Sensation and Perception

Instructor Manual

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This module covers two of the most fundamental topics in all of psychology: sensation and perception. These are among the topics that have the longest history of research attention, dating back to the 1700s when the "physicalists" such as Weber and Helmholtz first studied biological aspects of the nervous system and sensory organs. Sensation is largely organized around the five senses and emphasizes the biological aspects of basic information processing. Perception, on the other hand, is largely organized around using that information in effective ways. The good news with this module is that because it deals with sensory information it offers a number of opportunities to engage students by having them explore their own sensory understanding of the world!

Learning Objectives

- **Relevant APA Learning Objectives (Version 2.0)**
    - Describe key concepts, principles, and overarching themes in psychology (1.1)
    - Develop a working knowledge of psychology's content domains (1.2)
    - Describe applications of psychology (1.3)
    - Use scientific reasoning to interpret psychological phenomena (2.1)
    - Demonstrate psychology information literacy (2.2)
    - Build and enhance interpersonal relationships (3.2)
    - Adopt values that build community at local, national, and global levels (3.3)
- **Content Specific Learning Objectives: Sensation & Perception**

- Explain Signal Detection theory
- Explain the difference between sensation and perception
- Name the important anatomical aspects of the visual, auditory, olfaction and somatosensory systems
- Understand the opponent-process theory in color vision
- Define multimodal perception and understand the processes by which it integrates the constituent sensory information

Abstract

The topics of sensation and perception are among the oldest and most important in all of psychology. People are equipped with senses such as sight, hearing and taste that help us to take in the world around us. Amazingly, our senses have the ability to convert real-world information into electrical information that can be processed by the brain. The way we interpret this information-- our perceptions-- is what leads to our experiences of the world. In this module, you will learn about the biological processes of sensation and how these can be combined to create various perceptions.

Class Design Recommendations

This module can be taught in one 60-minute class, but it is more likely that it will be taught in two class periods (45 to 60 minutes). This is because of the sheer volume of material and especially because of the volume of new vocabulary related to the anatomy of the visual and auditory systems. Students tend to be interested in the visual system, specifically, and it is possible to teach Vision as one unit and the remaining Sensation & Perception content as another unit. Please also refer to the Noba PowerPoint slides that complement this instructor's manual. In addition, you may wish to explore the specific Noba modules and Power Points on related modules:

Vision: http://nobaproject.com/modules/vision

Taste and Smell: http://nobaproject.com/modules/taste-and-smell

Hearing: http://nobaproject.com/modules/hearing

The Vestibular System: http://nobaproject.com/modules/the-vestibular-system

Multi-modal Perception: http://nobaproject.com/modules/multi-modal-perception

Touch and Pain: http://nobaproject.com/modules/touch-and-pain

Note: Like the biological modules dealing with the brain and nervous system this module can seem formidable to students. This is largely because of the sheer volume of new and often difficult vocabulary words. It may be especially helpful for students to create study aids such as flashcards to help learn this new vocabulary. They may find it helpful if you define each term repeatedly when using it in lecture. We recommend openly addressing the potentially daunting amount of vocabulary and reassuring students that with effort and repetition they can learn it.

Overview

- Warm-Up Discussion: Which senses do you prefer?
- Understanding the difference between sensation and perception
- Vision
- Hearing
- Touch
- Smell and taste
- Multi-modal perception
- Conclusion

Module Outline

What is sensation? Why should students care?

- Sensation is simply the physical processing of stimuli through the sensory organs and channels. This includes, for example, seeing light and hearing sound. You will note the

emphasis on "physical" processing as sensation is a mechanical process by which the sensory organs detect and process stimuli. This is the primary distinction between sensation (physical processing of information) and perception (the psychological processing of interpreting and using that information).

- Some students may wonder why they are studying seemingly biological processes such as vision. These topics can seem more at home in anatomy or biology courses. In fact, it was a number of botanists and physiologists who first began the systematic investigation into the human sensory organs. For instance:

    - 1791: Luigi Galvani (from whom we get the term "Galvanic Skin Response" and who also partially inspired the novel Frankenstein) used frogs to identify the flow of electrical activity through the muscles and nervous system. This was a seminal study for understanding the mechanical foundations of the link between mental and physical processes (such as thinking and moving).
    - 1830: Ernst Heinrich Weber, a physiologist, used knitting needles dipped in carbon powder to identify "just noticeable differences" (the two points closest together on the skin that can still be distinguished from one another). In doing so he pioneered the field of human sensation/perception and research into the sense of touch.

- The answer to student concerns regarding why they are learning about biological processes is much the same as the answer as to why it is important for them to learn about the brain. The mechanical (i.e. physical) underpinnings of psychological processes are necessary for us to understand how thinking and emotions work. Imagine trying to study eyewitness testimony if you did not understand how eyes, or vision worked!

The Five Senses

- People constantly track sensory stimuli such as the direction and speed of movement or have their attention called by a sudden background noise. At a very fundamental level we use our classic five senses—seeing (vision), hearing (audition), smelling (olfaction), tasting, and touching—to receive information about the world around us. It is amazing that humans are specially equipped to take in stimuli, such as light or sound, and transform these into electrical signals that can be processed by the brain. Simply taking in the stimuli is "sensation" while processing it, understanding it, and using it to guide behavior is "perception."
- There are various ways to categorize senses. First, you can divide the 5 senses into "distance senses" and "contact senses." The former—including vision, hearing and olfaction—are the ability to sense at a distance. For the latter—taste and touch—a person must be in contact

with the stimuli for sensation to occur. Another categorization strategy is to parse out smell and taste, together, as "chemical senses." These two senses have specialized receptors that can convert environmental chemicals (tastants and odorants) into electrical signals that can be processed by the brain. It is also possible to break some senses into finer gradients. The sense of taste, for instance, is one overarching sense that includes more specific sensations (sweet, bitter, sour, salty, umami). Similarly, the sense of touch can be divided into sensitivity to pain, temperature, and texture. Finally, it is worth mentioning that the classic 5 senses are not the only senses. We also typically talk the vestibular system, which is implicated in the sense of balance and ability to locate the self in space. This ability to sense location might reasonably be thought of as a sixth sense.

Multi-modal Perception

- Multi-modal perception is, perhaps, the most overlooked aspect of sensation and perception as it is typically taught in high school and college courses. By necessity, we teach sensation parsed apart into the individual senses (touch, hearing, and so forth). But when perception occurs—when we make sense of these sensory inputs—the perception is more than the sum of its constituent parts.
- For example, when you witness a minor car accident you do not simply see the motion, hear the sound, and smell the odors of the accident. Instead, these sights, sounds and smells combine to create a mental image of what happened in the same way that a lasagna is more than just noodles, cheese, and sauce.
- The mingling of the senses can be seen, perhaps, most clearly in some well-known illusions: In the McGurk Effect a person's visual sensation influences the actual sounds they hear. Similarly, in the "rubber hand illusion" the combination of touch and sight can lead people to believe an artificial hand is their own!

Difficult Terms

Note: This module can seem formidable to students; largely because of the sheer volume of new and often difficult vocabulary words. Students may find it helpful if you define each term repeatedly when using it in lecture. We recommend openly addressing the potentially daunting amount of vocabulary and reassuring students that with effort and repetition they can learn it.

Difficult Terms

Absolute threshold
Agnosia
Anosmia
Audition
Auditory canal
Auditory hair cells
Binocular disparity
Binocular vision
Bottom-up processing
Chemical senses
Cochlea
Cones
Dark adaptation
Differential threshold (or just noticeable difference JND)
Dorsal pathway
Flavor
Gustation
Light adaptation
Mechanoreceptors
Multimodal perception
Nociception
Odorants
Olfaction
Olfactory epithelium
Opponent-process theory
Ossicles
Perception
Phantom limb
Phantom limb pain
Pinna
Primary auditory cortex
Primary somatosensory cortex
Primary visual cortex
Principle of inverse effectiveness
Retina
Rods

Sensation
Sensory adaptation
Shape theory of olfaction
Signal detection
Somatosensation
Somatotopic map
Sound waves
Superadditive effect of multisensory integration
Tastants
Taste receptor cells
Top-down processing
Transduction
Trichromatic theory
Tympanic membrane
Ventral pathway
Vestibular system
Weber's law

Lecture Frameworks

We recommend starting the class with a discussion that will engage students by bringing the module material into the realm of their everyday experience. Sensation and Perception is one module where students have ample personal life experience upon which to draw: they have all spit out unpleasant food, ducked out of the way of a flying object, or listened to beautiful music. You can begin by having students take stock of these personal experiences before going on to define sensation and perception, respectively, and articulating the difference between them. In addition, students can sometimes benefit from hearing why this topic is psychological in nature (as opposed to anatomical or biological). It can help to clarify the link between sensation (how stimuli gets inside your brain) to perception (how we make sense of the sensation) and other, higher-order psychological processes like motivation, relationships, and cognition.

Because of the volume of information in this module it is likely that you will teach this in two, rather than in a single, class session. If you do, we recommend teaching the overview material through the material on the sense of vision in one period, and in the second period cover: smell & taste, touch, hearing, vestibular system, and multi-modal perception. You can shift smaller learning units—such as the sense of touch—from one period to the other to balance your time according to your own scheduling needs.

- **Warmup:** Ask students to reflect on which of the 5 senses they would give up if they had to; this is especially effective when conducted in small groups. See Activities & Demonstrations below
- **Direct Instruction:**Refer to the PowerPoint slides for the following major topics: the distinction between sensation and perception. An easy example can be found in disagreements about music: if everyone senses the music in exactly the same way it is individualized perception that explains differences in musical taste.
- **Direct Instruction:** Refer to the PowerPoint slides to talk about signal detection and bottom-up versus top-down processing.
- **Direct Instruction:**Refer to the PowerPoint slides to talk about vision. Of all the senses there is, perhaps, the most to say about vision and it is possible to spend a large portion of a class period on this single topic. The main topics related to vision are: anatomy of the eye, depth perception, light and dark adaption, opponent process theory of color vision.
- **Activity/Demonstration:**To help students engage with the topic of vision you can have them hold a pen at arm's length and open each eye in turn (the pen appears to jump back and forth). This quick demonstration illustrates the way that binocular vision emerges from a combination of the monocular vision of each eye. You can also use the stimuli slides to demonstrate opponent process theory of color vision. See Power Point slides.
- **Direct Instruction:**Refer to the PowerPoint Slides to talk about hearing. The main topics include: anatomy of the inner ear, aspects of hearing such as pitch, timbre, and volume, and directional hearing.
- **Direct Instruction:**Refer to the PowerPoint Slides to talk about smell, taste, touch and the vestibular system.
- **Direct Instruction:**Refer to the PowerPoint Slides to talk about multi-modal perception. Of all topics typically taught in sensation/perception units this may be the least commonly addressed. Although it can be difficult to understand it can also produce "aha!" moments for students when they understand how the senses combine.

Activities & Demonstrations

Which sense could you live without?

- Time: 5-8 minutes
- Discussion: no materials required
- Directions:

1. Here, the instructor can have students work in small groups to discuss the question "If somehow you were forced to, which one sense would you give up?" This is an opportunity for students to reflect on the relative usefulness of all their senses, and also to appreciate individual differences in preferences. There are a variety of variations of this question, such as "how much money would it take for you to be willing to sacrifice this sense?" (students would write a monetary amount for each of the 5 senses; although some might be reluctant to write any amount!). You can also follow-up with an exploration of the ways life might be harder without this one sense (e.g. with no sense of smell a person could not detect spoiled food, would have limited ability to taste food, etc.)
2. Main Learning:
    - There may be some trends in preferences in which people generally place a premium on vision and hearing over smell.
    - All senses provide important information

Sensation versus Perception

- Time: 10 minutes
- Materials: Video "Skwerl" **https://www.youtube.com/watch?v=Vt4Dfa4fOEY** (Total run time: 4 minutes, although you can play the first 2 minutes 30 seconds for the same effect)
- Directions:

1. Show students 2.5 minutes or 4 minutes of the short film "Skwerl." This independent film project showcases what English might sound like to people who do not speak or understand English. Although the actors use some English words in their dialogue, these are randomly chosen words and are interspersed with non-sense words. The result is a conversation that English speakers will feel that they ought to be able to understand, but cannot. This film can be a powerful demonstration of how "hungry" the mind is to make sense out of stimuli (the difference between perception and sensation).
2. Instructions: Ask students to watch the film and pay particular attention to the language being used. After the video is over, have students present their reactions. Some will feel

as if they heard specific words, complete sentences, or whole meanings; others may feel that the words were made up. Consider using these questions as prompts for partner or large group discussion:

- What was the couple discussing while eating at the table?
- What percent of the words do you think were actually English? How similar is your answer to this question to that of other people in this class? If everyone heard the same words (sensation) why do we differ in our perception of those words?
- What was the relation of the two characters? Why do you think this (from sensations, or perceptions)?

3. Main Learning:

- Sensation is different from perception.
- People naturally try to make sense of sensations. When sensations are non-sensical—as in the case of the language used in this film—people try to "fill in meaning."
- The tendency to make meaning out of stimuli—to perceive sensations—suggests the usefulness of sensation.

Opponent Process Theory of Color Vision

After explaining the opponent process theory of color vision you can demonstrate this phenomenon.

- Time: 5 minutes
- Materials: Power Point Slides with (x2) "reverse images" as stimuli
- Directions:

After explaining the opponent process theory of color vision to your students you can use these two slides to demonstrate the phenomenon.

- Blue cross on red background: Instruct students to stare at the center of the cross for 25 seconds. It is okay of they accidentally blink but they should attempt to stare for as long as possible. Time them. At 25 seconds, tell them to continue staring at the white screen (you should click the Power Point at this time to advance to a blank, white screen). A reverse image should appear: a red cross on a blue background. Ask for student reactions.
- Reverse image of Girl with Pearl Earring portrait: Instruct students to stare at the center

of the portrait for 25 seconds. It is okay if they accidentally blink but they should attempt to stare for as long as possible. Time them. At 25 seconds, tell them to continue staring at the white screen (you should click the Power Point at this time to advance to a blank, white screen). A reverse image should slowly appear: the famous painting, in more detail, and with a different color scheme. Ask for student reactions.

Additional Activities

The Emission Theory of Vision

Although this widely-accepted theory of vision has been relegated to a historical footnote in modern times it was a common sense explanation that endured for more than a thousand years. Introducing it to students can offer them insight into their own assumptions as well as a fresh appreciation of how advanced and often times counterintuitive is the modern understanding of the world.

Today, people easily accept the fact that when we see an object-- a dog, a fingernail, spider-man-- it is really reflected light we are seeing. Natural light from the sun, or artificial light, bounces off the object and enters our eye. When you take time to reflect on this it quickly becomes apparent that this is an unusual, and counterintuitive way to explain vision. More sensible is the emission theory held by Plato and other noteworthy thinkers of antiquity.

In the Emission Theory of Vision light shoots out from the eye and lands on the object a person sees. It's a bit like superman's X-ray vision only instead of seeing through objects you simply see objects. This explanation is particularly sensible in the context of its earliest versions. For instance, the physician/scientist Empedocles believed that the goddess Athena created human eyes out of a combination of the 4 Greek elements (air, earth, fire and water) and infused eyes with the fundamental fires of the universe itself. To Empedocles, the eye was a small cosmic lantern in which a divine fire burned and was the source of all vision.

It should be readily apparent that this explanation has a few drawbacks, even if you were to accept concepts of elements, goddesses and universal fires. Chief among these, is the idea that people cannot see well in the dark. If sight emanates from within the eye day and night should not affect our ability to see. Later thinkers, including Plato, dealt with this pesky problem by suggesting that the inner light of the eye co-mingled with sunlight to produce vision.

You can read a brief Wikipedia article on the topic here:

https://en.wikipedia.org/wiki/Emission_theory_(vision)

Potential discussion questions for students:

A) Many people in the ancient world believed that sight emanated from the eye and shot out like a ray. You, a modern person, know better. You understand that sight is just the taking in of external light that reflects off of objects in the world around us and enters our eye. How would you disprove this ancient theory?

The Case of Neil Harbisson

Artist Neil Harbisson is best known, perhaps, for his widely viewed TED talk "I listen to color" (viewed more than 2 million times). In it, Harbisson describes being born completely color-blind, seeing the world only in gray scale. Harbisson describes how he senses the world and how he interprets sound as color. It is an extreme, unusual, and fascinating study of sensation and perception. Run Time: 9 and a half minutes.

https://www.youtube.com/watch?v=ygRNoieAnzI

Discussion Questions:

A) What are your reactions to this?

B) How would the world be different if everyone sensed in this way?

Outside Resources

Audio: Auditory Demonstrations from Richard Warren's lab at the University of Wisconsin, Milwaukee
http://www4.uwm.edu/APL/demonstrations.html

Audio: Auditory Demonstrations. CD published by the Acoustical Society of America (ASA). You can listen to the demonstrations here
http://www.feilding.net/sfuad/musi3012-01/demos/audio/

Book: Ackerman, D. (1990). A natural history of the senses. Vintage.
http://www.dianeackerman.com/a-natural-history-of-the-senses-by-diane-ackerman

Book: Sacks, O. (1998). The man who mistook his wife for a hat: And other clinical tales. Simon and Schuster.
http://www.oliversacks.com/books-by-oliver-sacks/man-mistook-wife-hat/

Video: Acquired knowledge and its impact on our three-dimensional interpretation of the world - 3D Street Art
https://youtu.be/GwNeukAmxJw

Video: Acquired knowledge and its impact on our three-dimensional interpretation of the world - Anamorphic Illusions
https://youtu.be/tBNHPk-Lnkk

Video: Cybersenses
https://www.youtube.com/watch?v=_8rPD6xLB4A

Video: Seeing Sound, Tasting Color
https://www.youtube.com/watch?v=FTr1VnXKr4A

Video: The Phantom Limb Phenomenon
https://www.youtube.com/watch?v=1mHIv5ToMTM

Web: A regularly updated website covering some of the amazing sensory capabilities of non-human animals.
http://phenomena.nationalgeographic.com/category/animal-senses/

Web: A special ringtone that is only audible to younger people.
https://www.youtube.com/watch?v=IrewnzQYrPI

Web: Amazing library with visual phenomena and optical illusions, explained
http://michaelbach.de/ot/index.html

Web: An article on the discoveries in echolocation: the use of sound in locating people and things
http://www.psychologicalscience.org/index.php/publications/observer/2015/december-15/using-sound-to-get-around.html

Web: An optical illusion demonstration the opponent-process theory of color vision.
https://www.youtube.com/watch?v=qA2brNUo7WA

Web: Anatomy of the eye
http://www.eyecareamerica.org/eyecare/anatomy/

Web: Animation showing tonotopic organization of the basilar membrane.
https://www.youtube.com/watch?v=dyenMluFaUw

Web: Best Illusion of the Year Contest website
http://illusionoftheyear.com/

Web: Demonstration of contrast gain adaptation
http://www.michaelbach.de/ot/lum_contrast-adapt/

Web: Demonstration of illusory contours and lateral inhibition. Mach bands
http://michaelbach.de/ot/lum-MachBands/index.html

Web: Demonstration of illusory contrast and lateral inhibition. The Hermann grid
http://michaelbach.de/ot/lum_herGrid/

Web: Demonstrations and illustrations of cochlear mechanics can be found here
http://lab.rockefeller.edu/hudspeth/graphicalSimulations

Web: Double Flash Illusion
https://vimeo.com/39138252

Web: Further information regarding what and where/how pathways
http://www.scholarpedia.org/article/What_and_where_pathways

Web: Great website with a large collection of optical illusions
http://www.michaelbach.de/ot/

Web: McGurk Effect Video
https://www.youtube.com/watch?v=G-lN8vWm3m0

Web: More demonstrations and illustrations of cochlear mechanics
http://www.neurophys.wisc.edu/animations/

Web: Scientific American Frontiers: Cybersenses
http://www.pbs.org/saf/1509/

Web: The Genetics of Taste
http://www.smithsonianmag.com/arts-culture/the-genetics-of-taste-88797110/?no-ist

Web: The Monell Chemical Sense Center website
http://www.monell.org/

Web: The Rubber Hand Illusion
https://www.youtube.com/watch?v=sxwn1w7MJvk

Web: The Tongue Map: Tasteless Myth Debunked
http://www.livescience.com/7113-tongue-map-tasteless-myth-debunked.html

Evidence-Based Teaching

Seeing the Light: A Classroom-Sized Pinhole Camera Demonstration for Teaching Vision

Prull, M. & Banks, W. (2005). Teaching of Psychology, 103-106.

Abstract

We describe a classroom-sized pinhole camera demonstration (camera obscura) designed to enhance students' learning of the visual system. The demonstration consists of a suspended rear-projection screen onto which the outside environment projects images through a small hole in a classroom window. Students can observe these images in a darkened classroom. Instructors can demonstrate the function of the lens and pupil and the structural basis for nearsightedness and farsightedness. Students who saw the demonstration as part of a lecture on the visual system learned more (i.e., showed greater performance gains from pretest to posttest) than a comparable group of students who received the lecture only. Students reacted favorably to the demonstration. These data suggest that incorporating the demonstration into class presentations on vision can improve student learning.

Problem-Based Group Activities for Teaching Sensation and

Perception

Kriener, D. S. (2009). Teaching of Psychology, 253-256.

Abstract

This article describes 14 problem-based group activities for a sensation and perception course. The intent was to provide opportunities for students to practice applying their knowledge to real-world problems related to course content. Student ratings of how effectively the activities helped them learn were variable but relatively high. Students rated their ability to apply their knowledge of sensation and perception to real-world issues substantially higher at the end of the course than at the beginning. Furthermore, student performance on an objective assessment of knowledge was significantly higher at the end of the semester than at the beginning. The results provide preliminary evidence that it is possible to develop an effective sensation and perception course that incorporates problem-based learning activities.

Suggestions from the Society for Teaching's Introductory Psychology Primer

POSSIBLE ASSESSMENTS

(Out of Class)

One common problem in sensation is the large amount of anatomical structures that must be learned. Students can help study these features by scrolling through interactive sites. These are great for independent knowledge acquisition and to gain familiarity with the anatomical structures.

- For the eye: http://www.lensshopper.com/eye-anatomy.asp
- For the ear: http://hyperphysics.phyastr.gsu.edu/hbase/sound/ear.html

Have students compare and contrast any two systems (i.e. vision vs. audition) to further reinforce the process of sensation. This helps students relate to the concept of sensation, perception and how it relates to all of our senses.

Assessing sensation and perception when one has suffered an injury or interruption in the process: Randomly assign a case study from "The Minds Eye" by Oliver Sacks. Students should be able to answer questions regarding the sensory or perceptual processes affected.

I also like to use an excerpt from the book, "Island of the Colorblind" by Oliver Sachs as a means of getting students to understand the concept of sensation and perception. You could also show them a video of these phenomena available on youtube. This is a 6 part series and will allow you to talk about sensation and perception as well as nature vs. nurture (if that is a theme in your classroom as it is in mine). The video or excerpt could be used in class or as an out of class assessment, possibly as a means to prepare for a potential essay topic.

- http://www.youtube.com/watch?v=CM06G26X-rQ

(In Class)

The brain uses the information it receives to piece together a fairly accurate representation of the external world. One method the brain uses to make meaning from the sensations it receives is through algorithms and past experiences; similar to the way we solve cryptograms. There are a number of websites where students can try their hand at solving these puzzles, such as http://www.cryptograms.org/play.php or http://www.rinkworks.com/brainfood/p/crypts1.shtml Students could either complete the same one or pick their own. Then have the class explain what rules of the English language they used, as well as what past experiences lead to the solution. This allows students to understand that the brain performs a similar task in perception. Students really enjoy this activity and it only takes a few minutes within a lecture. I use it to introduce perception.

ACTIVITIES & TECHNIQUES

(In Class)

Explain the process of perception using the neural "algorithms" within the brain.

Gestalt laws of organization:

- These organizational processes can be explained nicely using real examples from art. Students like this way to present perception because they can relate to the art and many have prior knowledge of the pieces I choose.

Related Background Readings (instructors):

- Verstegan, I. (2005). Arnheim, Gestalt, and Art, New York, NY: SpringerWeinNewYork. http://www.springerlink.com/content/978-3-211-28864-1/
- Arnheim, R. (1943). Gestalt and art. The Journal of Aesthetics and Art Criticism, 2, 71-75.
- Solso, R. L. (2005). The psychology of art and the evolution of the conscious brain. Cambridge, MA: MIT Press.

Illusions are a great resource to help explain perception because we are able to see the visual system attempting to correctly solve the puzzle and creating an inconsistent perception. These are easy to incorporate into a lecture (Most of them taking only a few minutes) and could also be used to assign as an out of class assessment. Michael Bach's website is a treasure trove of visual illusions. This site offers the most current scientific explanations for each illusion. You can select just the right illusion to incorporate into the lecture. What I like about his website is he gives the best explanation for why the illusion exists in a concise and straightforward way. http://www.michaelbach.de/ot/

- Color perception
- Depth Perception
- Auditory illusions are available to help students understand auditory perception. To help students understand how prior knowledge can affect perception use the sound files listed on the following website http://www.lifesci.sussex.ac.uk/home/Chris_Darwin/SWS/
- Taste illusions are easily created with food coloring and a food item. I have used orange juice before and it has worked nicely. Orange juice colored differently will have a profound effect on taste. I have students rate the three different drinks (which are really orange juice without any additive color, OJ with orange food coloring to make it darker, and OJ with a little red food coloring) on different characteristics-real orange taste, sweetness, bitterness, etc. Students will typically rate the three drinks differently. After the demo, I have them rate the taste of two glasses of water with orange and red added to show them that the taste of the orange juice was not physically affected by the addition of the food coloring. Instead, their taste was affected by the visual perception of the drinks. This works better if you have a small class. I have used it in a larger class as an opening activity before class begins and it requires about 8-10 minutes.
- Sensory thresholds and sensory adaptation
- Sensory adaptation: A number of different classroom activities are listed that can even be adapted depending on the time available in class. Note: I never seem to have enough

time to get to these activities because sensation and perception always require more time than I typically allocate.

- Based on O'Drobinak, D. M., & Woods, C. B. (2002). Compelling classroom demonstrations that link visual system anatomy, physiology, and behaviour. Advances in Physiology Education, 26, 204-209. http://advan.physiology.org/content/26/3/204.full.

(Out of Class)

Related Student Reading: I assign this outside of class as a way to get students thinking about perception and as a possible essay topic for an exam.

- Griggs, J. (2010). Windows to the mind. New Scientist, 34-39. smc.neuralcorrelate.com/files/inpressfiles/newscientist_100918.pdf

Many students are interested in subliminal advertising or subliminal persuasion. You could incorporate a discussion about the difference between the two. To get the ball rolling you could show them a video clip from Derren Brown (http://www.youtube.com/watch?v=f29kF1vZ62o).

- A good review of subliminal advertising is Broyles, S. (2006). Subliminal advertising and the perpetual popularity of playing to people's paranoia. Journal of Consumer Affairs, 40, 392-406.
- Subliminal perception occurs when our behavior is influenced by a stimulus below our threshold. What should be noted to the students is that subliminal perception occurs in highly controlled environments, usually in the lab. Note: I will oftentimes use this for an out of classroom assessment/homework assignment to get students to think critically.

RELEVANT TOP ARTICLES

(Annotated Bibliography)

Haws, L. & Oppy, B. J. (2002). Classroom demonstrations of auditory perception. *Teaching of*

Psychology, 29, 147-150.

When educators include sensation and perception into their introductory psychology course, vision is more oftentimes discussed with little or no coverage of audition. In this article, the

authors give four related demonstrations that allow students to experience auditory perception under different situations and can ultimately enhance the topic of perception in general.

Horner, D. T. (1997). Demonstrations of color perception and the importance of contours.

Teaching of Psychology, 24, 267-268.

This article is a great resource for helping students to understand how one theory of color vision is not enough to explain color processing and color perception. Using visual adaptation and afterimages, the article first explains a demonstration that supports the Young-Helmholtz trichromacy theory of color vision. Changing the stimulus slightly will begin to show that the Young-Helmholtz theory cannot explain every color perception we have. In this case, the opponent processing theory may help to better explain the after image experienced. The color theories are difficult to understand but including these demonstrations allows for a more active engagement in in the concept of color perception.

Links to ToPIX Materials

Activities, Demonstrations, Handouts, etc.:
http://topix.teachpsych.org/w/page/19981036/Sensation in the Classroom

Books & Films:
http://topix.teachpsych.org/w/page/39235989/Sensation-and-Perception

Video/Audio:
http://topix.teachpsych.org/w/page/19981024/Perception Video

Teaching Topics

Teaching The Most Important Course
https://nobaproject.com/documents/1_Teaching_The_Most_Important_Course.pdf

Content Coverage
https://nobaproject.com/documents/2_Content_Coverage.pdf

Motivating Students
https://nobaproject.com/documents/3_Motivating_Students_Tips.pdf

Engaging Large Classes
https://nobaproject.com/documents/4_Engaging_Large_Classes.pdf

Assessment Learning
https://nobaproject.com/documents/5_Assessment_Learning.pdf

Teaching Biological Psychology
https://nobaproject.com/documents/6_Teaching_Bio_Psych.pdf

PowerPoint Presentation

This module has an associated PowerPoint presentation. Download it at https://nobaproject.com//images/shared/supplement_editions/000/000/184/Sensation%20-and%20Perception.pptx?1529525392.

About Noba

The Diener Education Fund (DEF) is a non-profit organization founded with the mission of re-inventing higher education to serve the changing needs of students and professors. The initial focus of the DEF is on making information, especially of the type found in textbooks, widely available to people of all backgrounds. This mission is embodied in the Noba project.

Noba is an open and free online platform that provides high-quality, flexibly structured textbooks and educational materials. The goals of Noba are three-fold:

- To reduce financial burden on students by providing access to free educational content
- To provide instructors with a platform to customize educational content to better suit their curriculum
- To present material written by a collection of experts and authorities in the field

The Diener Education Fund is co-founded by Drs. Ed and Carol Diener. Ed is the Joseph Smiley Distinguished Professor of Psychology (Emeritus) at the University of Illinois. Carol Diener is the former director of the Mental Health Worker and the Juvenile Justice Programs at the University of Illinois. Both Ed and Carol are award- winning university teachers.

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