



Sensation & Perception

Chapter 6 Psy 12000.003

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Exam 1

- Top Score: 50
- Mean: 43.4
- Median: 44.5
- Mode: 44
- SD: 5.11
- Problems:
 - Start time screwed up for both; got resolved within 15 minutes
 - Duplicate question (my fault)
 - Wrong answers for 3rd graph question (changed within 15 minutes, only affected 5 students; their scores have been corrected)
- HELP LINE: 1-800-936-6899
- Suggestions:
 - No go back?
 - Others?

2

Announcement

- Participants Needed
 - \$10 to participate in experiment.
 - You (ask a friend, too)
- Contact: Eric Wesselmann
 - edwesse@psych.purdue.edu

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Sensation & Perception

How do we construct our representations of the external world?

- To represent the world, we must first detect physical energy (a stimulus) from the environment and convert it into neural signals. This is a process called **sensation**.
- Wilhelm Wundt: “Father of Experimental Psychology”
 - Introspectionism



When we select, organize, and interpret our sensations, the process is called **perception**.

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The Dark Restaurant

“I went to this restaurant in Berlin...”

- http://www.unsicht-bar.com/unsicht-bar-berlin-v2/en/html/home_1_idea.html

5

The Senses

- Traditional Five:
 - Sight
 - Hearing
 - Touch
 - Smell
 - Taste
- Six others that humans have
 - Nociception (pain)
 - Equilibrioception (balance)
 - Proprioception & Kinesthesia (joint motion and acceleration)
 - Sense of time
 - Thermoception (temperature)
 - Magnetoception (direction)

6

Bottom-up Processing

Analysis of the stimulus begins with the sense receptors and works up to the level of the brain and mind.



Letter "A" is really a black blotch broken down into features by the brain that we perceive as an "A."

7

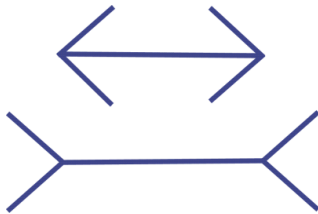
Top-Down Processing

Information processing guided by higher-level mental processes as we construct perceptions, drawing on our experience and expectations.

THE CAT

8

Top-Down or Bottom-Up?

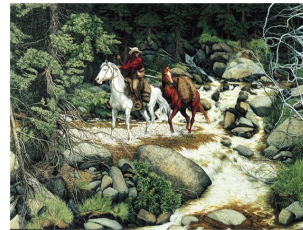


Learned depth cues make this a top down perceptual distortion

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Making Sense of Complexity

Our sensory and perceptual processes work together to help us sort out complex images.



"The Forest Has Eyes," Bev Doolittle

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Sensing the World

Senses suit an organism's needs, enabling survival.

A **frog** feeds on flying insects so visual acuity must be very sensitive;
a **male silkworm moth** is sensitive to female sex-attractant odor;
and we as **human beings** are sensitive to sound frequencies that represent the range of human voice.



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Exploring the Senses

- What stimuli cross our threshold for conscious awareness?
- Could we be influenced by stimuli too weak (subliminal) to be perceived?
- Why are we unaware of unchanging stimuli, like a band-aid on our skin?

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Psychophysics

A study of the relationship between physical characteristics of stimuli and our psychological experience with them.

Physical World	Psychological World
Light	Brightness
Sound	Volume
Pressure	Weight
Sugar	Sweet

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22nd October 1850

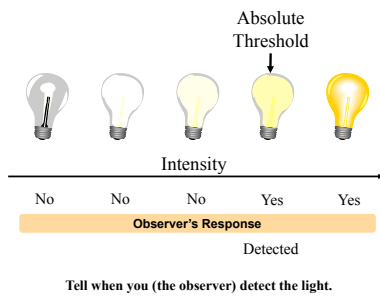
A relative increase in mental intensity, Fechner realized, might be measured in terms of the relative increase in physical energy required to bring it about.



Gustav Fechner
(1801-1887)

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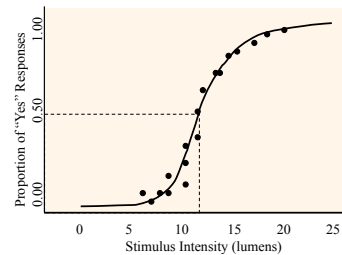
Detection



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Thresholds

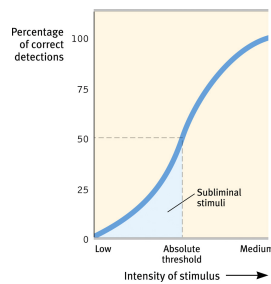
Absolute Threshold: Minimum stimulation needed for an individual to detect a particular stimulus 50% of the time.



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Subliminal Threshold

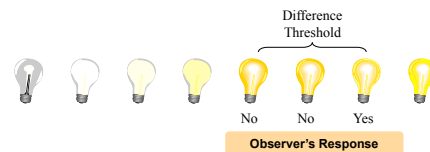
Subliminal Threshold: When stimuli are below one's absolute threshold for conscious awareness.



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Difference Threshold

Difference Threshold: Minimum difference between two stimuli required for detection 50% of the time, also called *just noticeable difference (JND)*.



Tell when you (observer) detect a difference in the light.

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Weber's Law

Two stimuli must differ by a constant minimum percentage (rather than a constant amount), to be perceived as different. Weber fraction: $k = \delta/I$.

Stimulus	Constant (k)
Light	8%
Weight	2%
Tone	3%

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Signal Detection Theory (SDT)

Predicts how and when we detect the presence of a faint stimulus (signal) amid background noise (other stimulation). SDT assumes that there is no single absolute threshold and detection depends on:

Person's experience
Expectations
Motivation
Level of fatigue



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SDT Matrix

The observer decides whether she hears the tone or not, based on the signal being present or not. This translates into four outcomes.

		Decision	
		Yes	No
Signal	Present	Hit	Miss
	Absent	False Alarm	Correct Rejection

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Sensory Adaptation

Diminished sensitivity as a consequence of constant stimulation.



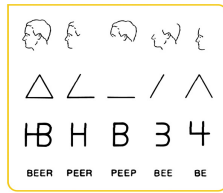
Put a band aid on your arm and after awhile you don't sense it.

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Now you see, now you don't



(a)



(b)

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Sensation without Perception

Video on Visual Prosopagnosia



Sense of Touch

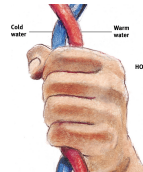
The sense of touch is a mix of four distinct skin senses —pressure, cold, warmth, and pain.



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Skin Senses

Only pressure has identifiable receptors. All other skin sensations are variations of pressure, warmth, cold and pain.



Burning hot



Pressure



Vibration



Vibration



Cold, warmth and pain

26

Touch Sensation/Perception

- The intense tickling sensation that makes you laugh uncontrollably...
 - Only happens when someone else tickles you
 - You cannot tickle yourself and get this response (Blakemore, et al., 2000)
- Why?



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Taste

Traditionally, taste sensations consisted of sweet, salty, sour, and bitter tastes. Recently, receptors for a fifth taste have been discovered called "Umami".



Sweet



Sour



Salty



Bitter



Umami
(Fresh Chicken)

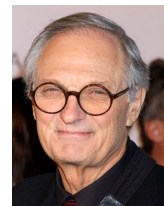
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Sensory Interaction

When one sense affects another sense, **sensory interaction** takes place. So, the taste of strawberry interacts with its smell and its texture on the tongue to produce flavor.

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Taste

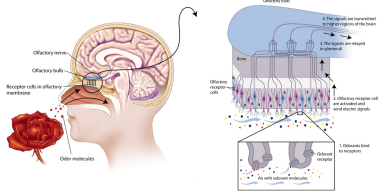


Scientific American Frontiers:
Tasters and Super-tasters

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Smell

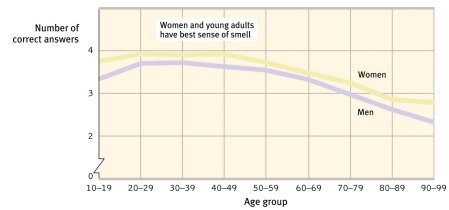
Like taste, smell is a chemical sense. Odorants enter the nasal cavity to stimulate 5 million receptors to sense smell. Unlike taste, there are many different forms of smell.



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Age, Gender, and Smell

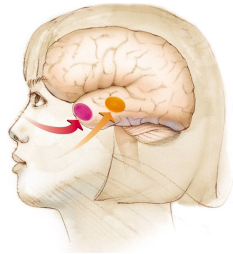
Ability to identify smell peaks during early adulthood, but steadily declines after that. Women are better at detecting odors than men.



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Smell and Memories

The brain region for smell (in red) is closely connected with the brain regions involved with memory (limbic system). That is why strong memories are made through the sense of smell.



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Example of Sensory Interaction Audition/Vision

Count the Fs:

FINISHED FILES ARE THE RESULTS
OF YEARS OF SCIENTIFIC STUDY
COMBINED WITH THE EXPERIENCE
OF YEARS.

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Pheromones, Odor, and Sweaty T-Shirts

- http://www.pbs.org/wgbh/evolution/library/01/6/I_016_08.html
- Adaptive to prefer mate with different immune system to one's own: MHC (major histocompatibility locus)
- Women preferred the scents of T-shirts worn by men whose MHC genes were different from their own.



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Vision

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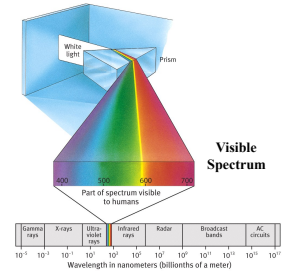
Transduction

In sensation, the transformation of stimulus energy into neural impulses.

Phototransduction: Conversion of light energy into neural impulses that the brain can understand.

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The Stimulus Input: Light Energy



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Light Characteristics

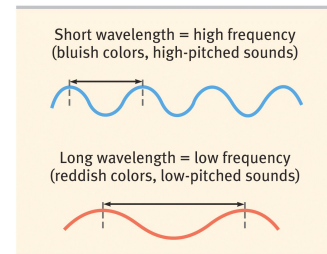
- Wavelength (hue/color)
- Intensity (brightness)
- Saturation (purity)

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Wavelength (Hue)

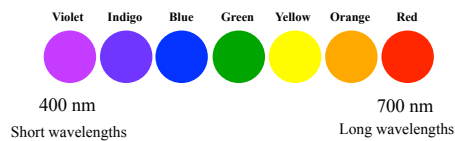
Hue (color) is the dimension of color determined by the wavelength of the light.

Wavelength is the distance from the peak of one wave to the peak of the next.



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Wavelength (Hue)

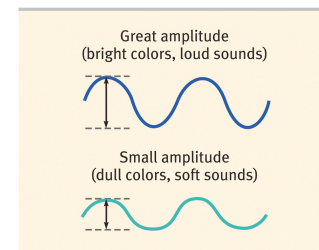


Different wavelengths of light result in different colors.

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Intensity (Brightness)

Intensity
Amount of energy in a wave determined by the amplitude. It is related to perceived brightness.



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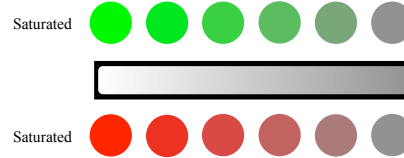
Intensity (Brightness)



Blue color with varying levels of intensity. As intensity increases or decreases, blue color looks more “washed out” or “darkened.”

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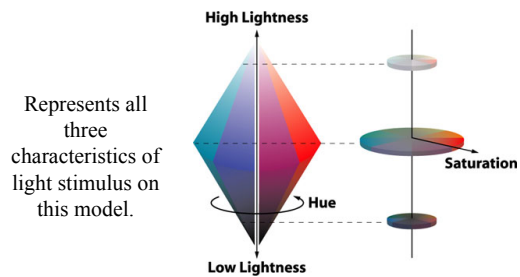
Purity (Saturation)



Monochromatic light added to green and red makes them less saturated.

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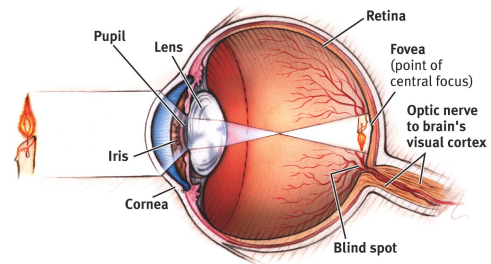
Color Solid



<http://www.visionconnection.org>

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The Eye



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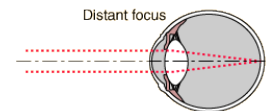
Parts of the eye

1. **Cornea:** Transparent tissue where light enters the eye.
2. **Iris:** Muscle that expands and contracts to change the size of the opening (pupil) for light.
3. **Lens:** Focuses the light rays on the retina.
4. **Retina:** Contains sensory receptors that process visual information and sends it to the brain.

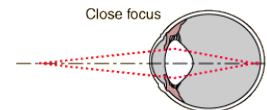
47

The Lens

Lens: Transparent structure behind the pupil that changes shape to focus images on the retina.



Accommodation: The process by which the eye's lens changes shape to help focus near or far objects on the retina.

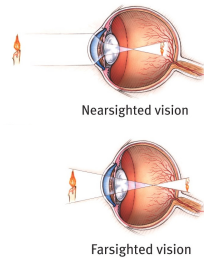


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The Lens

Nearsightedness: A condition in which nearby objects are seen more clearly than distant objects.

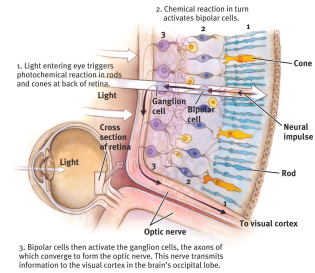
Farsightedness: A condition in which faraway objects are seen more clearly than near objects.



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Retina

Retina: The light-sensitive inner surface of the eye, containing receptor rods and cones in addition to layers of other neurons (bipolar, ganglion cells) that process visual information.



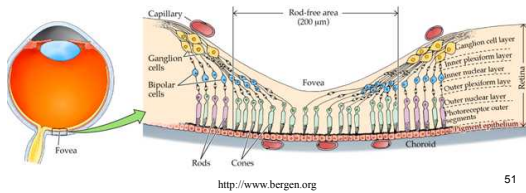
50

Optic Nerve, Blind Spot & Fovea

Optic nerve: Carries neural impulses from the eye to the brain.

Blind Spot: Point where the optic nerve leaves the eye because there are no receptor cells located there. This creates a blind spot.

Fovea: Central point in the retina around which the eye's cones cluster.



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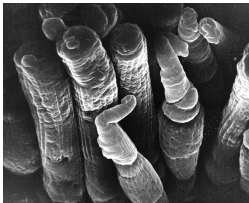
Test your Blind Spot

Use your textbook. Close your left eye, and fixate your right eye on the black dot. Move the page towards your eye and away from your eye. At some point the car on the right will disappear due to a blind spot.



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Photoreceptors



E.R. Lewis, Y.Y. Zeevi, F.S. Werblin, 1969

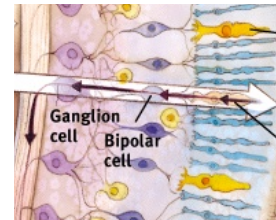
RECEPTORS IN THE HUMAN EYE

	Cones	Rods
Number	6 million	120 million
Location in retina	Center	Periphery
Sensitivity in dim light	Low	High
Color sensitive?	Yes	No
Detail sensitive?	Yes	No

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Bipolar & Ganglion Cells

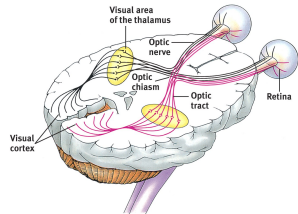
Bipolar cells receive messages from photoreceptors and transmit them to ganglion cells, which are for the optic nerve.



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Visual Information Processing

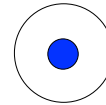
Optic nerves connect to the thalamus in the middle of the brain, and the thalamus connects to the visual cortex.



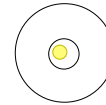
55

Ganglion & Thalamic Cells

Retinal ganglion cells and thalamic neurons break down visual stimuli into small components and have receptive fields with center-surround organization.



ON-center OFF-Surround

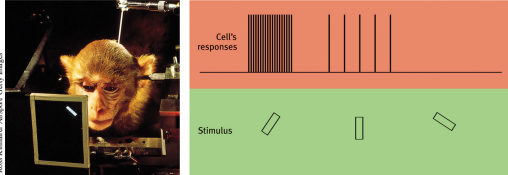


Action Potentials

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Feature Detection

Nerve cells in the visual cortex respond to specific features, such as edges, angles, and movement.



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Shape Detection

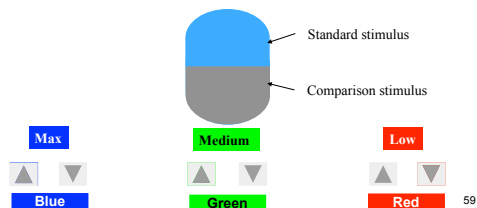
Specific combinations of temporal lobe activity occur as people look at shoes, faces, chairs and houses.



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Theories of Color Vision

Trichromatic theory: Based on behavioral experiments, Helmholtz suggested that the retina should contain three receptors that are sensitive to red, blue and green colors.



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Subtraction of Colors

If three primary colors (pigments) are mixed, subtraction of all wavelengths occurs and the color black is the result.

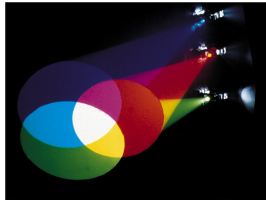


Subtractive color mixing

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Addition of Colors

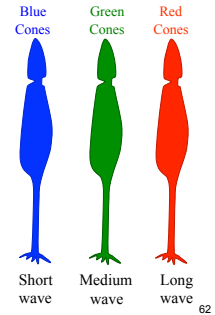
If three primary colors (lights) are mixed, the wavelengths are added and the color white is the result.



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Photoreceptors: Trichromatic Theory

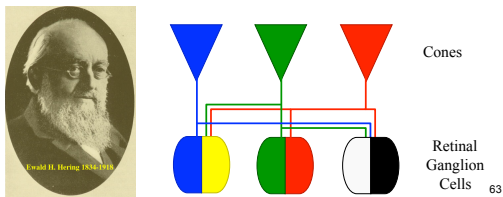
MacNichol, Wald and Brown (1967) measured directly the absorption spectra of visual pigments of single cones obtained from the retinas of humans.



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Opponent Process Theory

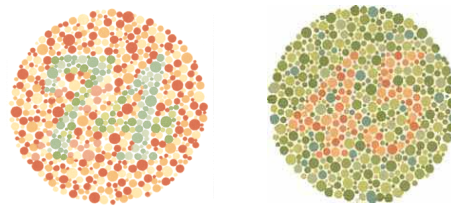
Hering proposed that we process four primary colors combined in pairs of red-green, blue-yellow, and black-white.



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Color Blindness

Genetic disorder in which people are blind to green or red colors. This supports the Trichromatic theory.



Ishihara Test

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Opponent Colors

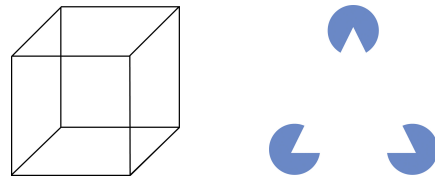


Gaze at the middle of the flag for about 30 Seconds. When it disappears, stare at the dot and report whether or not you see Britain's flag.

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Perception in Brain

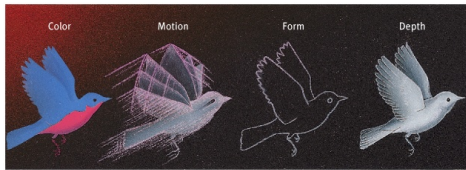
Our perceptions are a combination of sensory (bottom-up) and cognitive (top-down) processes.



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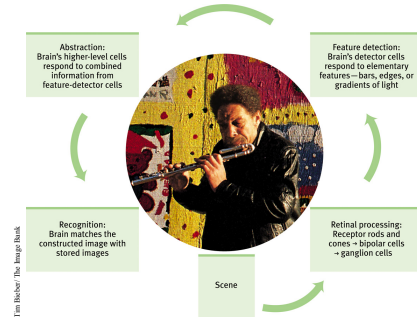
Visual Information Processing

Processing of several aspects of the stimulus simultaneously is called **parallel processing**. The brain divides a visual scene into subdivisions such as color, depth, form and movement etc.



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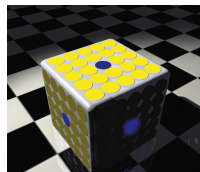
From Sensation to Recognition



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Color Constancy

Color of an object remains the same under different illuminations. However, when context changes the color of an object may look different.



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Change Blindness

- Phenomenon that occurs when a person viewing a visual scene apparently fails to detect large changes in the scene.
- The change typically has to coincide with some visual disruption (saccade: eye movement) or a brief obscuration of the observed scene or image.
- Memory (short term) may be involved.



<http://www.youtube.com/watch?v=0qrANix7y2E>

McConkie & Currie (1996)

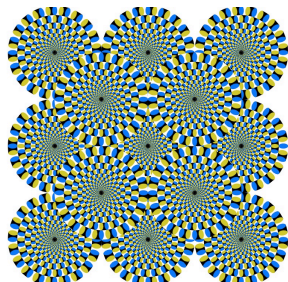
<http://nivea.psychology.univ-paris5.fr/ECS/ECS-CB.html>

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Visual Illusions

- <http://www.michaelbach.de/oi/>

More on this in next lecture....



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Audition

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The Stimulus Input: Sound Waves

Sound waves are composed of compression (more dense) and rarefaction (less dense) of air molecules.



Acoustical transduction: Conversion of sound waves into neural impulses in the hair cells of the inner ear.

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Sound Characteristics

Physical (psychological)

- Frequency (pitch)
- Intensity (loudness)
- Quality (timbre)

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Frequency (Pitch)

Frequency (pitch): The dimension of frequency determined by the wavelength of sound.

Wavelength: The distance from the peak of one wave to the peak of the next.

Short wavelength = high frequency
(bluish colors, high-pitched sounds)



Long wavelength = low frequency
(reddish colors, low-pitched sounds)



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Intensity (Loudness)

Intensity (Loudness): Amount of energy in a wave, determined by the amplitude, relates to the perceived loudness.

Great amplitude
(bright colors, loud sounds)

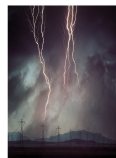
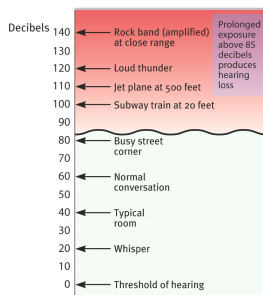


Small amplitude
(dull colors, soft sounds)



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Loudness of Sound



120dB



70dB

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Quality (Timbre)

Quality (Timbre): Characteristics of sound from a zither and a guitar allows the ear to distinguish between the two.



Zither

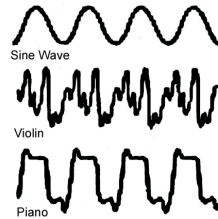


Guitar

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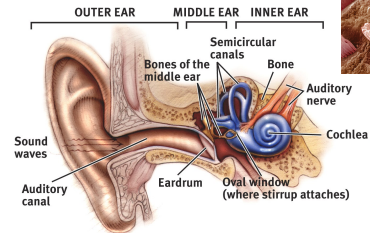
Overtones

Overtones: Makes the distinction among musical instruments possible.



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The Ear



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The Ear

Outer Ear: Pinna. Collects sounds.

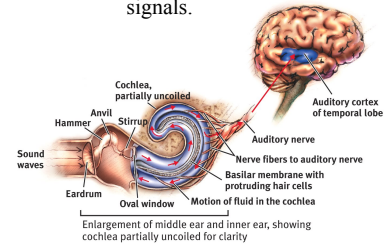
Middle Ear: Chamber between eardrum and cochlea containing three tiny bones (hammer, anvil, stirrup) that concentrate the vibrations of the eardrum on the cochlea's oval window.

Inner Ear: Innermost part of the ear, containing the cochlea, semicircular canals, and vestibular sacs.

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Cochlea

Cochlea: Coiled, bony, fluid-filled tube in the inner ear that transforms sound vibrations to auditory signals.

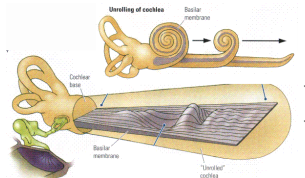


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Theories of Audition

Place Theory suggests that sound frequencies stimulate the basilar membrane at specific places resulting in perceived pitch.

Can not explain low frequencies



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Theories of Audition

Frequency Theory states that the rate of nerve impulses traveling up the auditory nerve matches the frequency of a tone, thus enabling us to sense its pitch.

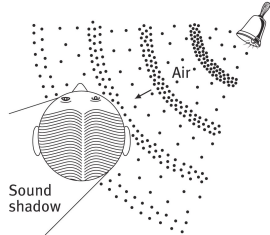


Can not explain high frequencies

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Localization of Sounds

Because we have two ears, sounds that reach one ear faster than the other ear cause us to localize the sound.



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Localization of Sound

1. Intensity differences
2. Time differences

Time differences as small as 1/100,000 of a second can cause us to localize sound. The head acts as a “shadow” or partial sound barrier.

86

Hearing Loss

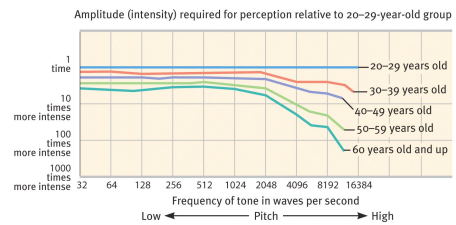
Conduction Hearing Loss: Hearing loss caused by damage to the mechanical system that conducts sound waves to the cochlea.

Sensorineural Hearing Loss: Hearing loss caused by damage to the cochlea’s receptor cells or to the auditory nerve, also called nerve deafness.

87

Hearing Deficits

Older people tend to hear low frequencies well but suffer hearing loss when listening for high frequencies.



88

BREAKING NEWS: Haitian judge recommends that 10 detained American missionaries be released

Technology & science | Wireless | Sponsored by Sprint

Students find ring tone adults can't hear
High-pitched "Mosquito" originally created to dispense youngsters

NEW YORK — Students are using a new ring (tone) to receive messages in class — and many teachers can't even hear the ring. Some students are downloading a ring tone off the Internet that is too high-pitched to be heard by most adults.

With it, high schoolers can receive text message alerts on their cell phones without the teacher knowing.

Ring tones for young and old: June 12, 2006. Available on: Only Johnson talks to MSNBC-TV's Chris Jaramola on a high-pitched mobile phone ring tone that only young ears can hear. MSNBC.

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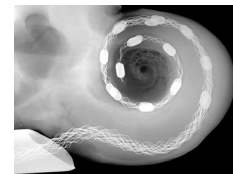
89

Deaf Culture

Cochlear implants are electronic devices that enable the brain to hear sounds.



Deaf Musician



Cochlear Implant

90

PAIN

91

Pain

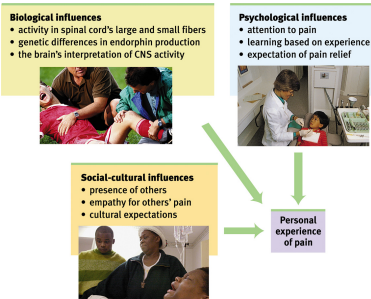
Pain tells the body that something has gone wrong. Usually pain results from damage to the skin and other tissues. A rare disease exists in which the afflicted person feels no pain. (CIPA: Congenital Insensitivity to Pain)



Ashley Blocker (right) feels neither pain nor extreme hot or cold.

92

Biopsychosocial Influences



93

Gate-Control Theory

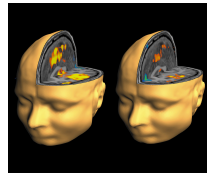
Melzack and Wall (1965, 1983) proposed that our spinal cord contains neurological "gates" that either block pain or allow it to be sensed.



94

Pain Control

Pain can be controlled by a number of therapies including, drugs, surgery, acupuncture, exercise, hypnosis, and even thought distraction.



95

Body Position and Movement

The sense of our body parts' position and movement is called **kinesthesia**. The **vestibular sense** monitors the head (and body's) position.



Whirling Dervishes



Wire Walk

96