Chapter 4

Sensation and Perception

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Multimedia Suggestions

Interactive Presentation Slides for Introductory Psychology:

  6.1 Introduction to Sensation and Perception
  6.4 Perception

Worth Video Series:

  Video Anthology for Introductory Psychology: Sensation and Perception –
  Synesthesia: The Man Who Tastes Words
  Video Anthology for Introductory Psychology: Consciousness – Visual Attention:
  Piecing Things Together
  Video Anthology for Introductory Psychology: Consciousness – Visual Attention:
  There’s a Gorilla on the Court

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*Blind* (2007, 98 min, not rated) (p. 4-16)

*Hollywood Ending* (2002, 112 min, rated PG-13) (p. 4-16)

Interactive Presentation Slides for Introductory Psychology: 6.2 Vision and Hearing

PsychInvestigator: Psychology of Vision

PsychSim 5 Tutorials: Colorful World

Worth Video Series:

Video Anthology for Introductory Psychology: Consciousness – “Blindsight”: Seeing Without Awareness


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Interactive Presentation Slides for Introductory Psychology: 6.2 Vision and Hearing

PsychSim 5 Tutorials: Visual Illusions

Worth Video Series:

Video Anthology for Introductory Psychology: Sensation and Perception – The Man Who Cannot Recognize Faces

Video Anthology for Introductory Psychology: Sensation and Perception – Seeing the World Upside Down

Video Anthology for Introductory Psychology: Sensation and Perception – Depth Cues
Video Anthology for Introductory Psychology: Sensation and Perception – Mueller-Lyer Illusion

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Interactive Presentation Slides for Introductory Psychology: 6.2 Vision and Hearing
PsychSim 5 Tutorials: The Auditory System
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Worth Video Series:

Video Anthology for Introductory Psychology: Sensation and Perception – Losing One’s Touch: Living Without Proprioception

Video Anthology for Introductory Psychology: Sensation and Perception – Pickpockets, Placebos, and Pain: The Role of Expectations

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*Multimedia Suggestions*

Interactive Presentation Slides for Introductory Psychology: 6.3 Body Senses, Taste, and Smell

Worth Video Series:

Video Anthology for Introductory Psychology: Sensation and Perception – “Supertasters”

Video Anthology for Introductory Psychology: Sensation and Perception – The “Red Hot” Chili-Eating Contest: Sensitivity to Taste

Video Anthology for Introductory Psychology: Emotion, Stress, and Health – Do Body Smells Reveal Fear and Happiness?

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HANDOUTS

HANDOUT 4.1: Weber’s Law

HANDOUT 4.2: Decibel Levels for Various Sounds
HANDOUT 4.3: OSHA Daily Permissible Noise Level Exposure

Chapter Objectives

After studying this chapter, students should be able to:

1. Distinguish between sensation and perception, noting where in the body each process occurs, and explain why these processes are separable.

2. Explain what the process of transduction does in the process of sensation and perception.

3. Discuss how psychophysics laid the foundation for the psychological study of sensation and perception.

4. Describe the relationships between the absolute threshold, just noticeable difference, and Weber’s law.

5. Describe the principles of signal detection theory, discuss how it represents advancement over earlier research on thresholds, and relate to real-world decision making strategies.

6. Discuss why sensory adaptation is a useful process.

7. Compare the physical dimensions of wavelength, amplitude, and purity with their psychological counterparts, hue, brightness, and saturation.

8. Define the anatomical structures of the human eye and describe the path that light follows through it.

9. Distinguish between rods and cones and discuss how their relative concentrations around the fovea contribute to phototransduction in the retina.

10. Describe how we perceive color by trichromatic color representation and the color-opponent system.

11. Discuss visual processing in the brain, noting how area V1 contributes to this process.

12. Discuss neural systems for perceiving shape, and describe the dorsal and ventral streams of visual processing, including how damage to one system can produce visual form agnosia.

13. Illustrate the binding problem of perception by describing the illusory conjunction; describe how feature integration theory helps explain the binding problem, and discuss the role that attention and parietal processes play in feature binding.

14. Using perception of faces as an example, compare the modular view and the distributed representation view of object recognition, and describe the perceptual constancy that results from these processes.
15. Outline the basic principles of Gestalt perception, including simplicity, closure, continuity, similarity, proximity, common fate, and the figure/ground distinction.


17. Compare monocular depth cues and binocular disparity in vision and discuss how illusions of depth and size illustrate the otherwise typical process of perceiving depth or size.

18. Describe the processes involved in the perception of motion and change; briefly describe apparent motion, change blindness, and inattentional blindness.

19. Compare the physical dimensions of sound wave frequency, amplitude, and complexity with their psychological counterparts, pitch, loudness, and timbre.

20. Define the anatomical structures of the ear and describe the path that sound follows from the pinna to the auditory nerve.

21. Discuss how auditory processing takes place in the brain, noting how area A1, place codes, and temporal codes all contribute.

22. Describe the basic operations of the body senses, discussing how touch, pain, and the senses of balance and movement occur.

23. Describe the components of the olfactory system and discuss how the olfactory bulb, ORNs, and the glomerulus work together in olfaction.

24. Describe the components of the taste system and discuss how taste buds, papillae, and microvilli work together in taste.

I. SENSATION AND PERCEPTION ARE DISTINCT ACTIVITIES

(Chapter Objectives 1–6)

Sensation and perception are critical to survival and are separate events that, from the vantage point of the perceiver, feel like one single process. Sensation is the simple awareness that results from stimulation of a sense organ, whereas perception organizes, identifies, and interprets sensation at the level of the brain in order to form a mental representation. All sensory modalities depend on the process of transduction, which converts physical signals from the environment into neural signals carried by sensory neurons into the central nervous system.

In the 19th century, researchers developed psychophysics, an approach to studying perception that measures the strength of a stimulus and an observer’s sensitivity to that stimulus. These researchers developed procedures for measuring an observer’s absolute threshold, or the smallest intensity needed to just barely detect a stimulus, and the just noticeable difference (JND), or the smallest change in a stimulus that can just barely be detected. Signal detection theory represents a refinement of these basic approaches and
allows researchers to distinguish between an observer’s perceptual sensitivity to a stimulus and criteria for making decisions about the stimulus. **Sensory adaptation** occurs because sensitivity to lengthy stimulation tends to decline over time. This process illustrates that the perceptual system is more sensitive to changes in stimulation than to constant levels of stimulation.

**Lecture Suggestion 4.1**

**Too Much Sensation**

You probably don’t need to point out to your students that we live in busy times. There’s the busyness of stressful schedules, overbooked appointments, too many commitments, strained relationships, and all that goes with a hectic modern life. But there’s also the busyness associated with too much stimulation. The world is a busy place because there are so many things competing for our attention. This can drain even the hardiest of sensory systems, as the eyes, ears, nose, mouth, and hands get worked to capacity.

A clear illustration of this is the proliferation of advertising competing for our sensory attention. Billboards, magazine ads, radio jingles, and TV spots were bad enough, but now most people are exposed to advertising in unexpected (and often unwanted) places. For starters, ask your students how many ads they encounter each day that are linked to transportation. Buses, subways, and taxis routinely host placards and billboards, both on the vehicles themselves and in the terminals, depots, and bus stops on their route. A new trend in advertising is to make the entire vehicle an advertisement. Several companies offer “car wrapping” services that cover a bus, van, or automobile in a thin film capable of reproducing any digital visual material: photos, text, logos, and so on. Some of these are snazzy, others are not. Mobile billboards are increasing in popularity, as well. Companies such as AdsOnWheels will charge you $15,000 for 20 consecutive 8-hour days of driving a large truck around a specified route. The truck itself is a mobile billboard 22 feet long by 10 feet tall whose sole purpose is to advertise.

If you’d like a more personal touch, however, AdsOnFeet might be for you. This Boston-based company, started by David Everett, provides a walking video screen—that is, a video screen attached to the body of a human being. For about $2,500 a day, you can startle people in crowded areas with your advertising message. Franchises are available, and operators in New York have already signed on.

These examples have focused on visual stimulation in just one arena: messages we encounter while trying to navigate through the world. (You might point out that there are also ads on shopping carts, race cars, skateboards, surfboards, and pretty much any other means of travel.) Challenge your students to think of other modes of life besides moving through the world in which they are exposed to sensory information. Some examples of these aspects of daily living include socializing (ads in bars, ads in the student union, ads on television while you’re trying to just hang out with friends), working (ads on Internet sites, ads on the pens and T-shirts of your company), or recreating (ads on team jerseys, ads on the JumboTron, ads on the backs of stadium seats). Before the conversation devolves into a grumpy harangue about soulless advertising corporations and the pursuit
of the almighty dollar, bring it back to the topic of sensation and perception. What effect does all this stimulation have on our sensory systems? With so much to attend to in so many areas of life, the urgency, brashness, and salience of ads must be increasing: Can our sensory systems process it all? Given what we know about the visual system—perceiving color or form, responding to visual illusions—what recommendations do your students have about improving the effectiveness of advertising? Could a little go a longer way if advertisers simply knew more about the properties and processes of sensory systems?

If you’d like, you could also expand the discussion to other sensory systems beyond vision. The Where Do You Stand? feature at the end of the textbook chapter echoes these themes. Briefly, many companies (including Samsung, Sheraton Hotels, Yankee Candle Company, Starbucks, Singapore Airlines) are experimenting with scent branding, or associating a distinctive fragrance with a product or shopping experience. For example, some LG phones have a lavender-scented keypad; there are even billboards that emit odors to passersby. Auditory branding has long been practiced. The familiar NBC tones heard in so many station breaks and the distinctive ring of a Nokia versus ATT versus T-Mobile phone are examples. Even tactile experiences are associated with shopping, branding, and advertising. Bang and Olufsen, makers of elegant consumer audiovisual systems, have spent considerable time formulating a distinctive heft to their remote control units: When users pick up a B&O remote, they know it’s a B&O remote! Entire businesses are built on ensuring that a product’s closely guarded recipes taste like no other, and the proliferation of free samples makes sure consumers are aware of that fact. Ask your students to generate examples of these sensory-based experiences, and use the discussion to apply what they’re learning about the various sensory and perceptual systems to the world at large.

Sources:

http://www.carwrap.com/
http://www.ad-wraps.com/
http://www.carwraps.net/
http://www.adsonwheels.com/
http://www.innosolinc.com/
http://www.bang-olufsen.com/
http://www.fastcompany.com/53313/smells-brand-spirit

Lecture Suggestion 4.2

Snoezelen!

Most of us take our sensory abilities for granted. Sure, we might complain about trips to the optometrist, or lament that our strength isn’t what it used to be; but by and large our sensory apparatus works just fine. For many people, however, “just fine” would be a dream come true. For people with autism, profound multiple disabilities, debilitating chronic pain, dementia, profound mental retardation, or developmental disabilities, the sensory world can be an aggravating, confusing, bombastic place.

In the early 1970s, Dutch psychologist Ad Verheul developed the concept of the sensory room as a unique component of therapy for people with special needs. He noticed that many of his clients had, and benefited from, a unique way of interacting with their environments, and he introduced sights, smells, tactile stimulation, and even tastes as ways of producing a safe, comfortable, yet stimulating setting. He wrote a book with a colleague, Jan Hulsegge, titled Snoezelen (which comes from two Dutch words that mean to “sniff” and “doze”). Snoezelen rooms are now in place in rehabilitation centers, assisted living settings, and other institutions across the United States and Europe.

A typical snoezelen room might be equipped with a range of objects and experiences meant to stimulate the senses. For example, fiber optic cables (serving as a portal from room to room) help stimulate sight and touch. Mirror balls, Christmas tree lights, lava lamps, or other sensory novelties could also be employed: soft mats, beanbags, bubble blowers, music piped through unobtrusive speakers, bins of sand, wind chimes, glow-in-the-dark paint. You get the idea that there are many ways to create a multisensory room for the benefit of those who need it.

Share with your students this application of sensation and perception, and consider a broader discussion of how most of us take our sensory apparatus for granted. Many people can imagine being blind or deaf; what if we were deprived of the sense of smell, or what if touch sensations seemed excruciatingly painful or highly overstimulating? What might it be like to interact with the world under those conditions?

More information on snoezelen rooms can be found at the following Web sites:

http://www.worldwidesnoezelen.nl/en/

http://www.flaghouse.com//settings_AL.asp#special

http://www.thechildrensgarden.net/?The_Snoezelen_Experience

Lecture Suggestion 4.3

Signal Detection Theory

Imagine that you are home alone waiting for a friend to come over, and let’s assume that your doorbell isn’t very loud. You can’t always be sure whether you have heard the bell
ring or not and now you hear a faint sound. In this situation, some people are inclined to answer the door, sometimes finding that there isn’t anyone there. Others will answer the bell only when they are very confident that they have heard something. This predisposition to guess one way or another is known as response bias. The responding to stimuli when there is no stimulus present can be considered a background noise problem; people think they hear a signal but actually are just picking up background sounds in the environment or even within themselves.

A systematic method for measuring stimulus detection takes into account these and other distortions of the measurement process. This method, signal detection analysis, provides both an important approach to psychophysics and insights into the process of decision making. The key advantage of this method is that it allows the experimenter to separate out true sensitivity to a stimulus from distorting factors like response bias and background noise.

According to signal detection theory (SDT), four possible combinations of stimulus and response exist: hit, miss, false alarm, and correct rejection. By comparing the percentages of responses that fall into each of the four categories, psychologists can determine whether people tend to have a response bias toward giving more “yes” answers (a liberal response bias, low criterion) or toward giving more “no” answers (a conservative response bias, high criterion).

Signal detection theory assumes that to respond to a stimulus, we need to decide if the level of sensory activation we are experiencing is due to the presence of a real stimulus or just due to sensory noise (the ever-present activity of the sensory system, which varies in intensity from moment to moment). To do this, we set a decision criterion. The decision criterion divides the sensory continuum into two parts—less than threshold: noise; greater than threshold: signal.

Not only do individuals have differences in response biases, but individual situations can produce conservative or liberal response biases. Consider TSA employees operating scanners at airports. If they adopt a liberal response bias, they are going to have a high number of false alarms, that is, responding to a bomb when there is no bomb; but they should have no misses, that is, failing to detect a bomb when it is in fact present. In this case, the cost of a miss far outweighs the cost of a false alarm—suitcase is opened and examined. In other situations, the high cost of a false alarm would lead to a more conservative response bias.

**Classroom Exercise 4.1**

**The Size-Weight Illusion**

A discussion of absolute thresholds, difference thresholds, just noticeable differences, and the general findings of psychophysics sets the stage for a simple demonstration.

- Collect two boxes of different sizes, such as an earring box and a shoe box.
Wrap 25 pennies in tissue paper (to prevent them from rattling), and place them in the small box.

Tape enough pennies to the inside of the larger box so that it weighs the same or more as the smaller box (use a scale to verify this ahead of time).

Finally, wrap both boxes in newspaper, gift wrap, or butcher paper.

Ask volunteers to pick up the boxes and state which one is heavier.

Discussion:

You should find that students report the small box as heavier, even though it weighs the same (or less) than the large box. This is an effect of context: heaviness ought to be related to the size of the stimulus. Just as in the familiar Müller-Lyer illusion (where lines of the same length appear different due to their context), or visual illusions in which two circles of the same size appear larger or smaller when surrounded by either smaller or larger circles, one anticipates that the context of a larger box ought to be associated with greater weight. Discuss this misperception with your students, and link it to findings from psychophysics.

Classroom Exercise 4.2

Sensory Adaptation

Here are two brief but effective exercises for demonstrating sensory adaptation, especially for the “less popular” senses of touch and taste.

Exercise 1

Bring several strips of coarse sandpaper to class, and distribute them to your students.

Ask your students to gently rub their index fingers across the sandpaper, then rate how coarse it feels on a 9-point scale (1 = very soft and 9 = very coarse).

After a few minutes have elapsed, ask your students to repeat this task and re-rate the coarseness. Their ratings should now be lower, as their senses have adapted to the coarseness of the paper.

Exercise 2

Bring to class one pitcher containing a strong solution of water and sugar, another pitcher containing pure water, and twice as many paper cups as you’ll need for your student volunteers.

Distribute two cups to each volunteer, one filled with the sugar-water solution and one filled with fresh water.
Ask the volunteers to take a sip of the sugar water and swirl it around in their mouths without swallowing. After a few seconds, the solution should taste less sweet. Volunteers can then swallow the concoction or spit it back in the original cup.

Next, they should drink from the cup containing fresh water.

Discussion:

Your volunteers will be surprised at how salty the water tastes and might even accuse you of spiking the water with salt beforehand. Explain to them that sensory adaptation has occurred. The overstimulated sweet-sensing taste buds have become temporarily less sensitive, and as a result the salt-sensing taste buds have become more prominent.

Classroom Exercise 4.3

Weber’s Law

Here are two variations on a demonstration of Weber’s Law, the idea that the just noticeable difference (JND) is a function of the relative intensity of the stimulus.

1. For this demonstration, you will need 125 pennies and two paper cups. The goal of this demonstration is to show that the difference threshold changes as a function of stimulus intensity. In other words, Weber demonstrated that it is not the absolute magnitude of the change in stimulus intensity but the relative size of the change. Depending on your resources, you can do this with just one student or have the class pair up and do the exercise. Use Handout 4.1 as a data collection sheet.

   Explain to your participant(s) that you will present them with two containers, one after the other, in their dominant hand, and their job is to say whether the weights of the containers are the same or different. Have the participant(s) sit with their eyes closed. The procedure is a simplified version of the Method of Limits to test the participant’s ability to discriminate between two weights. The first set of comparisons involves using 25 pennies as the standard weight and 40 pennies in the comparison cup. Alternate presentation of the standard and comparison cups to the participant, removing one penny from the comparison cup each time until the participant reports that the cups weigh the same. Then repeat the procedure but starting with 25 pennies in each cup and adding one penny each trial to the comparison cup until the participant reports that they are different. Depending on how precise you wish to be, you can take the average of these two trials as the JND or repeat the process several times and take the average across the multiple ascending and descending trials. The second comparison involves repeating the procedure but with 50 pennies as the standard weight and starting with 70 pennies in the comparison cup. You should find that the JND for the 50 penny standard is larger than the JND when 25 pennies are the standard. In fact, the JND should be roughly twice the size because you have doubled the weight of the standard stimulus in the second task.

2. This is a quicker demonstration to show that it is not the absolute magnitude of the change in stimulus but rather the relative change in stimulus intensity that is critical to
determining the JND. Have a student take off his or her shoes and then place a quarter in one of the two shoes. The student is asked to determine which shoe weighs more, but of course will be unable to distinguish between the two. Then take the quarter and place it in one of two envelopes, and this time the student will have no difficulty identifying the heavier envelope.

**Multimedia Suggestions**

See the Preface for product information on the following items:

**Interactive Presentation Slides for Introductory Psychology**

6.1 Introduction to Sensation and Perception

6.4 Perception

**Worth Video Series**

Video Anthology for Introductory Psychology: Sensation and Perception – Synesthesia: The Man Who Tastes Words

Video Anthology for Introductory Psychology: Consciousness – Visual Attention: Piecing Things Together

Video Anthology for Introductory Psychology: Consciousness – There’s a Gorilla on the Court

**II. VISION I: HOW THE EYES AND THE BRAIN CONVERT LIGHT WAVES TO NEURAL SIGNALS**

(Chapter Objectives 7–13)

Light waves have the properties of length, amplitude, and frequency. These properties are perceived as color, brightness, and saturation (or purity), respectively. Light initially passes through the cornea and pupil of the eye, with the retina linking the world of light outside and the world of visual perception inside the central nervous system. Two types of photoreceptor cells in the retina transduce light into neural impulses: cones, which operate under normal daylight conditions and sense color, and rods, which are active only under low-light conditions for night vision. There are three layers that make up the retina, with the outermost layer consisting of retinal ganglion cells that collect signals from the middle layer, containing bipolar cells that receive signals from the photoreceptor layer and send them to the brain. The point where the axons that make up the optic nerve leave the back of the eyeball is called the blind spot because it doesn’t have any photoreceptors.

Light striking the retina causes a specific pattern of response in each of three cone types that are critical to color perception: short-wavelength (bluish) light, long-wavelength (greenish) light, and medium-wavelength (reddish) light. Cones also operate
in red-green and blue-yellow opponent combinations to contribute to color vision. Both additive and subtractive color mixing determine how shades of color can be produced.

**Classroom Exercise 4.4**

*Magic Prism Eyes*

Jim Matiya, an award-winning psychology teacher at Carl Sandburg High School in Orland Park, Illinois, makes prism goggles that invert the visual field or displace it by a predetermined number of degrees. With these goggles on, people reach for objects that are actually several inches to the left or right of what they perceive, and when walking with inversion goggles on, their shaky missteps leave them grasping for any available handhold!

Beyond these shenanigans, however, you can use these disrupted experiences to illustrate several points:

- **First**, the visual world is a complex place, and it’s a wonder we can navigate through it as successfully as we do, let alone at all. Donning inversion goggles nicely demonstrates how a relatively minor shift in sensation can produce a drastic shift in perception.

- **Second**, wearing displacement goggles is a unique way to illustrate a mindbug of vision: what our brain thinks it “sees” is actually not right there in reality. The complex interplay between eye and brain usually hums along quite smoothly, but when that relationship is fiddled with, the brain scrambles to make sense out of the information it receives.

- **Third**, most people adapt to inversion or displacement goggles fairly readily; that is, with a minimum of experience, people learn to adjust their actions to fit the constraints produced by their distorted visual system. This suggests you can fool some of the visual system some of the time, but not all of the visual system all of the time!

**Classroom Exercise 4.5**

*See Your Retina*

Here’s a dramatic demonstration that’s best conducted in a classroom with light-colored walls and either no windows or windows with blinds you can close. You’ll need enough cheap keychain-type flashlights to give to each student (or to share in pairs, depending on your enrollment). These can be found at dollar stores or party supply stores, or perhaps your university’s marketing department has several on hand.

- **Distribute a flashlight to each student.**

- **Darken the room, and explain to your students that the retina is essentially a “web” of blood vessels and neurons (retina means “web” in Latin). This means we constantly**
look through blood vessels and neurons during visual perception. We can’t see the neurons, but we can see the blood vessels if we look hard enough.

- Ask your students to stand facing the wall (not a chalkboard blackboard or any dark surface), tilt their heads downward slightly, and look up with their eyes at about a 45-degree angle onto the wall.

- They should then turn on the flashlight, hold it next to one of their eyes, and jiggle the light a bit.

- They should be able to see a web of blood vessels out of the corner of their eye, and if they focus closely enough on this web, they will see that the blood vessels all converge at one point. That is where the optic nerve begins; in other words, the blind spot.

Discussion:

Discuss with your students the paradox of having filmy blood vessels to contend with when perceiving the world around us. Point out the active nature of visual perception, noting that the retina is not like a blank sheet of paper upon which an image is drawn or a blank optical disk upon which a digital image is captured. Rather, the retina is a living thing, part of the overall living thing that takes sensations from the world and turns them into meaningful perceptions.

Source:


**Classroom Exercise 4.6**

Dark Adaptation

Here’s a quick, easy, and somewhat freaky demonstration of the principle of dark adaptation.

- Ask each student to blindfold one eye at the beginning of class. You can distribute cardboard and tape to create makeshift eye patches or, with a little planning, you can construct patches out of cardboard and rubber bands. (If you’re feeling quite generous, stock up on adhesive patches or “pirate patches” ahead of time; see the sources below.)

- Conduct class as you normally would, and after about 30 minutes darken the room.

- Ask your students to remove their blindfolds. The differential sensitivity of their two eyes should be immediately apparent. From there you can discuss dark adaptation, or, if you’ve timed it correctly, perhaps you’ll have finished discussing dark adaptation just when they shed their patches.
Sources:
http://eyepatches.com/
http://ortopadusa.com/
http://www.goipatch.com/
http://www.anissasfunpatches.com/
http://www.eyepatchheaven.com/

Multimedia Suggestions

Feature Film: Proof (1991, 86 min, rated R) Hugo Weaving stars as Martin, a blind photographer. As you might imagine, that scenario presents quite a challenge—who would hire a blind photographer without some proof of his work? Martin himself requires an inordinate amount of proof from others: proof of their loyalty, honesty, and affection. He finds that in Andy, played by Russell Crowe, an affable restaurant worker who comes into Martin’s life. This is a film that casts blindness as its central motif, yet reveals a great deal about motivation, interpersonal relationships, and trust.

Feature Film: Blind (2007, 98 min, not rated) This Dutch film focuses on the romantic relationship between an albino woman and a blind man. Their love is fulfilling, nonjudgmental, and rewarding. But what happens when he regains his sight? Will love remain blind?

Feature Film: Hollywood Ending (2002, 112 min, rated PG-13) Woody Allen plays Val Waxman, a formerly famous film director who has been reduced to directing TV commercials. When he gets an offer to make a big film, he goes temporarily blind. With the help of a few friends he tries to disguise his disability, without the studio executives knowing that he is directing the film blind.

See the Preface for product information on the following items:

Interactive Presentation Slides for Introductory Psychology 6.2 Vision and Hearing

PsychInvestigator Psychology of Vision

PsychSim 5 Tutorials Colorful World

Worth Video Series

Video Anthology for Introductory Psychology: Consciousness - “Blindsight”: Seeing Without Awareness

Video Anthology for Introductory Psychology: Sensation and Perception - Visual Processing: Elementary Concepts
III. VISION II: RECOGNIZING WHAT WE PERCEIVE

(Chapter Objectives 14–18)

Once the visual system perceives the different aspects of a stimulus—orientation, shape, color, size, etc.—these different aspects have to be combined into the perception of a single unified object, what psychologists refer to as the **binding problem**. Evidence suggests that structures in both the ventral and dorsal visual streams are involved in this process. Once a unified object is perceived, the next challenge for the visual system is to recognize what it is looking at.

Both the modular view and the distributed representation view offer explanations of how we perceive and recognize objects in the world. At a minimum, humans show a great deal of **perceptual constancy**: Even as aspects of sensory signals change, perception remains consistent. We are rarely led to believe that distant objects are actually tiny. Gestalt principles of perceptual grouping, such as **simplicity**, **closure**, and **continuity**, govern how the features and regions of objects fit together. We also tend to perceive figures against some sort of background. Many visual illusions capitalize on the perceptual ambiguities related to these principles. Depth perception depends on **monocular cues**, such as **familiar size** and **linear perspective**, and binocular cues, such as retinal disparity. We experience a sense of motion through the differences in the strengths of output from motion-sensitive neurons. These processes can give rise to illusions such as **apparent motion**.

Lecture Suggestion 4.4

Meet My Friend, Art

A dynamic way to illustrate many of the principles of visual perception is to show your students these principles in artwork. Many well-known artists have created images that trade on the interplay between eye and brain that takes place during illusions or that capitalize on principles such as opponent-process color perception, depth cues, and so on. For example, many of the surrealists incorporated visual illusions into their paintings, usually quite intentionally. Salvador Dali, for instance, went through a lengthy period in which illusions and visual puns played a central role in his work. Other artists, such as those working in the Op Art movement, used the regularity of geometric forms to their advantage, often producing work that was bold and jarring in its impact, primarily because of the effect it had on the viewer’s eyes . . . literally! Simply trying to focus on a shifting set of illusions rendered in psychedelic colors puts the most basic of visual processes to the test.

You no doubt rank some artists or artwork as your personal favorites; why not incorporate those into your lecture? You’ll share a bit about yourself with your students and also illustrate some visual principles in a memorable way. As another resource, here are some Web sites of the artists René Magritte, Salvador Dali, and Victor Vasarely,
along with some suggestions for particularly effective images to discuss with your students:

*René Magritte:*

http://www.musee-magritte-museum.be

http://www.magrittemuseum.be

*Dangerous Liaisons* (1926)

*The Acrobat’s Exercises* (1928)

*The Giantess* (1929/1930)

*La Condition Humaine* (1933)

*The Red Model* (1934)

*Collective Invention* (1934)

*The Key to the Fields* (1936)

*The Magician (Self-Portrait with Four Arms)* 1952

*Salvador Dali:*

http://www.salvadordali.com

http://www.dali-gallery.com/

http://thedali.org/home.php

http://www.daligallery.com/

*Weaning of Furniture—Nutrition* (1934)

*Disappearing Image* (1938)

*Apparition of Face and Fruit Dish on a Beach* (1938)

*The Endless Enigma* (1938)

*Slave Market with Disappearing Bust of Voltaire* (1940)

*Raphaelesque Head Exploding* (1951)

*Skull of Zurburan* (1956)

*The Sistine Madonna* (1958)
Portrait of My Dead Brother (1963)

Hallucinogenic Toreador (1970)

Victor Vasarely:

http://www.vasarely.com/

http://www.artnet.com/artists/victor-vasarely/

Almost anything Vasarely painted in the 1950s or 1960s would work, especially images from the Vega series

Classroom Exercise 4.7

Gestalt Psychology in the Most Common of Places

Many elements of Gestalt psychology were inspired by everyday observation. For example, the textbook describes how Max Wertheimer had an insight into the phi phenomenon while taking a train ride (Chapter 1). Theorists such as Kurt Lewin were explicit in their linking of theoretical psychology with practical application. In fact, Gestalt psychology as a whole was fundamentally a system for explaining how we perceive the world around us, correctly and (sometimes) incorrectly.

But somewhere along the way, Gestalt psychology became more popular as a vehicle for exploring things we don’t see that often in the real world: Necker cubes, incomplete line drawings, faces that look like vases, and Dalmatians made up solely of spots. Although these examples illustrate important principles, consider challenging your students to find real-life examples of Gestalt principles at work.

For example, Fred Kozub reports that his students were quite successful at finding examples of proximity, similarity, and repetition in products ranging from advertising to fine art to catalogs.

- Encourage your students to be creative and to look around them; there are doubtless dozens of examples of Gestalt principles at work in everyday objects.

- As a start, recommend looking at some of Andy Warhol’s paintings. His series of Marilyn Monroe (and other celebrities) holds a wealth of examples, such as similarity, continuity, repetition, incomplete figures, and so on. The iconic 100 Campbell’s Soup Cans (1962), a rendering of one hundred Campbell’s soup cans, also provides a well-known example.

- Consider asking students to focus on one domain (such as fine art, CD covers, or magazine ads), or ask them to find as many varied examples as they can.

- Similarly, you might assign students one principle (such as common fate, figure/ground, or simplicity) and ask them to find 5 or 10 examples.
Make this a brief written project or simply a fun in-class activity to get students involved in learning more about Gestalt principles.

Source:

**Multimedia Suggestions**

See the Preface for product information on the following items:

*Interactive Presentation Slides for Introductory Psychology* 6.2 Vision and Hearing

*PsychSim 5 Tutorials* Visual Illusions

*Worth Video Series*

Video Anthology for Introductory Psychology: Sensation and Perception – The Man Who Cannot Recognize Faces

Video Anthology for Introductory Psychology: Sensation and Perception – Seeing the World Upside Down

Video Anthology for Introductory Psychology: Sensation and Perception – Depth Cues

Video Anthology for Introductory Psychology: Sensation and Perception – Mueller-Lyer Illusion

*Scientific American Introductory Psychology Videos: Vision: How We See*

**IV. AUDITION: MORE THAN MEETS THE EAR**

(Chapter Objectives 19–21)

Hearing takes place when sound waves are transduced by receptors in the ear. Perceiving sound depends on three physical dimensions of a sound wave: The frequency of the sound wave determines the **pitch**; the amplitude determines the **loudness**; and differences in the complexity, or mix, of frequencies determines the sound quality, or **timbre**. Auditory perception begins in the ear, which consists of an outer ear that funnels sound waves toward the middle ear, where tiny bones called ossicles mechanically transmit the vibrations to the inner ear, which contains the **cochlea**. Stimulation of thousands of tiny **hair cells**, embedded in the **basilar membrane**, initiates neurotransmitter release that results in a neural signal sent to the brain. Both a **place code**, which is better for high-frequency sounds, and a **temporal code**, which is better for low-frequency sounds, are involved in transducing sound frequencies. Auditory signals travel to area A1, the primary auditory cortex, located in the temporal lobe. Our ability to localize sound sources depends critically on the placement of our ears on opposite sides of the head.
Lecture Suggestion 4.5

TeenBuzz

Here’s some information you might not want to share with your students.

Just as Old Man Johnson used to complain about “those darn kids . . . no-good whippersnappers” stealing from his apple orchard, modern businesses have been faced with the problem of teenagers loitering around their storefronts. Not that teens—armed with credit cards, hormones, and poor judgment—aren’t good for the economy; it’s just that you’d rather they not smoke, yell, and congregate in a way that drives off other shoppers. Modern science has stepped in to help modern business, in the form of the Mosquito Teen Repellent.

Developed by Howard Stapleton in Wales in 2005, Teen Repellent emits a tone between 17.5 KHz and 18.5 KHz, which is at the top end of auditory perception for people in their late teens and early 20s. Most people older than the age of 25 can’t hear the tone at all, due to “aging ear,” or the decrease in responsiveness to sounds at very high frequencies. As such, a 5–10 minute exposure to Teen Repellent usually sends the kids running, making business owners happy and leaving legitimate (older) customers unaffected. The Mosquito system is marketed in the United States by a company called NoLoitering.

But here’s the part to keep from your students. Teens have turned the tables on adults, by turning the Mosquito frequency into a ringtone for their cell phones. Because adult teachers can’t hear the sound, students are able to receive text message alerts during class, which is customarily frowned upon by most instructors. The ringtone has been nicknamed TeenBuzz, and a considerable amount of anecdotal evidence suggests that teachers are vexed and kids are chortling over its success. The ringtones are easily available for download on the Internet, at sites such as:

http://www.ultrasonic-ringtones.com/

http://www.freemosquitoringtones.org/

If you’d like to share this information with your students (they probably already know), be prepared for the consequences. You might consider placing a large bin by the classroom door for students to dump their cell phones and pagers into as they enter class. That, or think about bringing a dog to class. When its ears perk up, stop lecturing and search out the guilty text messager in the crowd!

Sources:


Lecture Suggestion 4.6

Guest Lecturer from the Deaf Community

It has become commonplace that, at a lecture, performance, or city council meeting, an interpreter is on hand to translate the proceedings for the hearing impaired. Many of us have seen a person standing to the side of a podium, using American Sign Language (ASL) to make sure that all members of an audience are included in the event. In the world of the hearing, it’s nice to know that accommodations can be made for those who can’t hear as well.

You might consider flipping this situation around by inviting a member of the deaf community to speak to your class about what a world without hearing is like. That person may feel more comfortable bringing a friend who can translate from ASL to spoken English so that your students (most of whom probably aren’t fluent in ASL) can understand the communication . . . that’d be the person at the side of the podium accommodating those who can hear! You might have a colleague who would be willing to speak about her or his experiences as a person with hearing loss or perhaps even a student in your current class (or another). If your university is large enough, it might have a center for hearing research or testing for deafness. For example, many schools of communication have a specialization in communication disorders, often focusing on teaching ASL, identifying children with hearing impairments, and so on. Ask around; chances are good that you can track down a guest lecturer to share some valuable insights into the experience of deafness.

Lecture Suggestion 4.7

Huh? Wha?

As your students learn about frequency, amplitude, and complexity, this might be a good time to point out that the human auditory system can handle only so much input. At some point too many decibels can become painful. Handout 4.2 gives the decibel level equivalents of some common auditory experiences. Handout 4.3 gives the daily permissible noise level exposures recommended by the Occupational Safety and Health Administration (OSHA).

After sharing some or all of this information, poll your students. First, ask how many of them own an iPod (or similar device). Next, ask what kinds of headphones they use; the “over the ear” enclosure type, or the “directly in the ear” earbud variety. Next, ask them what they think the typical loudness setting is that they use: Half of the maximum? More? The estimated maximum sound level of iPods is between 100 and 115 decibels (visit http://www.apple.com/sound/ for more information). Finally, engage your students in a brief discussion of the dangers and consequences associated with sticking a high-volume device directly in one’s ear for extended periods each day.
Lecture Suggestion 4.8

Advances in Hearing Restoration

The *Hot Science* feature in the textbook chapter describes cochlear implants as a promising means of restoring sensorineural hearing loss and also mentions that surgery, medication, and amplification can be used to treat conductive hearing loss. You might share with your students some other advances being made in hearing restoration.

For example, BAHA (Bone Anchored Hearing Appliance) has been available in the United States since 1996. It is designed for people with single-sided hearing loss or those with damaged middle or outer ears. BAHA works by channeling sound vibrations from the damaged ear to the working one. A processor implanted near the damaged ear picks up the vibrations, then sends them around the skull to the healthy ear, where the cochlea sends auditory signals to the hearing centers in the brain. BAHA can also be used to send signals to an intact cochlea on the deaf side by rerouting vibrations around the point of damage.

Another advance is PABI (Penetrating Auditory Brainstem Implant), used for people with damaged auditory nerves (from meningitis, birth defects, tumors, or other origins). An implant bypasses the damaged nerve and sends signals directly to brain centers that process auditory information. The process involves a microphone that registers a sound and a processor that converts it to an electrical signal. These signals are sent through the skin to a receiver implanted near the ear. Wires transmit the signal to two electrode pads that have been surgically implanted in the auditory area of the brainstem. These electrodes selectively stimulate neurons that respond to different frequencies, resulting in the ability to reproduce a range of sounds. PABI is an experimental treatment at present.

Sources:

House Ear Institute: http://www.hei.org/


Classroom Exercise 4.8

BA + GA = DA

When the word “illusions” comes up, people typically think of one of two things: either David Copperfield is coming to town to make an airplane disappear, or else a Necker cube is on the horizon. Yes, “illusion” sometimes means “magic,” and more often “visual illusion.” But there is a compelling auditory illusion that you can share with your students.

The McGurk effect, named for the late Harry McGurk, is a visual-auditory illusion usually investigated in the context of speech perception.

- Listener-viewers watch a videotape of a person mouthing the syllable “ga.”
Dubbed onto the video, however, is the sound of the syllable “ba.”

What gets perceived, however, is neither syllable. Rather, listeners report hearing the syllable “da.”

Summary:

The effect changes depending on whether the listener-viewer is both listening and viewing, or just listening. This effect can be produced with other syllable combinations as well. Taken as a whole, these demonstrations illustrate how language perception enlists both the visual and auditory systems. What’s more, what we think we hear is not always what is actually spoken.

Several demonstrations of the McGurk effect can be found on the Internet. For more information, visit these sites:

http://www.faculty.ucr.edu/~rosenblu/lab-index.html

http://mambo.ucsc.edu/psl/dwmdir/da.html

http://www.haskins.yale.edu/featured/heads/mcgurk.html

Sources:


Classroom Exercise 4.9

Demonstrating Auditory Perception

There’s no question that among the senses—at least in popular perception—vision rules. We tend to be unaware how much of our knowledge of the world around us comes from our other senses. Even textbook coverage often has pages and pages on eyes and foveas and area VI . . . and precious little on hearing, and even less on taste and smell (which is emotionally possibly the most evocative of the senses). So let’s lend an ear to some interesting demonstrations of auditory perception.

Exercise 1

To demonstrate sound localization:
- Get a 30-inch length of 3/8-inch flexible plastic hose, the kind you’d get from a hardware store (or part of a garden hose you don’t mind chopping up).

- Mark the exact midpoint of this length of tubing using a straight line drawn with a marker.

- Ask one student to volunteer to be the Listener, and another student to be the Tapper. The Listener should hold the ends of the hose up to each ear with eyes closed, while the Tapper taps the hose gently with the end of a pencil.

- Instruct the Tapper to tap anywhere on the hose within 1 inch to 12 inches away from the midpoint (in either direction), but not hard enough to provide the Listener with any tactile cues.

- The Listener’s job is to determine the location of the sound source.

Summary:

After a few trials (with Tappers and Listeners alternating roles) your students should find that they are quite accurate at locating the sound source, even within an inch away from the center midpoint. Explain that the interaural time difference—the fact that the ear closer to the source receives the sound a little sooner than the farther ear—allows this to happen.

Exercise 2

Another demonstration of sound localization involves a trip to a pet shop or novelty store.

- Get a clicker—the kind used to train dogs, or to irritate parents at a child’s birthday party—and a 12-inch length of 3-inch plastic pipe (a heavy cardboard tube will also do).

- Ask a Listener to sit facing the class, with eyes closed.

- The Clicker stands behind the Listener and clicks 2 or 3 feet from the Listener in any direction; to the left, to the right, or directly overhead.

- The Listener should be able to accurately identify the source of the sound.

- Next, have the Listener place the pipe up to one ear, and ask the Clicker to repeat the clicking process.

- The Listener should now perceive a click originating directly overhead as being closer to the ear without the pipe. This is again due to the interaural time difference: the soundwave has to travel farther to reach the “pipe ear” than the unadorned ear.

Exercise 3

Finally, you can demonstrate the effects of sound traveling through different media.
Attach two 20-inch lengths of string to the bottom of a wire clothes hanger, so that the hanger can be suspended, hook-side down, from the strings.

Ask a Listener to wrap one string around each index finger, then stick those fingers into the ears, allowing the hanger to suspend loosely.

A Tapper should then strike the hanger with a pen or pencil.

Summary:

The Listener should hear what sounds like church bells pealing, whereas all other observers should simply hear the muffled thud of a pen hitting wire. This effect is produced by sound waves traveling through different media. Waves that travel through the air dissipate quickly, resulting in an unimpressive “blap” from the pen. Waves that travel through string and bone carry with them all the tones and overtones produced by striking the hanger with the pen, thereby producing a much richer sound sensation for the Listener.

Sources:


Multimedia Suggestions

**Feature Film: Sound and Fury (2000, 80 min, not rated)** This Academy Award–nominated documentary examines the lives of a deaf family immersed in deaf culture. Although cochlear implants are an option for the children, the family grapples with the pros and cons of this technology. What might be gained from entering the world of hearing? And what might be lost?

**Feature Film: The Miracle Worker (1962, 106 min, not rated)** Although this film is almost 50 years old, it still powerfully conveys the story of Annie Sullivan (played by Anne Bancroft) and Helen Keller (played by Patty Duke). Sullivan struggled to teach Keller (who became blind and deaf at an early age) to communicate and interact with the external world.

**Feature Film: Vertigo (1958, 106 min, rated PG)** Beautiful San Francisco locales, thrilling plot twists, and a dizzy James Stewart. What more could you want from a classic film? The story is well-known: A detective who suffers from vertigo (actually, fear of heights) becomes dangerously obsessed with an old friend’s wife as he investigates a case. There are several selected scenes in this film that would be appropriate for illustrating what happens when the body senses go awry.

See the Preface for product information on the following items:
**V. THE BODY SENSES: MORE THAN SKIN DEEP**

(Chapter Objective 22)

**Haptic perception** involves the active exploration of the environment through touching and grasping. Four types of specialized receptor cells are located under the surface of the skin to transduce pressure, texture, pattern, or vibration. Touch is represented in the brain according to a topographic scheme in which locations on the body project sensory signals to locations in the somatosensory cortex, a part of the parietal lobe. Areas of the body that are more sensitive occupy a greater area in this strip of cortex. For example, the fingertips have a greater representation than do the trunk or legs.

A-delta fibers transmit the initial sharp pain from sudden injury, and C-fibers transmit the duller lasting pain that persists after an injury. The experience of pain depends on signals that travel along two distinct pathways. One sends signals to the somatosensory cortex to indicate the location and type of pain and another sends signals to the emotional centers of the brain to initiate escape. The experience of pain varies across individuals, which is explained by bottom-up and top-down aspects of **gate-control theory**.

Body position and movement are regulated by receptors located in the muscles, joints, and tendons. Balance is regulated by the semicircular canals in the inner ear and to some extent by visual cues.

**Lecture Suggestion 4.9**

Minty Fresh, Freezing Cold

Many an ad for candy or cough drops suggests that “a cool burst of mint” can freshen breath or quiet a nagging hack in the back of your throat. Beyond good advertising copy, the link between “cool” and “mint” has some additional evidence.

There are several types of skin receptors specialized for different tasks. For example, hair follicle endings respond to hair displacement, just as Krause corpuscles respond to pressure or Pacinian corpuscles respond to vibration. Researchers at the University of California, San Francisco, inserted genes from a variety of different nerve cell receptors into human kidney cells. These modified cells produced receptors on their surface, which were then tested for their cold sensitivity. Because the process is more complex than just wheeling the cells into a freezer and then later asking if they’re chilly, the research team used menthol to stimulate the cells. They discovered a receptor type that reacted to both cold and chemical... chilliness plus menthol. Dubbed CMR1 (cold-and menthol-sensitive receptor one), it is an ion channel that lets potassium and calcium enter a nerve
cell, thereby setting off a nerve impulse. The action is reminiscent of VR1, an ion channel discovered in 1997 that reacts to both heat and the chemical capsaicin (the chemical found in chili peppers that gives them their “bite”).

Sources:


Classroom Exercise 4.10

All Hands on Deck

There are several ways you can demonstrate haptic perception to your students. Each of these activities hinges on the amount of time, money, and preparation you’d like to devote to the topic.

Exercise 1

- Construct an elaborate “magician’s table,” complete with a felt-covered surface, two sturdy rods supporting a black curtain at the average eye-level of most students, a bin for holding various objects, and so on.

- Alternatively, you might invest in an inexpensive blindfold, or even fashion one from a piece of cardboard and some rubber bands.

- Earplugs? Maybe. Eventually you can create “that deaf dumb and blind kid” from *The Who’s Tommy*, if you’d like. In any event, the idea is to make sure that student volunteers can engage only in haptic perception—perceiving using the sense of touch—and that other sensory cues are eliminated (or at least minimized). Now, ask a student volunteer positioned on one side of your elaborate stage setup (or, more simply, with a blindfold on) to reach into a bin of objects and draw them out one at a time. (Here are some options: you could simply hand the volunteer each object in turn, or lay them out in a row in front of the volunteer, or challenge the volunteer to find an object placed somewhere on the table, and so on.)
Summary:

The volunteer’s task is to identify each object using only the sense of touch; the volunteer can feel it, squeeze it, rotate it, heft it, but no peeking (and if the object makes noise, no shaking . . . hence, the possibility of earplugs). Some interesting objects to include are:

- cookie cutters in familiar shapes
- a toothbrush
- a simple pen
- an elaborate pen
- a cup
- a wristwatch
- a wooden cube
- a small book
- a child’s toy
- a lock of hair
- a playing card
- a computer cable
- a spoon
- a pad of Post-It notes
- a closed safety pin
- a rubber duck
- a shard of glass (okay, not that one)
- an envelope
- a cell phone
- a sponge
- a small hammer
a facial tissue
a CD
a handful of moss
a slice of bread
a portable USB drive
a copy of Schacter/Gilbert/Wegner’s *Psychology*

As you might imagine, the kinds of objects you select are limited only by safety, availability, and your imagination.

Discussion:

Having a range of objects can lead to some interesting results, as volunteers either grasp at identifications or, having roughly identified an object, grasp at explanations. For example, suppose you had an extremely smooth stone that you had placed in a freezer for 30 minutes before coming to class. Would the volunteer be able to identify it by shape, weight, temperature, texture, or all of these? It might not feel like a stone; most stones are rough. It might feel like a coin, but most coins aren’t that heavy. Stones usually aren’t cold, but this object is. Suppose you introduced something squishy and slimy, such as a handful of Floam or one of those squishy novelty tubes that are so popular at children’s birthday parties and arcades? The inability to describe the object is no doubt compounded when other senses are unavailable. A person without a blindfold would be able to quickly shout out, “Hey, it’s one of those squishy things you see in arcades . . . I don’t know the name of it, though,” whereas a person working from touch alone might be able to “recognize” the object, but have a harder time naming it.

**Exercise 2**

You might consider a race of sorts to illustrate the relative contributions of the various sensory systems.

- Ask for three volunteers.

- As in the example just described, have three squishy tubes available but hidden from sight.

- Blindfold two of the volunteers, and on your count, “reveal” the object to all three.

- Volunteer 1 simply sees the squishy tube placed on a table when a covering is lifted from it.

- Blindfolded Volunteer 2 has the object placed in the hand, but is instructed not to manipulate it (i.e., a passive perception task).
Blindfolded Volunteer 3 grasps the object and tries to identify it by any haptic means (i.e., an active perception task).

Summary:

You should quickly find that Volunteer 1 wins the race almost every time (depending on the bizarreness of the objects you choose); in fact, you might want to give Volunteers 2 and 3 a bit of a head start! If you’d like to include Volunteers 4 and 5 in a “smell” and “taste” condition, feel free . . . first make sure the squishy stuff is nontoxic. You can include as many objects, trials, and senses as you’d like.

In short, you can use this type of exercise to demonstrate the limitations of haptic perception, but also the special strategies for identification that haptic perception requires. The ability to manipulate an object (active versus passive perception) should contribute to success at identifying the object. Then again, even the most extensive amount of touch may fail to reveal an item’s identity, compared with one brief glance or one quick sniff.

Source:


**Classroom Exercise 4.11**

**A Touch Too Much**

There are several illusions of touch that your students can demonstrate to themselves, working in pairs. Start with the old standby: the *dead finger*.

**Exercise 1**

- Two students place their hands together, palms touching, so that their index, middle, ring, and pinkie fingers match up. (That means one student’s right hand is touching the other student’s left hand.)

- Students can then take turns rubbing the index finger and thumb of their other hand up and down the matched “outsides” of the touching index fingers.

Summary:

As any 6-year-old will tell you, the resulting sensation is an eerie “dead finger” effect. In part, this is due to the greater concentration of nerve endings on the underside of the index finger (i.e., the part that typically touches, grasps, and manipulates objects) compared to the outer side. If you were to simply rub the inner and outer surfaces of your own index finger, a greater range of sensations would be triggered by the more sensitive underside. Rubbing the two outsides, then, results in the weird sensation of some kind of disembodied hand.
Exercise 2

Another standby of body illusions is the water trick.

- If you can arrange it, get a large beaker of very cold water, and another large beaker of rather hot water.
- Ask a volunteer to submerge the right hand in the cold beaker and left hand in the hot beaker.
- After about a minute, ask the volunteer to then place both hands into a beaker of lukewarm water.

Summary:

The previously cold hand should now feel hot, and the previously hot hand should now feel cold. The comparative differences in temperature—switching from one extreme or the other to a common midpoint—produces this change in perception.

Exercise 3

The cutaneous rabbit illusion involves presenting a rapid series of taps first to the wrist and then to the elbow of a volunteer. The illusion is a sensation of sequential taps “hopping” up the arm. This illusion also works moving from the elbow down to the wrist. fMRI studies reveal that the touch centers of the post-central gyrus are activated during this illusion, creating the perception that untouched areas of the forearm between the wrist and elbow are being stimulated. Besides being a cool trick, research on the cutaneous rabbit may hold implications for understanding phantom limb pain.


Sources:


Multimedia Suggestions

*Feature Film: Sick: The Life and Death of Bob Flanagan, Supermasochist (1997, 90 min, not rated)* This documentary is not for the faint-hearted. It deals with adult themes
in a straightforward, unflinching manner and contains scenes of sadomasochistic behavior. This documentary may not be appropriate for all viewers, even in a college classroom. The film profiles a unique individual. Before his death in 1996, Bob Flanagan was the longest-living cystic fibrosis patient in the world. Cystic fibrosis often claims its victims in the teens and early twenties, so to live until age 43 was unheard of. Throughout his life, Flanagan had to endure a range of painful experiences, from the ravages of the disease to the ravages of the treatments. He coped with this pain by developing a masochistic fetish, essentially coupling pain with pleasure. Some scenes from this film might be profitably used in the context of discussing pain, and especially the self-perception of pain. This film should definitely be previewed before being considered for a general audience.

See the Preface for product information on the following items:

*Interactive Presentation Slides for Introductory Psychology* 6.3 Body Senses, Taste, and Smell

*Worth Video Series*

- Video Anthology for Introductory Psychology: Sensation and Perception – Losing One’s Touch: Living Without Proprioception
- Video Anthology for Introductory Psychology: Sensation and Perception – Pickpockets, Placebos, and Pain: The Role of Expectations
- Video Anthology for Introductory Psychology: Sensation and Perception – Coping with Pain

**VI. THE CHEMICAL SENSES: ADDING FLAVOR**

(Chapter Objectives 23–24)

Smell and taste are both chemical senses; smell occurs when molecules enter the nose, and taste occurs when molecules are dissolved in saliva. Smell and taste combine to produce the experience of flavor. Olfaction is the result of odorant molecules binding to sites on specialized olfactory receptors, which converge within the olfactory bulb. The olfactory bulb in turn sends signals to parts of the brain that control drives, emotions, and memories, which helps to explain why smells can have immediate and powerful effects on us. Pheromones are biochemical odorants that affect behavior, including some sexual behavior, and physiology.

The tongue is covered with papillae, which contain taste buds, the organs of taste transduction. Each taste bud contains taste receptor cells that respond to a taste sensation: salty, sweet, bitter, sour, and umami. Odorants from food enter the nasal cavity both through the nose and through the back of the mouth and upper throat.
Lecture Suggestion 4.10

Stench Warfare

Rancid horse meat. A decaying corpse. An open sewer. Months-old eggs, cracked into a bowl of human offal. Disgusted yet? Probably. As you read those descriptions of disgusting things, you no doubt formed a visual image of just how distasteful they’d appear. But more important, as you read those descriptions, your nose probably involuntarily raised up, as your cheek muscles raised along with your upper lip. These things don’t just sound bad or look disgusting; they smell bad, too. You’re not actually smelling those stenches at the moment, but the images are evocative enough that you can imagine how bad they’d smell, and your turned-up nose is an indication of how powerful the imagination of those smells can be.

So now imagine if you actually encountered the stench of rotting meat or putrid eggs. Your crinkled nose would simply be one part of your body that was trying to get away from the stink; in fact, your legs would probably be leading the charge. That’s what the U.S. military hopes might happen one day. Not that anyone’s declared war on you personally. The military has an interest in developing nonlethal weapons, and stink bombs are one avenue being explored.

Chemical warfare obviously has a long history. The mustard gas of World War I immediately comes to mind, although that and similar gases were intended to incapacitate an enemy through eye and other irritations. Some of these gases, in fact, were intentionally lethal, leading to treaties such as the Geneva Gas Protocol of the Third Geneva Convention of 1925. Stinkiness, as a motivator to lay down arms or flee the scene, is in a different camp. During World War II, the Who Me? compound was developed for these kinds of uses. The notion was that members of the French Resistance would carry the chemical in atomizers, try to get as close to German officers as they could, then surreptitiously release the fecal matter smell onto them. The officers would be so embarrassed that they’d be mocked by their troops, abandon their command, and eventually Germany would lose the war. Didn’t happen that way. For starters, Who Me? was rather volatile, leading to both the sprayer and sprayee smelling like farts in short order. The military abandoned the project, but they clung to the idea that one day smell as a weapon might be viable.

Starting in the 1990s, there was a renewed interest in nonlethal weapons, both on the battlefield and for crowd control, riot dispersal, and other domestic applications. “Bombs” that emitted blinding lights that stunned their viewers were tested, as were subsonic and ultrasonic sounds meant to incapacitate. Rubber bullets had been around for some time, but tasers now grew in popularity. Slippery foam to make driving or walking impossible and sticky foam to produce immobilization were tried with varying measures of success. On the olfactory front, however, researchers were met with a problem. Most people acclimate to smells after 15 minutes or so, thanks to the process of sensory adaptation. Our sensory systems are geared toward detecting changes in stimulation, so constancies in stimulation wear off after a while. What’s more, what’s stinky for one may
not be stinky for all. Finding a scent that would have “universal appeal” in many different cultures posed a challenge.

Cognitive psychologist Pam Dalton, at the Monell Chemical Senses Center in Philadelphia, has conducted extensive research on what people find malodorous. Reasoning that biologically based odors—vomit, feces, urine, sweat—might have a more universal quality, Dalton ran several tests of their stinkiness. Also included were sulfur (associated with putrefaction, of food or bodies) and the stench of burning hair; all perfectly noxious stimuli. The winner, however, was Who Me?, closely matched by US Government Bathroom Malodor. Think about that public restroom in a busy bus terminal, and you’ve got the idea.

Will any of this work translate into a viable stink bomb for defense or law enforcement? It’s difficult to tell. For starters, the government could have such weapons at the ready and simply not be telling anyone. On a less paranoid note, finding that a stench is malodorous in one context doesn’t necessarily mean it is in another. For example, people generally like the smell of wintergreen; but when told they’re about to smell an industrial solvent, they report a strong dislike of the scent . . . even though it’s nothing more than wintergreen. Clearly context comes into play. As another example, it’s fairly common practice in the United States to spray roadside fir trees with a chemical mix (including the scent of fox urine) to deter Christmas tree thieves looking for free yuletide cheer. The smell isn’t noticeable until the tree is placed indoors, in the warmth of the living room, near the roaring fire . . . at which point the stink molecules are unleashed. Finding a scent that’s reliably stinky, across contexts and across cultures, may require much more research. In the meantime, be sure to stop and smell the roses.

Sources:


Lecture Suggestion 4.11

Sniffy the Robot

Here’s an experience you’ve probably never had, nor ever will. You’re aboard a space shuttle, trying to conduct high-level research in a zero-gravity environment, when all of a sudden you feel yourself being overcome by poisonous fumes. There are only seconds to act, and it’s a matter of life and death. Will you be all right, or will you end up being the corpse pilot of space junk, floating through the universe for all eternity, like some science fiction short story from the 1950s?
As melodramatic as that purple prose renders it, it’s true that astronauts face an unusual dilemma. Space stations and shuttles are full of ammonia. This is okay, because ammonia circulates around the structure, pulling heat out of the cabin and dissipating it into space. The ammonia serves a vital purpose in maintaining the habitability of that distant environment. But ammonia is also quite poisonous, and a leak could spell disaster for the inhabitants. Humans can smell ammonia at a concentration of about 50 parts per million. However, ammonia can become dangerous in concentrations as low as a few parts per million. What’s more, there are scores of other chemicals and compounds aboard a space shuttle that can become life threatening if allowed to accumulate in the wrong way or the wrong place.

NASA has addressed these potential problems by recognizing that humans probably aren’t going to be the ones to save the day. No offense, but the human nose just isn’t sensitive or sophisticated enough to detect chemical leaks, smoldering fires, or other dangers. What’s needed is a better nose, and NASA aims to build one.

The Electronic Nose, or ENose for short, can be trained to detect almost any compound or combination of compounds. It is sensitive to detecting electronic changes at 1 part per million, and can even be trained to sniff out the difference between Coke and Pepsi! Here’s how it works. There are 16 polymer films specially designed to conduct electricity. When the molecules of a substance hit one of the films, the film expands slightly, thereby changing the way it conducts electricity. The changes that result form the complex interplay of all the polymers working in concert to produce the ability to detect such a variety of smells, stinks, and odors.

ENoses have found terrestrial applications as well. The food service industry uses them to detect spoilage, for example, and many a refrigerator visionary has proposed allowing that machine itself to tell you when the milk’s gone bad. There are also ETongues at work, capable of sensing compounds in liquids. Although most of us probably can live our lives quite successfully without ever owning an ESense of any kind, the range of applications is promising. Besides saving lives in space stations, ENoses could be employed in tandem to sniff out fires in oil refineries, detect chemical leaks in warehouses, alert the captain of a tanker to problems below decks, identify dangerous buildups of chemicals in sewer lines, and so on. There’s even recent evidence that “artificial snot” can improve the performance of electronic noses!

Be prepared. The day may come when your cat’s litterbox sends you an e-mail telling you it’s time to take action!

Sources:


Classroom Exercise 4.12

A Matter of Taste

Food must be dissolved in order to be tasted; some kind of liquid must be available to bind solid food to its appropriate taste receptor on the tongue. Thankfully, the available liquid is usually saliva; hence, solid food appears to have a taste all its own when hitting one’s tongue. People don’t think about receptor sites or molecules binding or any of that; they just know pancakes taste good with syrup on them.

To demonstrate the important interaction between saliva and food in producing taste:

■ Ask some student volunteers to dry their tongues by rubbing them on the backs of their hands (or, if everyone prefers, patting them dry with a paper towel).

■ The drier they can get their tongues, the better.

■ Have each student take a pinch of sugar that you provide and place it on the tip of their (dry) tongue.

■ They should not be able to taste anything until their mouths gradually moisten—with renewed saliva, the familiar sweet taste should come back.

Source:


Classroom Exercise 4.13

Name That Smell

Most people can discriminate among a large number of odors, although they have a surprisingly difficult time identifying the source of even the most familiar smells. You’ve no doubt encountered a familiar fragrance, known that you’ve smelled it before, and perhaps can even narrow it down to a few likely candidates, yet still are unable to place it exactly.

You can explore this phenomenon with your students by conducting a large-scale Smell-a-thon.

■ Collect 8 to 15 opaque containers with lids. In the pre-digital days, empty black film canisters were ideal containers, but empty pill bottles would also work, and you could also buy several inexpensive mini food-storage containers and spray-paint them black.

■ On a piece of tape, on each canister write a different number.

■ Be sure to keep a master coding sheet of which smell is associated with which number.
Place cotton balls at the bottom of each canister (to absorb the odor), and you’re ready to go.

Good substances to test include:

- coffee
- peanut butter
- Crayola crayons
- chocolate
- bubble gum
- ammonia
- baby powder
- lemon extract
- pencil shavings
- peppermint extract
- soap
- vinegar
- coconut
- Play-doh
- spices (e.g., cloves, pepper, garlic, cinnamon)

You can shave a bit of each substance into the canister, covered by the cotton (in the case of chocolate, coconut, or pencils), or soak the cotton with a bit of the scent (in the case of extracts or powders).

If you really want to get fancy, contact the Adams Extract Company (http://www.adamsextract.com/) and arrange to get sample scents of their wide range of products.

You might also simply raid your spice rack at home for a range of interesting possibilities. Instruct students to lift the lid of each canister in turn, but to keep their eyes closed when smelling the contents.

Have them indicate their responses on a sheet of paper.
Summary:

Your befuddled students will no doubt have a sense of familiarity (“Oh, I definitely
know this one . . . what is it?” “Oh! This reminds me of my childhood!”) more often than
they will have an exact identification.

Discussion:

If you have time, compile the number of correct guesses by a show of hands. Do good
or poor smellers have any hypotheses about the cause or lack of their abilities? Do the
results indicate that women generally have a better sense of smell than do men? Are there
other senses that could have come into play to make the identification task easier, such as
seeing a lump of brightly colored Play-Doh or tasting a bit of lemon extract? If so, how
do the senses work together in perceptual processes (e.g., smell and taste combining to
produce flavor)?

Classroom Exercise 4.14

Count the Taste Buds

You can spend $17 on a kit from PsychKits (http://www.psychkits.com/tastebuds.html)
or put this exercise together on your own. You will need food coloring, cotton swabs
(e.g., Q-tips), magnifying glass(es), and wax paper. In this exercise, students paint the tip
of their tongue with a small amount of green or blue food coloring, using a cotton swab
as a paintbrush. Having used a hole punch to make a hole in the wax paper, have the
students place the hole over the dyed area on their tongue. Using the magnifying glass,
another student counts the number of taste buds, those little pink bumps extending above
the dye. Most students will have between 15–35 taste buds within this circular area.
Fewer than 15 indicates that the individual is rather insensitive to taste, while over 35
indicates the student is a supertaster. If you would like to add to the experience, you can
play the song “John Lee Supertaster” by They Might Be Giants at the end of the exercise.

Multimedia Suggestions

See the Preface for product information on the following items:

Interactive Presentation Slides for Introductory Psychology 6.3 Body Senses, Taste, and
Smell

Worth Video Series

Video Anthology for Introductory Psychology: Sensation and Perception –
“Supertasters”

Video Anthology for Introductory Psychology: Sensation and Perception – The “Red
Hot” Chili-Eating Contest: Sensitivity to Taste
Video Anthology for Introductory Psychology: Emotions, Stress, and Health – Do Body Smells Reveal Fear and Happiness?

Other Film Sources

*The Anatomy of Pain* (2003, 49 min, FHS). Pain, in all of its manifestations—mental, physical, chronic, transient—is the focus of this segment from the series *Human Nature*.

*The Art of Food Presentation* (2007, 22 min, FHS). Eating food certainly involves the sense of taste. But the presentation of food enlists the senses of vision and smell as well. Add sounds of “yum yum” or “My compliments to the chef!” and you’ve got hearing thrown in. This film might be a nice way to introduce aspects of sensation and perception.

*Causes of Hearing Loss* (1995, 18 min, FHS). There are many causes of hearing loss: disease, ear infections, loud music, aging. Fortunately, there are also many treatments for hearing loss, such as antibiotics, cochlear implants, and hearing aids. Learn all about these options in this film.

*Connections: Sensation* (2006, 30 min, IM). The path from sensation to perception is traced in this overview of how brain and body coordinate to understand the physical world.

*The Eye: From Light Comes Sight* (2004, 22 min, IM). The gamut of visual perception is considered here: properties of light, structure and functions of the eye, transformations in the occipital lobe . . . you name it.

*Functions of the Face* (2003, 25 min, IM). Facial expressions of emotion are considered, but more relevant in the current context, the sensations of smell and taste (and their interaction) are discussed.

*How Much Do You Smell?* (1981, 50 min, FI) Nonhuman animals rely on smell signals to communicate a great deal of information. Humans may also rely on smell to a greater extent than most people might assume.

*How Touch Makes Sense of the World* (2004, 16 min, FHS). Touch is sort of the “forgotten sense,” compared to heavy hitters like vision and hearing. This brief video looks at the sense of touch as both a means of finding out about the world and communicating to others.

*Human Body Shop* (2004, 56 min, FHS). When *The Six Million Dollar Man* debuted in the 1970s, cyborgs seemed the weird stuff of science fiction. That fiction is increasingly becoming fact, as surgical techniques and technological advances make the replacement or enhancement of human systems a reality.

*Human Senses* (2003, 6 parts, 30 min each, FHS). This BBCW production takes a global view of how the senses develop, how they enrich daily life, and how they are valued across cultures.
Interpretations: Perception (2006, 30 min, IM). The brain’s acts of filtering, selecting, interpreting, and organizing sensory information are highlighted in this film.

Making a Life: Opportunity, Not Disability (2000, 27 min, FHS). Ability . . . disability . . . capability . . . there’s sometimes a fine line between what can and can’t be done when one’s sense or physical capacities are compromised. This video examines the issues surrounding this topic.

Optics: Bringing the World into Focus (2004, 16 min, FHS). This brief film, part of the Science Screen Report, explains the intricate system of visual sensation and perception.

Physics: Properties of Light (2001, 14 min, FHS). This video deals with the nonpsychological aspects of light, but it might be useful when discussing how light energy eventually transforms into perceptions.

Sensation and Perception (2001, 30 min, IM). This broad overview of sensation and perception offers a fine introduction to the processes involved in vision, hearing, taste, smell, and touch.

The Study of Attention (1996, 42 min, FHS). Selective attention, divided attention, and automaticity are illustrated. Examples of visual search and the Stroop effect are also shown.

Synesthesia: Derek Tastes of Earwax (2004, 50 min, IM). Who is Derek? And why are his ears so waxy? Perhaps this video will explain it all, along with an historical look at synesthesia and intriguing theories about how and why it develops.

Synesthesia: When the Senses Overlap (2004, 50 min, FHS). Enter the weird world of synesthesia with this fine overview of the condition, its origins, and its effects on the daily lives of synesthetes.

Taste and Flavor: The Inside Story (2000, 9 min, FHS). This very brief film can serve as a fine discussion starter on the topic of taste and where it comes from.

Technology and Deaf Culture (2001, 13 min, FHS). Cochlear implants offer the promise of hearing to many people who have had a lifetime of deafness. The pros and cons of this procedure for members of the deaf community are discussed.

To Walk (2003, 52 min, FHS). This Discovery Channel production examines the long road from crawling to walking. Motor skills, sensory feedback, and the kinesthetic senses come into play in this process.

Touch: The Forgotten Sense (2001, 53 min, FHS). This video presents a lengthy look at the many nuances of tactile sensation.

Vision (2003, 30 min, FHS). This video presents a case for the skills and shortcomings of the visual system. Vision is indeed a marvelous process, but sometimes we miss information that is literally right before our very eyes.
Visual Space Perception via Motion (1996, 20 min, IM). Here’s a film on a sometimes-overlooked topic: how humans perceive motion. A broad overview is provided, drawing on binocular and monocular cues, depth perception, motion paradox, and global and local optic flows.

Due to loss of formatting, Handouts are only available in PDF format.