Sensation and Perception

Preview

Sensation is the process by which we detect stimulus energy from our environment and transmit it to our brain. Perception is the process of organizing and interpreting sensory information, enabling us to recognize meaningful objects and events. Clear evidence that perception is influenced by our experience comes from the many demonstrations of perceptual set and context effects.

The task of each sense is to receive stimulus energy, transform it into neural signals, and send those neural messages to the brain. In vision, light waves are converted into neural impulses by the retina; after being coded, these impulses travel up the optic nerve to the brain’s cortex, where they are interpreted.

In organizing sensory data into whole perceptions, our first task is to discriminate figure from ground. We then organize the figure into meaningful form by following certain rules for grouping stimuli. We transform two-dimensional retinal images into three-dimensional perceptions by using binocular cues, such as retinal disparity, and monocular cues, such as the relative sizes of objects. We also use these cues to perceive motion. The perceptual constancies enable us to perceive objects as enduring in color, shape, and size regardless of viewing angle, distance, and illumination. The constancies explain several well-known illusions.

Both nature and nurture shape our perceptions. For example, when cataracts are removed from adults who have been blind from birth, these persons can distinguish figure and ground and can perceive color but are unable to distinguish shapes and forms. At the same time, human vision is remarkably adaptable. Given glasses that turn the world upside down, people manage to adapt and move about with ease.

In hearing, sound waves are transmitted to the fluid-filled cochlea, where they are converted to neural messages and sent to the brain. We locate sounds by differences in the timing and loudness of the sounds received by each ear.

Our other senses include touch, taste, smell, and body position and movement. The sense of touch is actually four senses—pressure, warmth, cold, and pain—that combine to produce other sensations such as “hot.” Taste, a chemical sense, is a composite of sweet, sour, salty, bitter, and umami sensations and of the aromas that interact with information from the taste buds. Smell, also a chemical sense, does not have basic sensations as there are for touch and taste. Our effective functioning also requires a kinesthetic sense and a vestibular sense, which together enable us to detect body position and movement. Although we describe the senses separately, they interact. In interpreting the world, our brain blends their input.

Although parapsychologists have tried to document ESP, most research psychologists remain skeptical, particularly because the results of experiments have not been reproducible.
Fact or Falsehood?

1. Advertisers can powerfully shape our buying habits through subliminal messages.  
2. If we stare at a green square for a while and then look at a white sheet of paper, we see red.  
3. Infants just learning to crawl do not perceive depth.  
4. Persons who have sight in only one eye are totally unable to gauge distances.  
5. A person who is born blind but gains sight as an adult cannot recognize objects that were familiar by touch.  
6. If required to look through a pair of glasses that turns the world upside down, we soon adapt and coordinate our movements without difficulty.  
7. Touching adjacent cold and pressure spots triggers a sense of wetness.  
8. People who are born without the ability to feel pain may die by early adulthood.  
9. Without their smells, a cold cup of coffee may be hard to distinguish from a glass of red wine.  
10. Laboratory evidence clearly indicates that some people do have ESP.
Guide

Learning Objectives

Every question in the Test Banks is keyed to one of these objectives.

**Basic Concepts of Sensation and Perception**

6-1. Define *sensation* and *perception*, and explain the difference between bottom-up and top-down processing.
6-2. Identify the three steps that are basic to all our sensory systems.
6-3. Distinguish between absolute thresholds and difference thresholds, and discuss what effect, if any, stimuli below the absolute threshold have on us.
6-4. Discuss whether subliminal stimulation enables subliminal persuasion.
6-5. Explain the function of sensory adaptation.
6-6. Explain how our expectations, contexts, motivation, and emotions influence our perceptions.

**Vision: Sensory and Perceptual Processing**

6-7. Describe the characteristics of the energy that we see as visible light, and identify the structures in the eye that help focus that energy.
6-8. Describe how the rods and cones process information, as well as the path information travels from the eye to the brain.
6-9. Describe how we perceive color in the world around us.
6-10. Describe the location and function of the feature detectors.
6-11. Explain how the brain uses parallel processing to construct visual perceptions.
6-12. Describe how Gestalt psychologists understood perceptual organization, and explain how figure-ground and grouping principles contribute to our perceptions.
6-13. Explain how we use binocular and monocular cues to perceive the world in three dimensions and perceive motion.
6-14. Explain how perceptual constancies help us construct meaningful perceptions.
6-15. Describe what research on restored vision, sensory restriction, and perceptual adaptation reveals about the effects of experience on perception.

**The Nonvisual Senses**

6-16. Describe the characteristics of air pressure waves that we hear as sound.
6-17. Explain how the ear transforms sound energy into neural messages.
6-18. Explain how we detect loudness, discriminate pitch, and locate sounds.
6-19. Describe how we sense touch.
6-20. Describe the biological, psychological, and social-cultural influences that affect our experience of pain, and discuss how placebos, distraction, and hypnosis help control pain.
6-21. Explain how our sense of taste and smell are similar, and how they differ.
6-22. Explain how we sense our body’s position and movement.
6-23. Describe how sensory interaction influences our perceptions, and define *embodied cognition*.
6-24. List the claims of ESP, and discuss the conclusions of most research psychologists after putting these claims to the test.

*Introductory Exercise: Fact or Falsehood?*

Define sensation and perception, and explain the difference between bottom-up and top-down processing.

Sensation is the process by which our sensory receptors and nervous system receive and represent stimulus energies from our environment. Bottom-up processing is analysis that begins with the sensory receptors and works up to the brain’s integration of sensory information. Perception is the process of organizing and interpreting sensory information, enabling us to recognize meaningful objects and events. Top-down processing is information processing guided by our experience and expectations.

Transduction and Thresholds

Identify the three steps that are basic to all our sensory systems.

All our senses perform three basic steps: They receive sensory stimulation, transform that stimulation into neural impulses, and deliver the neural information to our brain. The process of converting one form of energy into another that our brain can use is called transduction. Psychophysics is the study of how what we detect affects our psychological experiences.

Distinguish between absolute thresholds and difference thresholds, and discuss what effect, if any, stimuli below the absolute threshold have on us.

In studying our awareness of faint stimuli, Gustav Fechner identified an absolute threshold as the minimum stimulation needed to detect a particular stimulus 50 percent of the time. Signal detection theory predicts how and when we detect the presence of a faint stimulus (signal) amid background stimulation (noise), assuming that our individual absolute thresholds vary with our experiences, expectations, motivation, and alertness.

The priming effect, as shown in experiments, reveals that we can process some information from stimuli too weak to recognize (subliminal stimuli—below our absolute threshold), indicating that much of our information processing occurs automatically, unconsciously. In a typical experiment, an image or word is quickly flashed, then replaced by a masking stimulus that interrupts the brain’s processing before conscious perception.

A difference threshold is the minimum difference between two stimuli that a person can detect 50 percent of the time. In humans, difference thresholds (experienced as a just noticeable difference \([jnd]\)) increase in proportion to the size of the stimulus—a principle known as Weber’s law.

Discuss whether subliminal sensation enables subliminal persuasion.

The effect of subliminal stimuli is too fleeting to enable advertisers to exploit us with subliminal messages and produce subliminal persuasion. Sixteen double-blind experiments evaluating subliminal self-help recordings uniformly found that no recording helped more than a placebo, which works only because of our belief in it.
Sensory Adaptation

Exercises: Eye Movements; Sensory Adaptation in the Marketplace
Project: Sensory Adaptation

6-5. Explain the function of sensory adaptation.

**Sensory adaptation** refers to diminished sensitivity as a consequence of constant stimulation. Constant, unchanging images on the eye’s inner surface fade and then reappear. This continual flitting from one spot to another ensures that stimulation on the eyes’ receptors continually changes. The phenomenon of sensory adaptation enables us to focus our attention on informative changes in our environment without being distracted by uninformative background stimulation. Sensory adaptation even influences how we perceive emotions.

Perceptual Set, Context Effects, Motivation, and Emotions

Lecture: Do Red Objects Feel Warmer or Colder Than Blue Objects?
Exercises: Perceptual Set; Perceptual Set and Gender Stereotypes; Context and Perception

6-6. Explain how our expectations, contexts, motivation, and emotions influence our perceptions.

Clear evidence that perception is influenced by our experiences—our learned assumptions and beliefs—as well as by sensory input comes from the many demonstrations of **perceptual set**, a mental predisposition to perceive one thing and not another.

Through experience, we form concepts, or **schemas**, that organize and interpret unfamiliar information. Our preexisting schemas for monsters and tree trunks, for example, influence how we apply top-down processing to interpret ambiguous sensations.

A given stimulus may trigger radically different perceptions, partly because of our different schemas, but also because of the immediate context. For example, we would perceive the first word in “eel is on the wagon” as **wheel**, and the first word in “eel is on the orange” as **peel**.

Perceptions are influenced, top-down, not only by our expectations and by the context but also by our motivations and emotions. For example, we discern whether a speaker said “morning” or “mourning” or “dye” or “die” from the surrounding words. Emotions and motives color our social perceptions, too.

Vision: Sensory and Perceptual Processing

Light Energy and Eye Structures

Lecture: Classroom as Eyeball
Exercise/Project: Physiology of the Eye—A CD-ROM for Teaching Sensation and Perception
Projects: Color the Eyeball; Locating the Retinal Blood Vessels
Projects/Exercises: Rods, Cones, and Color Vision; Locating the Blind Spot
LaunchPad: Vision: How We See

6-7. Describe the characteristics of the energy that we see as visible light, and identify the structures in the eye that help focus that energy.

The energies we experience as visible light are a thin slice from the whole spectrum of electromagnetic energy. Our sensory experience of light is determined largely by the light energy’s **wavelength**, which determines the **hue** of a color, and its **intensity** (determined by a wave’s **amplitude**, or height), which influences brightness.
After light enters the eye through the cornea, it passes through the pupil, whose size is regulated by the iris; the iris also responds to our cognitive and emotional states. A transparent lens then focuses the rays by changing its curvature, a process called accommodation, on the retina. The retina doesn’t “see” a whole image. Rather, its millions of receptor cells convert particles of light energy into neural impulses and forward those to the visual cortex of the brain. There, the impulses are reassembled into a perceived, upright-seeming image. And along the way, visual information processing percolates through progressively more abstract levels.

Information Processing in the Eye and Brain

6-8. Describe how the rods and cones process information, as well as the path information travels from the eye to the brain.

The retina’s rods and cones (most of which are clustered around the fovea) transform the light energy into neural signals through a chemical reaction. These signals activate the neighboring bipolar cells, which in turn activate the neighboring ganglion cells, whose axons converge to form the optic nerve that carries information via the thalamus to the brain. Where the optic nerve leaves the eye, there are no receptor cells—creating a blind spot. The cones enable vision of color and fine detail, with each cone transmitting its message to a single bipolar cell. The rods enable black-and-white vision, remain sensitive in dim light, and are necessary for peripheral vision.

The information from the retina’s nearly 130 million rods and cones is received and transmitted by the million or so ganglion cells whose axons make up the optic nerve. When individual ganglion cells register information in their region of the visual field, they send signals to the occipital lobe’s visual cortex.

► Lecture: Color Vision in Primates
► PsychSim 6: Colorful World
► Exercises: The Color Vision Screening Inventory and Color Blindness; Subjective Colors

6-9. Describe how we perceive color in the world around us.

Like all aspects of vision, our perception of color resides not in the object itself but in the theater of our brains. Our difference threshold for colors is so low that we can discriminate more than 1 million different color variations (Neitz et al., 2001). At least most of us can. For about 1 person in 50, vision is color deficient—and that person is usually male, because the defect is genetically sex linked. Most people who are color deficient lack functioning red- or green-sensitive cones, or sometimes both. Their vision is monochromatic or dichromatic instead of trichromatic.

The Young-Helmholtz trichromatic (three-color) theory states that the retina has three types of color receptors, each especially sensitive to red, green, or blue. When we stimulate combinations of these cones, we see other colors. For example, when both red- and green-sensitive cones are stimulated, we see yellow.

Hering’s opponent-process theory states that there are two additional color processes, one responsible for red versus green perception and one for yellow versus blue plus a third black versus white process. For example, in both the retina and the thalamus, some neurons are turned “on” by red but turned “off” by green. Others are turned on by green but off by red (DeValois & DeValois, 1975). These opponent processes help explain afterimages.

Present explanations indicate that color processing occurs in two stages: The retina’s red, green, and blue cones respond in varying degrees to different color stimuli, as the Young-Helmholtz trichromatic theory suggested. Their signals are then processed by the nervous system’s opponent-process cells, as Hering’s theory proposed.
6-10. Describe the location and function of the feature detectors.

As discovered by Hubel and Wiesel, individual neurons (feature detectors) in the cortex respond to specific features of a visual stimulus. The visual cortex passes this information along to other areas of the cortex where teams of cells (supercell clusters) respond to more complex patterns. For example, one temporal lobe area by your right ear enables you to perceive faces.

6-11. Explain how the brain uses parallel processing to construct visual perceptions.

Subdimensions of vision (motion, form, depth, color) are processed by neural teams working separately and simultaneously, illustrating our brain’s capacity for parallel processing. Other teams collaborate in integrating the results, comparing them with stored information and enabling perceptions. Some people who have lost part of their visual cortex experience blindsight.

6-12. Describe how Gestalt psychologists understood perceptual organization, and explain how figure-ground and grouping principles contribute to our perceptions.

Gestalt psychologists described principles by which we organize our sensations into perceptions. They provided many compelling demonstrations of how, given a cluster of sensations, the human perceiver organizes them into a gestalt, a German word meaning a “form” or a “whole.” They further demonstrated that the whole may exceed the sum of its parts. Clearly, our brain does more than merely register information about the world. We are always filtering sensory information and constructing perceptions. Mind matters.

Our first task in perception is to perceive any object, called the figure, as distinct from its surroundings, called the ground. We must also organize the figure into a meaningful form. Gestalt principles for grouping that describe this process include proximity (we group nearby figures together), continuity (we perceive smooth, continuous patterns rather than discontinuous ones), and closure (we fill in gaps to create a whole object).

6-13. Explain how we use binocular and monocular cues to perceive the world in three dimensions and perceive motion.

Depth perception is the ability to see objects in three dimensions, although the images that strike the eye are two-dimensional. It enables us to judge distance. Research on the visual cliff (a miniature cliff with a drop-off covered by sturdy glass) reveals that most infants can perceive depth because they refuse to crawl out onto the glass. Learning seems to help because as infants become mobile, their experience leads them to fear heights.

Binocular cues require information from both eyes. In the retinal disparity cue, the brain computes the relative distance of an object by comparing the slightly different images an object casts on our two retinas. The greater the difference, the closer the object.
Monocular cues enable us to judge depth using information from only one eye. The monocular cues include relative size (the smaller image of two objects of the same size appears more distant), interposition (nearby objects partially obstruct our view of more distant objects), relative height (higher objects are farther away), relative motion (as we move, objects at different distances change their relative positions in our visual image, with those closest moving most), linear perspective (the converging of parallel lines indicates greater distance), and light and shadow (dimmer objects seem more distant).

Our basic assumption is that shrinking objects are retreating and enlarging objects are approaching. The brain will also interpret a rapid series of slightly varying images as continuous movement, a phenomenon called stroboscopic movement. By flashing 24 still pictures a second, a motion picture creates an illusion of movement. The phi phenomenon, another illusion of movement, is created when two or more adjacent lights blink on and off in succession. Lighted signs exploit the effect with a succession of lights that create the impression of, say, a moving arrow.

6-14. Explain how perceptual constancies help us construct meaningful perceptions.

Perceptual constancy is necessary to recognize an object. This top-down process enables us to see an object as unchanging (having consistent shape, size, brightness, and color) even as illumination and retinal images change.

Color constancy refers to our perceiving familiar objects as having consistent color, even if changing illumination alters the wavelengths reflected by the object. We see color as a result of our brain’s computations of the light reflected by any object relative to the objects surrounding it.

Brightness constancy (also called lightness constancy) enables us to perceive an object as having a constant brightness even while its illumination changes. This perception of constancy depends on relative luminance, which is the amount of light an object reflects relative to its surroundings. Thus, comparisons govern our perceptions.

Shape constancy is our ability to perceive familiar objects (for example, an opening door) as unchanging in shape, and size constancy is our ability to perceive objects as unchanging in size, despite the changing images they cast on our retinas.

Given the perceived distance of an object, we instantly and unconsciously infer the object’s size. The perceived relationship between distance and size is generally valid but, under special circumstances, can lead us astray. For example, one reason for the Moon illusion is that cues to objects’ distances at the horizon make the Moon behind them seem farther away. Thus, the Moon on the horizon seems larger. In the distorted (trapezoidal) room designed by Adelbert Ames, we perceive both corners as being the same distance away. Thus, anything in the near corner appears disproportionately large compared with anything in the far corner.

Perceptual Interpretation

6-15. Describe what research on restored vision, sensory restriction, and perceptual adaptation reveals about the effects of experience on perception.

In the classic version of the nature–nurture debate, the German philosopher Immanuel Kant maintained that knowledge comes from our inborn ways of organizing sensory experiences. On the other side, the British philosopher John Locke argued that we learn to perceive the world through
our experiences of it. It’s now clear that different aspects of perception depend more or less on nature’s endowments and on the experiences that influence what we make of our sensations.

When cataracts are removed from adults who have been blind from birth, these people remain unable to perceive the world normally. Generally, they can distinguish figure from ground and perceive colors, but they are unable to recognize objects that were familiar by touch. In controlled experiments, infant kittens and monkeys have been raised with severely restricted visual input. When their visual exposure is returned to normal, they, too, suffer enduring visual handicaps. For many species, infancy is a critical period during which experience must activate the brain’s innate visual mechanisms.

Exercise: Displacement Glasses
LaunchPad: Seeing the World Upside Down: Three Brave Souls

Human perception is remarkably adaptable. Given glasses that shift the world slightly to the left or right, or even turn it upside down, people manage to adapt their movements and, with practice, to move about with ease.

The Nonvisual Senses

Hearing
Lecture: Recognizing Our Own Voice
Project: Color the Ear
PsychSim 6: The Auditory System
LaunchPad: Hearing: From Vibration to Sound; Animation: Sound and the Cochlea

6-16. Describe the characteristics of air pressure waves that we hear as sound.

Audition, or hearing, is highly adaptive. The pressure waves we experience as sound vary in amplitude and frequency (length) and correspondingly in perceived loudness and pitch. Long waves have low frequency—and low pitch. Short waves have high frequency—and high pitch. Decibels are the measuring unit for sound energy, with zero decibels representing the absolute threshold for hearing.

6-17. Explain how the ear transforms sound energy into neural messages.

The visible outer ear channels the sound waves through the auditory canal to the eardrum, a tight membrane that vibrates with the waves. Transmitted via a piston made of three tiny bones of the middle ear (the hammer, anvil, and stirrup) to the fluid-filled cochlea in the inner ear, these vibrations cause the oval window to vibrate, causing ripples in the basilar membrane, which bends the hair cells that line its surface. Hair cell movement triggers impulses in the adjacent nerve cells. Axons of those cells converge to form the auditory nerve, which sends neural messages (via the thalamus) to the auditory cortex in the brain’s temporal lobe.

Damage to the cochlea’s hair cell receptors or their associated nerves can cause the more common sensorineural hearing loss (or nerve deafness). Biological changes linked with heredity, aging, or prolonged exposure to ear-splitting noise or music may cause sensorineural hearing loss. Problems with the mechanical system that conducts sound waves to the cochlea cause conduction hearing loss.

The only way to restore hearing for people with nerve deafness is a cochlear implant, which is wired into various sites on the auditory nerve, allowing them to transmit electrical impulses to the brain. It helps children to become proficient in oral communication. Cochlear implants can help restore hearing for most adults, but only if their brain learned to process sound during childhood.
6-18. *Explain how we detect loudness, discriminate pitch, and locate sounds.*

We detect loudness according to the *number* of activated hair cells, not the intensity of a hair cell’s response.

Herman von Helmholtz’s *place theory* presumes that we hear different pitches because different sound waves trigger activity at different places along the cochlea’s basilar membrane. Thus, the brain can determine a sound’s pitch by recognizing the place on the membrane from which it receives neural signals.

*Frequency theory* (also called *temporal theory*) states that the rate of nerve impulses traveling up the auditory nerve matches the frequency of a tone, thus enabling us to sense its pitch. The *volley principle* explains hearing sounds with frequencies above 1000 waves per second.

Place theory best explains how we sense high-pitched sounds, and frequency theory best explains how we sense low-pitched sounds. Some combination of the two theories explains sounds in the intermediate range.

*Exercises: Range of Human Hearing; Locating Sounds*
*Lectures: Hearing Loss; A Quiet World—Living With Hearing Loss*

Sound waves strike one ear sooner and more intensely than the other ear. We localize sounds by detecting the minute differences in the intensity and timing of the sounds received by each ear.

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6-19. *Describe how we sense touch.*

Our sense of touch is actually four senses—pressure, warmth, cold, and pain—that combine to produce other sensations, such as “hot.” Touch sensations involve more than tactile stimulation, however. A self-produced tickle produces less somatosensory cortex activation than does the same tickle from something or someone else.

*Exercises: Two-Point Thresholds; Touch Localization*
*LaunchPad: Losing One’s Touch: Living Without Proprioception*
*Exercises: The Revised Reducer–Augmenter Scale; Experiencing Phantom Sensations*

6-20. *Describe the biological, psychological, and social-cultural influences that affect our experience of pain, and discuss how placebos, distraction, and hypnosis help control pain.*

Pain is an alarm system that draws our attention to some physical problem. Without the ability to experience pain, people may die before early adulthood. Our individual pain sensitivity varies, too, depending on genes, physiology, experience, attention, and surrounding culture. Thus, our experience of pain reflects both *bottom-up* sensations and *top-down* cognition. There is no one type of stimulus that triggers pain. Instead there are different *nociceptors*—sensory receptors in our skin, muscles, and organs that detect hurtful temperatures, pressure, or chemicals. Melzack and Wall’s *gate-control theory* of pain is that small fibers in the spinal cord open a “gate” to permit pain signals to travel up to the brain, or large fibers close the “gate” to prevent their passage. Pain is not merely a physical phenomenon of injured nerves sending impulses to a definable brain area. The brain can also create pain, as it does in people’s experiences of *phantom limb sensations*, after a limb has been amputated.
The biopsychosocial approach views pain not only as a product of biological influences, for example, of injured nerves sending impulses to the brain, but also as a result of psychological influences such as our expectations, and social influences such as the presence of others.

We have some built-in pain controls, the *endorphins*, that our brain releases. Other pain controls involve distraction, an inert placebo (by dampening the central nervous system’s attention and responses to painful experiences), the tendency to remember only its peak moment or the pain we felt at the end of a procedure, and *hypnosis*. In trying to explain how hypnosis works, *dissociation* theory suggests that we have a divided consciousness, as evidenced by the fact that hypnotized people may carry out *posthypnotic suggestions*. *Social influence* theory believes that hypnosis is a by-product of normal social and mental processes. Another form of dual processing—*selective attention*—may also play a role in hypnotic pain relief.

**Lecture: Taste Preferences**
**Exercises: Taste: The Basic Taste Sensations; Genetic Effects in Taste**
**Exercise/Project: Taste**
**Project: Mapping Your Tongue**

**6-21. Explain how our sense of taste and smell are similar, and how they differ.**

Taste, a chemical sense, is a composite of sweet, sour, salty, bitter, and umami sensations. Taste buds on the top and sides of the tongue contain 200 or more taste buds, each containing a pore that catches food chemicals. In each taste bud pore, 50 to 100 taste receptor cells project antenna-like hairs that sense food molecules. These cells send information to an area of the brain’s temporal lobe. Taste receptors reproduce themselves every week or two. As we grow older, the number of taste buds and taste sensitivity decrease. Expectations can also influence taste.

**Lectures: Anosmia; Specific Anosmias; Odor and Sex Identification; Canine Olfaction**
**Exercise: Identifying Odors**

Smell (*olfaction*) is also a chemical sense. We smell something when molecules of a substance carried in the air reach a tiny cluster of 20 million receptor cells at the top of each nasal cavity. With their approximately 350 different receptor proteins, they recognize individual odor molecules. Some odors trigger a combination of receptors. The receptor cells send messages to the olfactory bulb, then to the temporal lobe and to the parts of the limbic system involved in memory and emotion. Gender and age influence our ability to identify scents.

**Exercises: Nystagmus; Vision and Balance**

**6-22. Explain how we sense our body’s position and movement.**

Important sensors in your joints, tendons, and muscles enable your *kinesthesia*, the system for sensing the position and movement of individual body parts. A companion *vestibular sense* monitors the head’s (and thus the body’s) position and movement. The biological gyroscopes for this sense of equilibrium are in the *semicircular canals* and *vestibular sacs* in the inner ear.

**Sensory Interaction**

**Lecture: Synesthesia**
**LaunchPad: Synesthesia: The Man Who Tastes Words**

**6-23. Describe how sensory interaction influences our perceptions, and define embodied cognition.**

*Sensory interaction* refers to the principle that one sense may influence another, as when the smell of food influences its taste. When our senses disagree—as when we see a speaker saying one syllable while we hear another—we experience the *McGurk effect*, that is, we may perceive a third syllable that blends both inputs.

In interpreting the world, our brain circuits blend our bodily sensations with brain circuits responsible for cognition. This *embodied cognition* is uniquely illustrated in a few select individuals in whom the senses become joined in a phenomenon called *synesthesia*, in which one kind of sensation such as hearing sound produces another such as seeing color.
Perception is the product of sensation, cognition, and emotion. And that is why we need biological, psychological, and social-cultural levels of analysis.

(Critical Thinking) ESP—Perception Without Sensation?

- Lecture: Belief in ESP
- Exercises: Belief in ESP Scale; ESP Tricks
- Project: The Psychic Challenge
- Project/Exercise: Testing for ESP

6-24. List the claims of ESP, and discuss the conclusions of most research psychologists after putting these claims to the test.

Claims are made by parapsychologists for three varieties of extrasensory perception (ESP): telepathy (mind-to-mind communication), clairvoyance (perceiving remote events), and precognition (perceiving future events). Closely linked with these is psychokinesis, or “mind over matter.”

Research psychologists remain skeptical because the forecasts of “leading psychics” reveal meager accuracy, because checks of psychic visions have been no more accurate than guesses made by others, and because sheer chance guarantees that some stunning coincidences are sure to occur. An important reason for their skepticism, however, is the absence of a reproducible ESP result.