process of determining if a signal exists against a background of noise.
- E. A **difference threshold** is the smallest difference between stimulus attributes that can be detected.
- F. A **just noticeable difference (jnd)** is the amount of change in a stimulus that makes it just noticeably different from what it was.
- G. **Sensory adaptation** occurs when our sensory experience decreases with continued exposure to a stimulus.
 - 1. **Dark adaptation** refers to the process in which the visual receptors actually become *more* sensitive to light as we spend time in the dark.
 - 2. **Light adaptation** is the process by which our eyes become more sensitive to dark as we spend time in the light.

III. The Stimulus for Vision: Light

- A. Light, in the form of electromagnetic energy, is the stimulus for vision.
- B. **Light** may be thought of as a waveform of radiant energy.
 - 1. Light waves have three important physical characteristics related to psychological experience: wave amplitude, wavelength, and wave purity.
 - 2. *Wave amplitude* refers to the intensity or brightness of light.

3. *Wavelength* is the distance between any point in a wave and the corresponding point on the next cycle from peak to peak.
4. The unit of measurement is the nanometer (nm), which is equal to one-billionth of a meter, or one-millionth of a millimeter.
5. Wavelength determines the hue, or color, of light we perceive
6. The human eye responds to radiant energy between roughly 380 nm and 760 nm.
7. *Wave purity* refers to the characteristic of saturation.
8. Monochromatic refers to light waves of all one length or hue.
9. White light consists of a random mixture of wavelengths.

IV. The Receptor for Vision: The Eye

- A. The **cornea** is the tough, round, virtually transparent outer shell of the eye that has two functions.
 1. It protects the delicate structures at the front of the eye.
 2. It is the first point where light rays are bent.
- B. The **pupil** is an opening through which light enters the eye.
- C. The **iris** (the colored part of the eye) can expand or contract depending upon the intensity of light that hits the eye.
- D. The lens is a flexible structure whose shape is controlled by powerful **ciliary muscles** that expand or contract to change the shape of the lens.
 1. This process brings an image into focus.
 2. This changing of shape is called **accommodation**.
 3. With age, lenses tend to harden and ciliary muscles weaken.
- E. The eye is filled with two fluids.
 1. The **aqueous humor** provides nourishment to the cornea and the other structures at the front of the eye.
 2. The **vitreous humor** fills the interior of the eye (behind the lens) where it functions to keep the eyeball spherical.
- F. Vision begins to take place at the **retina**, where light energy is transduced into neural energy.
- G. There are two types of photoreceptor cells for vision, the rods and the cones.
 1. **Rods** are photosensitive cells of the retina that are most active in low levels of illumination and do not respond differentially to various wavelengths of light.
 2. **Cones** are photosensitive cells of the retina that operate best at high levels of illumination and that are responsible for color vision.
- H. Fibers from ganglion cells form the **optic nerve**, the collection of neurons that leaves the eye and starts back toward other parts of the brain.
- I. The **fovea** is a small area of the retina where there are few layers of cells between the entering light and the cone cells that pack the area.
 1. There are no rods in the fovea, only cones.
 2. Visual acuity is best at the fovea.
- J. The **blind spot** is where the nerve impulses from the rods and cones leave the eye.

V. More on Rods and Cones and What They Do

- A. There are about 120 million rods in each eye.
 1. Rods are concentrated in a ring around the fovea, out toward the periphery.
 2. Rods operate best under low levels of illumination.
 3. Rods do not contribute to our appreciation of color.
- B. There are about six million cones in each eye.
 1. Cones are concentrated in the center of the retina, in the fovea.
 2. Cones function best in medium to high levels of illumination.
 3. Cones are primarily responsible for our experience of color.
- C. The dark-adaptation curve is not smooth and regular.
 1. At the 8 to 10 minute mark, the shape of the curve changes.
 2. This is called the rod-cone break.
 3. Initially, the cones increase their sensitivity; then they drop out.
 4. The rods lower their threshold, becoming more sensitive.

VI. The Visual Pathway After the Retina

- A. When you look at your world, everything off to your left is said to be in your left visual field.
- B. Everything you see off to your right is said to be in your right visual field.
 - 1. Stimuli in the left visual field end up in our right occipital lobe.
 - 2. Stimuli from our right visual field end up in our left occipital lobe.
- C. The sorting of which fibers in the optic nerve get directed where largely occurs in the **optic chiasma**.
- D. Each eye receives light energy from both visual fields.
 - 1. Light that enters our left eye from the left visual field initiates neural impulses that cross at the optic chiasma and go over to the right side of the brain.
 - 2. Light that enters the left eye from the right visual field initiates neural impulses that go straight back to the left hemisphere.
 - 3. From the optic chiasma, nerve fibers pass through other centers in the brain, including the lateral geniculate nucleus.
- E. Nerve fibers also pass through a cluster of cells on each side of the brain called the superior colliculus that controls the movement of the eyes over a patterned stimulus.
- F. Nerve cells then form synapses with neurons in the thalamus, which project neural impulses to the layers of cells in the visual cortex of the occipital lobe.
- G. Vision doesn't happen in the eyes: it happens in the brain.
- H. The detection and interpretation of patterns of light, shade, color and motion are functions of the cerebral cortex.

VII. Color Vision and Color Blindness

- A. One theory of color vision is the **trichromatic theory**, first proposed by Thomas Young and revised by Hermann von Helmholtz.
- B. The theory proposes that the eye contains three distinct receptors for color.
 - 1. Each receptor responds best to one of three primary hues of light: red, blue and green.
 - 2. By the careful combination of all three, all other colors can be produced.
- C. Ewald Hering proposed the **opponent-process theory** in 1870.
 - 1. He proposed three pairs of visual mechanisms that respond to different wavelengths of light.
 - 2. These include a blue-yellow processor, a red-green processor, and a third dealing with black-white differences or brightness.
 - 3. Each is capable of responding to either of the two hues that give it its name, but not both.
- D. There is support of Hering's theory.
 - 1. Excitatory-inhibitory mechanisms have been discovered at the layer of the ganglion cells and in a small area of the thalamus.
 - 2. The theory also is supported by the experience of negative afterimages.
- E. Defective color vision occurs in about 8 percent of males and slightly less than 0.5 percent in females.
 - 1. Most cases are genetic in origin.
 - 2. In dichromatism, there is a lack of one type of cone, which supports the Young-Helmholtz theory.
 - 3. Color vision defects higher in the visual pathway support the opponent-process theory.
- F. Both theories are probably correct, each in its own way.

VIII. SPOTLIGHT: Are There Gender Differences in the Perception of Color?

- A. As long ago as 1897 Jastrow reported that men prefer blue to red and women prefer blue to red.
- B. There do seem to be some reliable, stable gender differences in color preferences.
 - 1. Women prefer "cool colors" while men bright, strong colors.
 - 2. Women are more likely to have a favorite color.

3. Women can name significantly more colors than men can.
 4. Color simply seems to matter more to women than it does to men.
- C. It may be that women have one more photopigment receptor than men do.

IX. The Stimulus for Hearing: Sound

- A. Sound consists of a series of pressures of air (or some other medium) beating against our ear.
- B. This pressure can be presented as waves, which have three major characteristics.
1. The amplitude of a sound wave depicts its intensity—the force with which air strikes the ear.
 - a. The intensity of a sound determines the psychological experience we call loudness.
 - b. The higher the amplitude, the louder the sound.
 - c. The *decibel scale* of sound intensity reflects perceived loudness.
 - d. Zero point on the decibel scale is the lowest intensity of sound that can be detected—the absolute threshold.
 2. Wave frequency refers to the number of times a wave repeats itself within a given period.
 - a. Frequency is measured in terms of how many waves are exerted every second.
 - b. The unit of sound frequency is the hertz (Hz).
 - c. Pitch is the psychological experience produced by sound wave frequency.
 - d. Pitch refers to how high or low a tone is.
 - e. A healthy human ear responds to sound wave frequencies between 20 Hz and 20,000 Hz.
 3. A third characteristic is wave purity or complexity.
 - a. Timbre is the psychological quality or character of a sound that reflects its degree of purity.
 - b. White noise is a random mixture of sound frequencies.

X. The Receptor for Hearing: The Ear

- A. The outer ear is called the *pinna*.
- B. Sound waves leave the *pinna* and go through the *auditory canal*.
- C. Airwaves push against the **eardrum** (tympanic membrane) so that it vibrates at the same rate as the sound source.
- D. The eardrum transmits vibrations to three small bones: the **malleus, incus and stapes**, collectively known as the *ossicles*.
- E. These bones amplify and pass sound vibrations to the *oval window*.
- F. Beyond the oval window, sound vibrations are in the inner ear.
- G. The major structure of the inner ear is the **cochlea**.
 1. The receptor cells (hair cells)—the transducers for hearing—are here.
 2. When fluid inside the cochlea moves, the basilar membrane is bent up and down.
- H. Hearing takes place when the vibrations of the **basilar membrane** stimulate the receptors, called *hair cells*.
- I. The *hair cells* bend, starting the neural impulses that leave the ear, traveling on the auditory nerve toward the temporal lobe.

XI. The Chemical Senses

- A. The technical term for taste is **gustation**.
 1. Taste has four psychological qualities: sweet, salty, sour and bitter.
 2. The receptor cells for taste are located in the tongue and are called taste buds.
 3. We have about 10,000 taste buds.
 4. When parts die, new segments are regenerated.
 5. All four qualities of taste can be detected at all locations of the tongue, but some may be more distinct or discernable in specific locations.
- B. Smell (**Olfaction**)
 1. The sense of smell originates in hair cells high in the nasal cavity.

2. Many animals emit **pheromones**, chemicals that produce distinctive odors that are used as a method of communication between organisms.
3. The primary organ involved in the detection of pheromones is the vomeronasal organ (VNO).
4. The VNO appears to be involved in mating, territoriality and aggressiveness in animals.
5. The VNO also can be found in humans.

XII. The Skin, or Cutaneous, Senses

- A. A square inch of skin contains nearly 20 million cells.
- B. Some skin receptor cells have free nerve endings, while others have encapsulated nerve endings.
- C. Our ability to discriminate among types of cutaneous sensation is due to the unique combination of responses the receptor cells have to various types of stimulation.

XIII. The Position Senses

- A. The **vestibular sense** tells us about balance, about where we are in relation to gravity, and about acceleration or deceleration.
 1. Receptors are located on either side of the head, near the inner ears.
 2. Five chambers are located there.
 3. Over stimulation of receptor cells in these chambers can lead to motion sickness.
- B. The **kinesthetic sense** tells us about the position of various parts of our bodies and what our muscles and joints are doing.
 1. Receptors are located primarily in our joints, but some information also comes from muscles and tendons.
 2. Information from these receptors travels to the brain through pathways in the spinal cord.
 3. They provide examples of reflex reactions.

XIV. Pain: A Special Sense

- A. The experience of pain prompts more than 80% of all visits to the doctor.
- B. Many stimuli can cause pain.
- C. One theory of pain proposes that a gate control mechanism (high in the spinal cord) opens to let pain messages race to the brain or blocks messages by closing the gate.
- D. A cognitive-behavioral theory of pain also suggests that pain is influenced by attitudes, expectations and behaviors.
- E. Various techniques are used to manage pain.
 1. Drug therapy is one choice.
 2. Hypnosis and cognitive self-control also can be effective.
 3. The psychological process involved with a **placebo** (a substance a person believes will be useful in treating some symptom) is another technique.
 4. Counterirritation refers to stimulating an area of the body near the location of the pain.
 5. Acupuncture can be effective.
- F. There is some evidence that one's sensitivity to pain is genetically based.
- G. Gender and cultural issues can influence individual responses.
- H. Newborns do experience pain.

XV. Paying Attention: A Process of Selection

- A. A **salient detail** is one that captures our attention.
 1. It is remembered better than peripheral details.
 2. Peripheral details make up the perceptual background.
- B. Stimulus factors are those that make some stimuli more compelling than others.
- C. Personal factors are characteristics of a perceiver that influence which stimuli get attended to.

XVI. Stimulus Factors in Perceptual Selectivity

- A. The most important factor is **contrast**, the extent to which a stimulus is physically different from the other stimuli around it.
- B. Generally, the more intense a stimulus, the more likely we are to attend to it.
- C. Generally, the bigger the stimulus, the more likely we are to attend to it.
- D. Motion is another dimension for which contrast is important.
- E. Repetition can influence attention.

XVII. Personal Factors in Perceptual Selectivity

- A. When we are psychologically predisposed to perceive something, we have formed a mental set.
- B. What we perceive is influenced by our past experiences.
- C. When we attend to a stimulus, organize and identify it, and then store it in memory, we are referring to **bottom-up processing**.
- D. When motivation, mental set, and past experience influence perceptual selectivity, we label it as **top-down processing**.

XVIII. Organizing Our Perceptual World

- A. A **gestalt** forms when one sees the overall scheme of things: the whole, totality or configuration.
- B. A basic principle of Gestalt psychology is the figure-ground relationship.
 - 1. Of all the stimuli in your environment, those you attend to and group together are “figures.”
 - 2. The other stimuli become “ground.”

XIX. Grouping Stimuli with Bottom-Up Processing

- A. **Proximity** or contiguity refers to events occurring close together in space or time and being perceived as belonging together as part of the same figure.
- B. **Similarity** refers to stimuli that have properties in common and tend to be perceived together.
- C. **Continuity**, or good continuation, is operating when we see things ending up consistently with the way they started off.
- D. **Common fate** describes our tendency to group together in the same figure those elements of a scene that appear to move together in the same direction and at the same speed.
- E. **Closure** is the tendency to fill in gaps in our perceptual world.
 - 1. A special case of this refers to **subjective contours**.
 - 2. Here, arrangements of lines and patterns enable us to see figures that are not actually there.

XX. Grouping Stimuli with Top-Down Processing

- A. This refers to perceiving stimuli because we want to, expect to, or have experienced them together in the past.
- B. How we ultimately organize our experiences of the world seems to depend on both types of processing.

XXI. Perceiving Depth and Distance

- A. Ocular cues are built into our visual systems and tell us about depth and distance.
 - 1. Cues that involve both eyes are called binocular cues.
 - 2. **Retinal disparity** refers to each eye getting a somewhat different view of a three-dimensional object.
 - 3. **Convergence** refers to the eyes turning in, toward each other, when something is viewed up close.
- B. Monocular cues require only one eye to have their influence.
 - 1. Accommodation refers to the changing of the shape of the lens, by the ciliary muscles, to focus images on the retina.
 - 2. Physical cues to depth and distance are those we get from the structure of our environment.

- a. **Linear perspective** describes the fact that parallel lines seem to come together in the distance.
- b. **Interposition** refers to the fact that objects in the foreground tend to cover, or partially hide from view, objects in the background.
- c. **Relative size** refers to the judgment of distance; an object that produces the larger retinal image will be close to us.
- d. **Texture gradient** refers to a surface of individual pieces blending into a smooth surface as distance increases.
- e. **Patterns of shading** tell us a great deal about an object's shape and solidity.
- f. **Motion parallax** refers to the apparent difference in motion between objects that are closer to us and those that are farther away.

XXII. The Constancy of Visual Perception

- A. **Perceptual constancies** help us organize and interpret the stimulus input we get from our senses.
 1. **Size constancy** is the tendency to see objects as being of constant size regardless of the size of the retinal image.
 2. **Shape constancy** refers to the perception that objects maintain their shape even though the retinal image they cast may change.
 3. **Brightness constancy** causes the apparent brightness of objects to be perceived as being the same regardless of the actual amount or type of light under which they are viewed.
 4. **Color constancy** allows you to perceive the color of a familiar object as constant, despite changing conditions.

XXIII. When Constancy Fails: Geometric Illusions and Impossible Figures

- A. **Illusions** are experiences in which our perceptions are at odds with what we know as physical reality.
- B. Illusions remind us that perception is a higher-level process than sensation.

XXIV. SPOTLIGHT: Cultural Differences in Perceptual Organization

- A. Cultural constraints may influence a process as simple as depth perception.
 1. People who live in the dense jungle cannot judge depth or distance when brought out into open, grassy plains.
 2. All the usual cues to distance are gone.
 3. Such deficits are quickly overcome by learning and experience.
- B. Pictorial representations of depth and distance tend to be meaningless to those who have not experienced them before.
- C. Even an illusion as simple as the Müller-Lyer fails for members of the Zulu culture of Africa who have not experienced a "carpentered world," but live in round houses with arched doorways and domed roofs.

Practice Test Questions

Multiple Choice

- Which term is most descriptive of the process of sensation?
 a. transportation c. selection
 b. interpretation d. transduction
- Which terms are most descriptive of the process of perception?
 a. selecting and organizing c. learning and memory
 b. seeing and hearing d. detecting and feeling
- The major thrust of psychophysics is the search for
 a. lawful relationships between events in our world and our experiences of those events.
 b. the elemental particles of thought and experience that make up consciousness.
 c. logical ways to relate how we feel (affect) to the way we think (cognition) and behave.
 d. the physiological or biological bases that allow us to experience the world as we do.
- If a sound is below your absolute threshold
 a. you will never hear that sound.
 b. that sound will only enter your subconscious mind.
 c. you will hear that sound less than 50 percent of the time.
 d. you cannot tell if it is any different from any other sound.
- Signal detection theory suggests that determining one's sensory threshold values (e.g., for brightness)
 a. is virtually impossible.
 b. is largely a matter recognizing detection to be a decision-making process.
 c. requires a subject to detect whether signals are different from each other.
 d. can only be done in a very dark room.
- The notion of sensory adaptation suggests that what we tend to experience most readily are
 a. lights and sounds, not smells and tastes.
 b. stimuli that have remained the same for a very long time.
 c. objects or events that we are used to, or have adapted to.
 d. changes in level or type of stimulation.
- Wavelength is to hue as wave amplitude is to
 a. color. b. purity.
 b. brightness. d. saturation.
- If I were to show you all of the lights of the visible spectrum (a rainbow of light), and if I had adjusted the amplitudes of all the light waves in that spectrum so that they were all exactly equal, which light would appear to be the brightest?
 a. a white light
 b. a red light
 c. a yellow-green light
 d. They would all appear equally bright.
- Where does the transduction of light take place in the eye?
 a. the lens and the ciliary muscles
 b. the blind spot and optic nerve
 c. the rods and cones
 d. the aqueous and vitreous humors

10. If we want to identify some small object at night, in low levels of illumination, the most sensible thing to do (other than to make more light available) is to have the image of the object fall on the
 a. fovea. c. periphery of the retina.
 b. blind spot. d. optic nerve.
11. When we plot a curve that shows how our eyes become sensitive as we spend time in the dark, the curve is not a smooth one, but shows a “break” at about the 7-minute mark. This break in the curve occurs because
 a. the cones have stopped adapting to the dark.
 b. the retina changes its orientation after about 7 minutes in the dark.
 c. at that point, our ability to see decreases markedly.
 d. the rods have reached a point where they no longer continue to become more sensitive.
12. The Young-Helmholtz theory of color vision proposes that there are specifically sensitive receptors for the wavelengths of light that correspond to the primary colors of light,
 a. red, green, and yellow.
 b. black and white.
 c. red, orange, yellow, green, blue, and violet.
 d. blue, green, and red.
13. The stimulus for audition is
 a. electromagnetic energy in wave form.
 b. pressures of a medium vibrating against a membrane.
 c. chemicals that are dissolved in the air or in a liquid.
 d. the cochlea of the inner ear.
14. If we can tell the difference between two people singing the very same note at the very same loudness, it is because
 a. of our experience of the saturation of the sounds.
 b. we know who the people are and recognize their voices.
 c. both sounds are at or above our difference thresholds for loudness.
 d. we can detect a difference in the timbre of the two voices.
15. Wave amplitude of light is to brightness as wave amplitude of sound is to
 a. loudness. c. hue or color.
 b. pitch. d. timbre.
16. The transducers for sound are
 a. waves of air pressure. c. cochleas.
 b. ossicles. d. hair cells.
17. The best name for one’s sense of taste is
 a. flavor. c. biochemical transduction.
 b. gustation. d. olfaction.
18. In what way are taste buds different from other sense receptor cells?
 a. They conduct, or transmit, nerve impulses.
 b. They are really specialized neurons.
 c. They transduce physical energy into neural energy.
 d. They are replaced by new cells when they die.
19. Which sense informs us about the position of our bodies with respect to gravity?
 a. the vestibular sense c. the cutaneous sense
 b. the kinesthetic sense d. the gravitational sense

20. If there is such a thing as a “gate” in Melzack and Moore’s gate-control theory, that gate is said to control our experience of
- a. arousal or excitement. c. temperature and other skin senses.
 b. pain. d. balance.
21. Factors that direct our attention to some stimuli and not to others are classified in the text as being either
- a. stimulus or personal. c. primary or secondary.
 b. learned or inherited. d. sensory or perceptual.
22. When we say that someone is likely to perceive something that he or she expects to perceive, we are saying that
- a. figures and grounds are often confused.
 b. some stimuli are inherently more attention-grabbing than others.
 c. our motivational states often direct our attention.
 d. we can form a mental set that influences attention.
23. We tend to hear the individual speech sounds of a word organized together and separate from other words largely because of the Gestalt organizational principle of
- a. proximity. c. continuity.
 b. novelty or familiarity. d. similarity.
24. What makes our perception of the world as being three-dimensional remarkable is that
- a. it is a skill or ability found only in humans.
 b. it is a perception with no particular survival function.
 c. images of the world are inverted by the lens of the eye to appear upside-down.
 d. the retina records visual experiences in only two dimensions.
25. Research from cross-cultural psychology would suggest that persons with the best ability to discern great distances would be people who spent most of their lives in
- a. downtown New York City. c. the African Congo.
 b. the Sahara Desert. d. the Amazon River Valley.
26. The perceptual constancies serve as reminders of the
- a. fact that the world is an orderly and predictable place.
 b. influence of motivation on psychological processes.
 c. differences between what is sensed and what is perceived.
 d. similarities that exist in the way that people of all cultures perceive the world.

True/False

1. ___ True ___ False If a stimulus is above your absolute threshold, you will detect it every time it is presented.
2. ___ True ___ False As one's sensory threshold goes up, one's sensitivity in that sense goes down.
3. ___ True ___ False When their amplitudes are equal, a yellow-green light and a red light will appear to be the same hue.
4. ___ True ___ False Because they operate best at low levels of illumination, our rods give us more information about the colors of objects in our environments.
5. ___ True ___ False Because hearing is so important in language acquisition, psychologists believe that hearing is the most important of all the human senses.
6. ___ True ___ False The decibel scale provides a measure of the perceived loudness of sounds.
7. ___ True ___ False Receptors for pain are found only in—or near—the skin.
8. ___ True ___ False Women may report seeing more colors and more vibrant colors because they have a pigment receptor in the retinas that men do not.
9. ___ True ___ False Novelty and familiarity are both stimulus factors AND personal factors that influence attention.
10. ___ True ___ False Common fate is a Gestalt organizational principle that is applicable only to objects in motion.
11. ___ True ___ False Motion parallax is an example of a common illusion of motion—seeing motion when there is really none there to be seen.

Key Terms and Concepts

information processing _____

sensation _____

sense receptors _____

transducer _____

perception _____

sensory threshold _____

psychophysics _____

absolute threshold _____

signal detection theory _____

difference threshold _____

just noticeable difference (jnd) _____

sensory adaptation _____

dark adaptation _____

light adaptation _____

white light _____

cornea _____

pupil _____

iris _____

lens _____

ciliary muscles _____

accommodation _____

aqueous humor _____

vitreous humor _____

retina _____

rods _____

cones _____

optic nerve _____

fovea _____

blind spot _____

optic chiasma _____

trichromatic theory _____

opponent-process theory _____

decibel scale _____

eardrum _____

malleus, incus, stapes _____

cochlea _____

basilar membrane _____

hair cells _____

gustation _____

olfaction _____

taste buds _____

pheromones _____

vomer nasal organ (VNO) _____

vestibular sense _____

kinesthetic sense _____

salient detail _____

peripheral detail _____

contrast _____

mental set _____

bottom-up processing _____

top-down processing _____

gestalt _____

figure-ground relationship _____

proximity _____

similarity _____

continuity _____

common fate _____

closure _____

subjective contours _____

retinal disparity _____

convergence _____

accommodation _____

perceptual constancies _____

size constancy _____

shape constancy _____

brightness constancy _____

color constancy _____

illusions _____

Answers to Practice Test Questions

Multiple Choice

1. **d** Alternative **a** is rather meaningless. Alternatives **b** and **c** are more related to perception than to sensation, but alternative **d**, transduction, is nearly synonymous with sensation.
2. **a** Perception may involve all of the terms in all of the alternatives, but, by definition, it is a cognitive process involving the selection and organization of incoming sensory information.
3. **a** Alternative **a** gives as simple a statement of what psychophysics is about as we can manage.
4. **c** By definition (have you noticed already how many items seek knowledge of definitions?), stimuli that are below one's threshold will be detected less than 50 percent of the time.
5. **b** The complete statement that signal detection is essentially a decision-making process (is it there, or isn't it?) is almost a direct quote from the text.
6. **d** You might get this one by elimination. The first alternative is downright silly. The second and third both say virtually the same thing, which makes **d** the best choice.
7. **b** Here's another analogy item—and a simple one at that. What is the issue here? Wavelength determines hue; wave amplitude determines what? Right! brightness.
8. **c** As illogical as it sounds at first, when all amplitudes are adjusted to be equal, a yellow-green light (about 550 nm—right in the middle of the spectrum) will appear brighter than the others.
9. **c** The cells that change the physical energy of light into neural impulses are the rods and cones of the retina.
10. **c** Because it is where our rods are located, and because our rods function best “in the dark,” or in low levels of illumination, we would want the object to fall on the periphery of the retina.
11. **a** The dark adaptation curve has a “break” in it because at about the 7-minute mark, the cones are no longer becoming more sensitive, while the rods continue to adapt.
12. **d** The major problem here for some of us is remembering that although red, blue, and yellow are the primary colors for paints or pigments, this item is asking about light, where the primary hues are red, blue, and green.
13. **b** The stimulus for audition is sound, of course, and alternative **b** gives a reasonable definition or description of sound.
14. **d** You really should have expected this item—or one very much like it. Everything else being equal, we rely on timbre.
15. **a** Another analogy. Wave amplitude of sound determines loudness.
16. **d** Located within the cochlea, or inner ear, the actual transducers for hearing are called hair cells.
17. **b** We think that it is important for college students to know the actual (“technical”) names for the various senses. Smell is olfaction; taste, gustation.
18. **d** The first three alternatives are statements that could be made about any of the senses. Only taste buds, however, are replaced when they die.
19. **a** Again, this is a matter of definition. Vestibular senses tell us about position relative to gravity; cutaneous senses about touch and pressure, and kinesthetic senses about the movement of muscles and joints. There is no such thing as a gravitational sense.
20. **b** The gate-control theory is one meant to describe the important features involved in our experience of pain.
21. **a** Attentional factors can be classified in many ways, of course, but of these alternatives, the choice would be the scheme used in your text, referring to them as stimulus or personal factors.
22. **d** To say that some stimuli are attended to because of an expectation to perceive them is to say that one has developed a mental set.
23. **a** Speech sounds within a word are perceived and organized together because they are close together, which reflects the Gestalt factor of proximity—which means “nearness” in space or time.
24. **d** Alternatives **a** and **b** are quite absurd. Alternative **c** is a correct statement, but relevant to 3-dimensionality. The retina is 2-dimensional, making the last statement the best choice.
25. **b** The logic here—extrapolating from research cited in the text—is that persons in environments that are cramped and cluttered are less often required (or able) to view things (such as approaching camel caravans) over great distances.

26. **c** Perceptual constancies allow us to perceive familiar objects as unchanged, even though our sensory experience may change—making alternative **c** the best choice.

True/False

1. **F** Not in actuality; only in theory. If it is above threshold, all we can say is that it will be detected more than 50 percent of the time.
2. **T** This correctly states the inverse relationship between one's threshold and one's sensitivity—as one increases, the other decreases.
3. **F** They would not appear equally bright, and they certainly would not appear to be the same hue, because hue is determined by wavelength.
4. **F** In fact, our rods are colorblind. Don't let the fact that this item starts off with a correct assertion (rods operate best at low levels of illumination) confuse you.
5. **F** I hope you got this one correct. Hearing is involved in language acquisition, but psychologists are not going to try to rank order the senses in terms of which is most important.
6. **T** This statement is a true, straightforward definition.
7. **F** Here's one of those key words in true/false items: "only." Yes, pain receptors are found in the skin, but not only in the skin, as you'll realize after a moment's reflection on all those non-skin parts of your body in which you have experienced pain.
8. **T** This sounds almost too far-fetched to be true, but apparently some women (how many is not known as yet) do have a fourth type of photopigment receptor in their retinas.
9. **T** We tend to see familiar things in novel settings and novel things in familiar settings. What is novel and what is familiar reflects the stimuli involved and may also reflect one's personal experience.
10. **T** This is true by definition. If you're not convinced, maybe you should go back and check.
11. **F** This one is almost tricky. The name is deceiving. In fact, motion parallax has little to do with our perception of motion, real or illusory. It is a cue to depth and distance.

A Few Flash Card Possibilities for Chapter 3

(And please do not forget: The best flash cards are those you make yourself!)

A TRANSDUCER	something that changes energy from one form to another, e.g. sense receptor
PSYCHOPHYSICS	the study of the relationships between the physical qualities of a stimulus and our psychological experience of them
ABSOLUTE THRESHOLD	the intensity of a stimulus that is just barely detected; below 50%, above 50%
RELATION OF LIGHT TO VISION	wave amplitude—brightness wavelength—hue (color) wave purity—saturation
ACCOMMODATION	changing of the shape of the lens to focus an image on the retina
PRIMARY HUES/ PRIMARY COLORS	light: Red, Blue, & Green pigment: Red, Yellow, & Blue
HAIR CELLS	transducers for both audition & olfaction
MENTAL SET	predisposed, expected way of perceiving; we perceive what we expect to perceive
FIGURE/GROUND	in any one sense we perceive only one stimulus (the figure) against the ground (background) of others
RETINAL DISPARITY	the cue to depth related to the fact that each eye gets a different (disparate) view of the same 3-D object

EXPERIENCING PSYCHOLOGY

How Many Pennies Make a Difference?

Here's a simple demonstration of the nature of difference thresholds. All you need for this project are two small boxes (boxes about the size that bandages come in work just fine) and two dollars worth of pennies. You can either make the called-for judgments yourself, or use a volunteer to make the judgments for you. For now, we'll assume that you have found a willing volunteer.

Begin with 10 pennies in each box. Have your volunteer compare the weights of the two boxes. (Of course, he or she should say that they seem equally heavy.) Now, without your volunteer seeing what you are doing, add one penny to one box. Have your friend judge the relative weights of the boxes. Keep adding pennies (to the same box each time) until your volunteer detects a difference (a "just noticeable difference," right?) between the two boxes. How many pennies did it take to just notice a difference?

Now start with 50 pennies in each box, and repeat the same procedure. First judge the boxes as they are, then add one penny to a box and ask for another judgment. Add another penny and then another until the volunteer detects a difference in the weight of the two boxes. How many pennies were needed this time?

Because you are starting with a heavier weight, it will take more pennies added to the box than it did before to reach a *just noticeable difference* (or jnd) for the 50-penny boxes than for the 10-penny boxes. You might weigh all the boxes involved to see if the difference (in weight—not in the number of pennies) is 5 times as great for the 50-penny boxes as for the 10-penny boxes.

Using the Internet to Expand Your Appreciation of Psychology

1. CONCEPTS RELATED TO ALL SENSORY PROCESSES (pp. 83-86)

Sensory psychology deals with how each of our many senses take stimuli from the environment and convert those stimuli into information that can be processed by the central nervous system—a process is called **transduction**. Chapter Three looks at each of the senses, and asks about how physical stimuli are transduced into neural impulses. There also are issues that are relevant for all of the senses—and websites devoted **psychophysics** and **adaptation**.

<http://www.psychophysics.org>

(a site with everything you would want to know about psychophysics—the study of the relationship between the physical characteristics of stimuli and the psychological experiences they produce)

<http://www.psy.ulaval.ca/~isp/isp.htm>

(the website for the International Society for Psychophysics)

<http://www.candletech.com/comparingscentthrow.htm>

(A commercial website—about candles. A concern of candle makers is what they call “scent throw”—or, *from how far away and for how long can I smell this candle?* Even candle makers need to know about psychophysics.)

<http://www.umich.edu/~onebook/pages/frames/psychF.html>

(A site providing a great set of links to everything you would want to know about subliminal (below-threshold) perception.)

2. VISION (pp. 87-96)

Clearly, we know more about the sense of vision than we do any other sense. Scientists have been studying vision for longer than they have the other senses, and vision is obviously a significantly important sense by which most of us learn about the world around us.

<http://www.colormatters.com>

(If you should think that color does not matter, visit this website. Please also click on the link “Color & Science.”)

<http://www.science.howstuffworks.com/eye2.htm>

(The concern here is the human eye. You’ll find subsections on perceiving light, color vision, and color blindness—brief, yet adequately detailed.)

<http://www.allaboutvision.com>

(a commercial site, really about “eye care products and services,” but some good stuff—check out the “Resources” link)

http://www.accessexcellence.org/AE/AEC/CC/vision_background.html

(from the National Health Museum; do click on “Activities” at the bottom)

<http://www.vision3d.com>

(a fun—and informative—site on seeing in three dimensions)

<http://www.photo.net/photo/edscott/vis00010.htm>

(a well-done, simple summary of color vision)

3. AUDITION: THE SENSE OF HEARING (pp. 98-101)

It certainly is true that we learn a lot about our environments through our sense of vision. It also is true that the quality of experience, even the quality of life is a reflection of the input from our other senses. Audition and the other senses do remain less well understood than vision, but that gap of knowledge is rapidly closing.

<http://hes.ucf.k12.pa.us/gclaypo/senses/hearing.html>

(a bit childish, and it does take some clicking around, but this is a great site on hearing, sight, smell, touch, and taste)

<http://www1.omi.tulane.edu/departments/pathology/fermin/Hearing.html>

(an excellent site on hearing, with balance/equilibrium just a click away)

<http://faculty.washington.edu/chudler/hearing.html>

(good ol' Neuroscience for Kids – on hearing)

<http://ctl.augie.edu/perry/ear/hearmechn.htm>

(cute—a “Virtual Tour of the Ear”)

<http://www.hearinglossweb.com>

(This site is home to many articles and insights, and is regularly updated)

<http://www.nidcd.nih.gov/health/hearing/index.asp>

(a loaded site from the National Institute on Deafness and other Communication Disorders)

4. THE OTHER SENSES (pp. 102-108)

Calling the senses of taste, smell, touch, location/position, and pain “minor senses” (as some have), hardly seems fair. Yes, we take these sense for granted, but reflect for a moment on the sense of smell of a perfume maker, the sense of taste of a great chef, the sense of touch of a masseuse, the sense of balance of a tightrope walker, the sense of pain of an accident victim. The minor senses can play a major role.

<http://www.hhmi.org/senses>

(“Seeing, Hearing, and Smelling the World” from the Howard Hughes Medical Institute)

<http://www.tasteandsmell.com>

(the name says most of it—but the site is on the loss of the chemical senses)

<http://www.cf.ac.uk/biosi/staff/jacob/teaching/sensory/olfact1.html>

(an expansive tutorial on the sense of smell)

<http://www.senseofsmell.org>

(an unbelievable site of the “Sense of Smell Institute”)

<http://faculty.washington.edu/chudler/tasty.html>

(Neuroscience for Kids on taste—outstanding!)

<http://faculty.washington.edu/chudler/chtouch.html>

(why not—it’s great!)

<http://www.painonline.org/index.htm>

(yes, it’s a commercial site, but with many interesting links)

<http://faculty.washington.edu/chudler/pain.html>

(another winner. Be sure to note all of the excellent links to other sites at the bottom of this page)

5. PAYING ATTENTION: A PROCESS OF SELECTION (pp. 109-112)

As we know, **perception** is a cognitive process that involves selecting (attending to) and organizing the stimulus world that is presented to us by our senses. It is a much more cognitive process than a physiological one. If you would like to search the Internet on your own, you are likely to be rewarded, but please do beware of the many commercial websites that manage to have “perception” somewhere in their titles.

<http://en.wikipedia.org/wiki/Attention>

(It is quite brief, but provides a few interesting links to other sites.)

<http://add.org>

(This website is devoted to the problem of disordered attention, generally ADD, or “attention deficit disorder.”)

<http://www.studygs.net/classr.htm>

(a relevant discussion: “Paying attention in the classroom”)

http://www.ciadvertising.org/student_account/fall_01/adv382j/howardm_o/selectiveperception.html

(a great essay—with a slant toward advertising)

http://www.age-of-the-sage.org/psychology/social/hastorf_cantril_saw_game.html

(a college football game and a classic study of perceptual selectivity)

6. ORGANIZING OUR PERCEPTUAL WORLD (pp. 113-117)

Once the bits and pieces of our sensory experience are selected, they are organized into meaningful wholes, or **gestalts**. We do not, after all, see minute bits of light, shade and color. We see horses and trees and college professors. We do not hear the individual sounds of speech. We hear words and phrases and complete sentences.

<http://psy.ed.asu.edu/~classics/Wertheimer/Forms/forms.htm>

Max Wertheimer is often referred to as the father of Gestalt psychology. Here is a 1923 paper by Wertheimer on perceptual organization. It is surprisingly readable and contains many great examples, several of which are commonly found in today's textbooks.

<http://www.webrenovators.com/psych/GestaltPsychology.htm>

(a brief piece on Gestalt psychology and perceptual organization)

7. PERCEIVING DEPTH AND DISTANCE (pp. 117-120)

<http://news.bbc.co.uk/1/hi/health/4135233.stm>

(why not to drink and drive—depth perception)

<http://webvision.med.utah.edu/KallDepth.html>

(great examples of the cues for the perception of depth and distance)

<http://www.grand-illusions.com>

(Of the websites devoted to illusions, most are very commercial. This one is busy trying to sell you things, but if you practice good, focused attention you will find some excellent examples of illusions at this Internet address.)