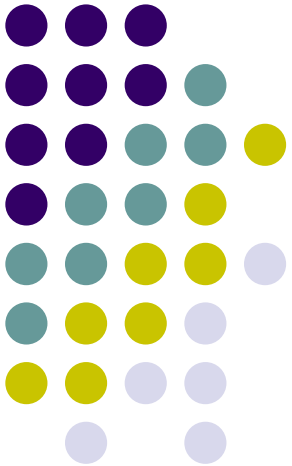
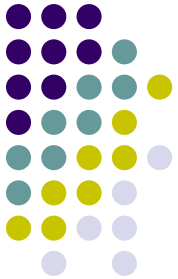
Sensation and Perception

AP Psychology: An Introduction



Chapter Objectives:



- AP students in psychology should be able to do the following:
- Discuss basic principles of sensory transduction, including absolute threshold,difference threshold, signal detection, and sensory adaptation.
- Describe sensory processes (e.g., hearing, vision, touch, taste, smell, vestibular, kinesthesis, pain), including the specific nature of energy transduction, relevant anatomical structures, and specialized pathways in the brain for each of the senses.
- Explain common sensory disorders (e.g., visual and hearing impairments).
- Describe general principles of organizing and integrating sensation to promote stable awareness of the external world (e.g., Gestalt principles, depth perception).
- Discuss how experience and culture can influence perceptual processes (e.g., perceptual set, context effects).
- Explain the role of top-down processing in producing vulnerability to illusion.
- Discuss the role of attention in behavior.
- Challenge common beliefs in para-psychological phenomena.
- Identify the major historical figures in sensation and perception (e.g., Gustav Fechner, David Hubel, Ernst Weber, Torsten Wiesel).

Lesson One: Objectives

By the end of this lesson, I will be able to:

- 1. Discuss basic principles of sensory transduction, including absolute threshold, difference threshold, signal detection, and sensory adaptation.

This is my favorite sport to watch:

0%	1.	Baseball
0%	2.	Basketball
0%	3.	Football
0%	4.	Hockey
0%	5.	Golf
0%	6.	Track / Cross Country
0%	7.	Soccer
0%	8.	Tennis
0%	9.	Volleyball
0%	10.	Hey! My favorite sport isn't up here!

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How do you perceive the world around you?

- We understand the world through our senses.
- Two basic processes make up our experience in this world:
  - **Sensation:** Gathering information
  - **Perception:** Interpreting information

The Detection Question – Absolute Threshold:

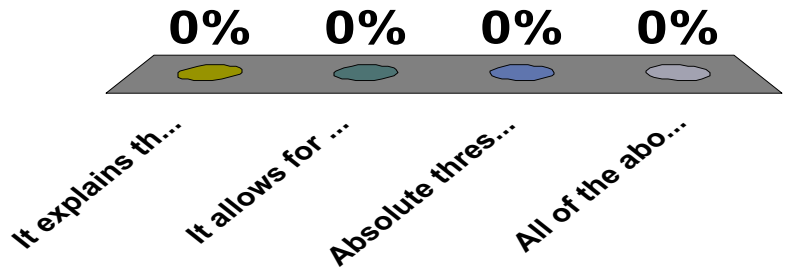
- **Absolute threshold** is the weakest level of stimulus that can be detected 50% of the time.
  - **Examples:**
- 1. candle flame seen at 30 miles on a dark clear night
- 2. Tick of a watch under quiet conditions at 20 feet.
- 3. 1 teaspoon of sugar in 2 gallons of water.

What do you think about this?

- Do you think you taste ½ a teaspoon of sugar in a cup of water?
- Do you really taste it or do you just WANT to taste it?
- Is everyone a bit different with their detection abilities?
- Yes
- **Signal detection theory** – There is no absolute threshold – fatigue, motivation, and expectations can change this.

Why does signal detection theory appear to be more credible than absolute threshold theory?

1. It explains that people can have different abilities depending on the situation
2. It allows for human error
3. Absolute threshold may only apply to younger people
4. All of the above



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Subliminal Messages!

- **Subliminal stimulus** is one that is detected only up to 49% of the time.
- **Example**: If a person turns up your IPOD just a hair, you probably will not hear the difference (even though there is one)
- **Subliminal messages** are perceived below your absolute threshold.

Subliminal Messages:

- Subliminal techniques have occasionally been used in advertising, propaganda, and even music.
- The purpose, effectiveness, and the frequency of the application of such techniques is debated.

The Difference Question – Just noticeable difference:

- A **difference threshold** is the minimum difference between two stimuli that is detected 50% of the time. This is also called….
- **Just-noticeable difference**
  Example: Car stereo – how much do you have to turn up the volume to notice a "real" difference?

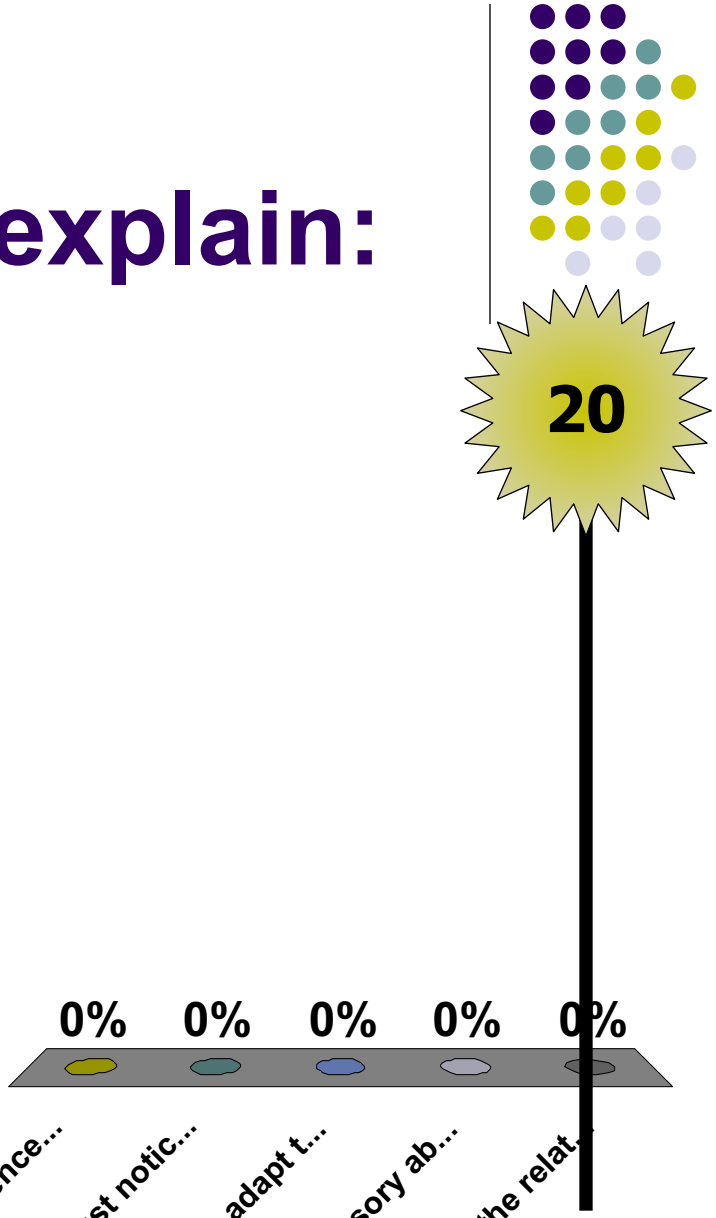
Weber's Law:

I don't think this guy understands Weber's Law!

- **Weber's Law**
  –Difference thresholds increase in proportion to the size of the stimulus.
- **Example**: When you are in a noisy environment you must shout to be heard while a whisper works in a quiet room.

Weber's Law aims to explain:

1. The difference between two thresholds
2. The just noticeable difference between multiple thresholds
3. How we adapt to our surroundings
4. The sensory abilities of people are the same
5. Show the relationship between sensation and perception



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Sensory Adaptation:

- **Sensory adaptation** is the disappearance to repetitive or unchanging stimuli
- Think about a hot tub – when you first get in, you think it is really hot. But after a few minutes it feels normal.

Lesson Two: Objectives

- By the end of this lesson I will be able to:
- 1. Describe sensory processes (e.g., hearing, vision, touch, taste, smell, vestibular, kinesthesis, pain), including the specific nature of energy transduction, relevant anatomical structures, and specialized pathways in the brain for each of the senses.
- 2. Explain common sensory disorders (e.g., visual and hearing impairments).

Hearing 101:

- Sight will always been our most used sense, though hearing is a close second
- Hearing (**audition**) is most helpful for language transmission
- So, how does the process of hearing work?
- Let's find out!

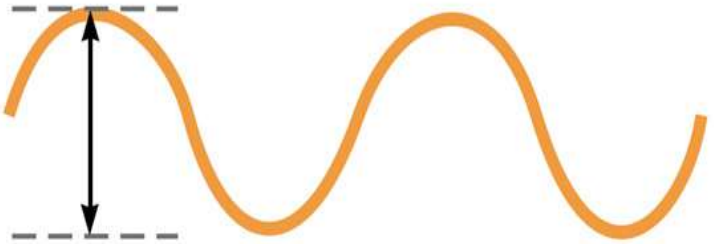
The science behind hearing

- **Sound waves** - result from the mechanical vibration of molecules from your vocal chords or from a musical instrument / other source.
- The compressed vibrations move through the air and then move apart.
- The compression and expansion is equal to one cycle of a sound wave.

A Typical Waveform and Its Characteristics

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

Great amplitude
(bright colors, loud sounds)



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

Small amplitude
(dull colors, soft sounds)

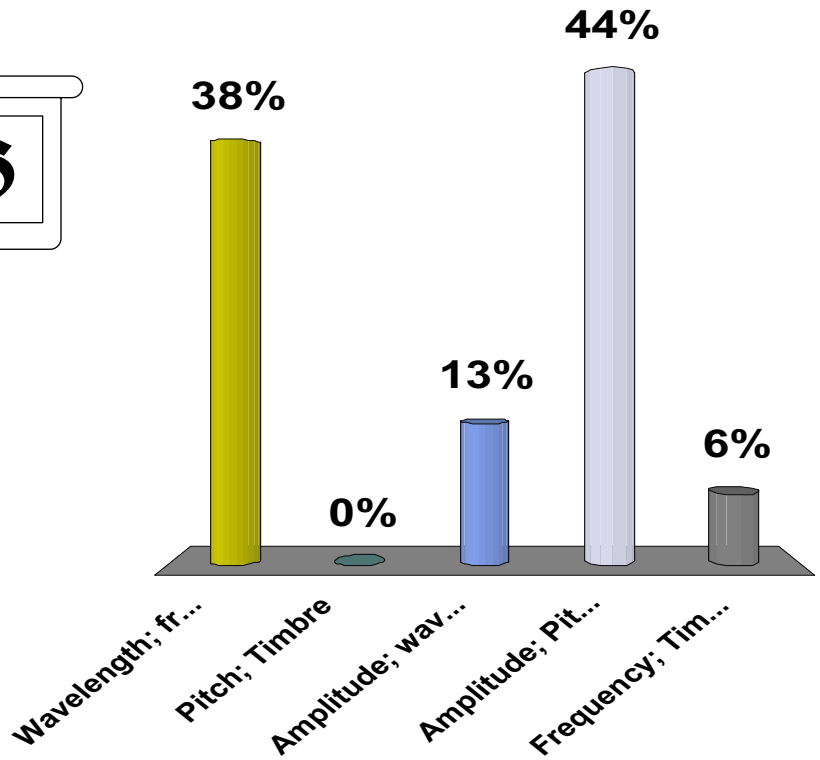
Physical Characteristics of Sound Waves

Milford Sound – NZ

- **Wavelength** - distance in one cycle of a wave, from one crest to the next
- **Amplitude** is the amount of energy in a wave, its intensity, which is the height of the wave at its crest (dB)
- **Frequency** is the number of times a sound wave cycles in one second
- **Pitch –** The highness or lowness of the sound (Hz)
- **Timbre** (pronounced “TAM-bur”)
  - The distinguishing quality of sound
  - Can you tell the difference between a trumpet playing a C# and a guitar playing a C#?

Decibels are to____ as Hertz are to_____.

1. Wavelength; frequency
2. Pitch; Timbre
3. Amplitude; wavelength
4. Amplitude; Pitch
5. Frequency; Timbre



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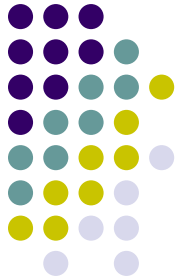
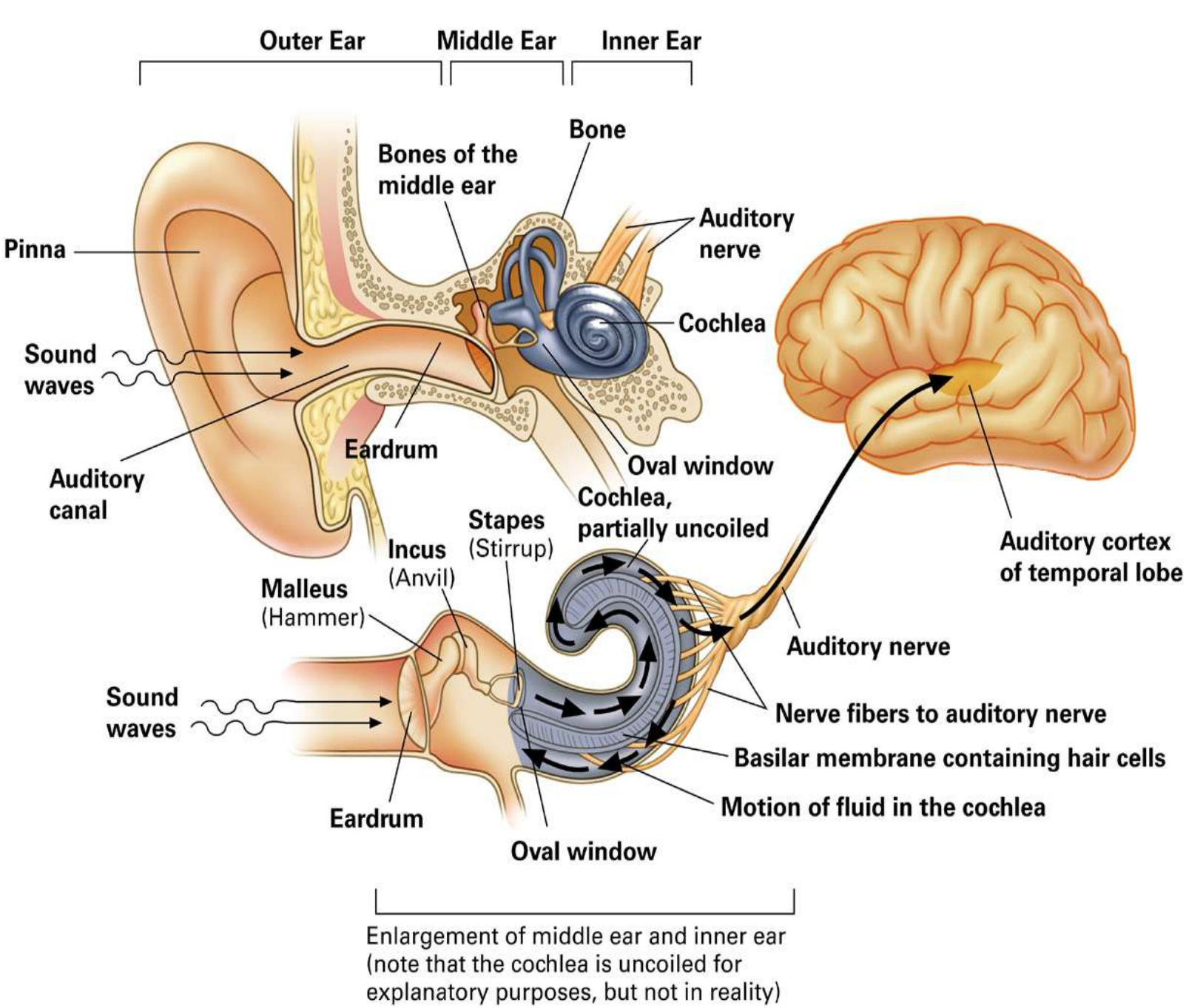
What does the ear do with sound – WARNING – this is cool!

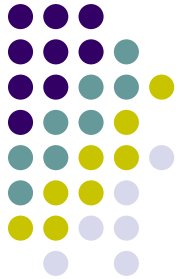


- When you “hear” a sound, your ear picks up the sound waves and converts them into neural impulses that you perceive as music or language.
- **Transduction** – The transformation of stimulus energy to the electrochemical energy of neural impulses.
- Now what? – we are going to learn the exact process that your ear completes in order to understand sound.



Enlargement of middle ear and inner ear (note that the cochlea is uncoiled for explanatory purposes, but not in reality)

The Journey of Sound!



- 1. Your outer ear (Pinna) channels sound waves to the eardrum (typanum)
- 2. This causes three tiny bones called the ossicles (hammer, anvil, stirrup) in your middle ear to vibrate
- 3. The vibrating stirrup pushes against the oval window of the cochlea in the inner ear
- 4. Inside the cochlea is the basilar membrane with hair cells that are bent by the vibrations and transduce this mechanical energy to electrochemical neural impulses.
- 5. Finally, auditory neurons stimulate the auditory nerve which transmits sound messages through your medulla, pons, and thalamus to the auditory cortex of the temporal lobes.

The process by which sensory information is converted into neural energy is called:

0%	1. Conversion
0%	2. Emersion
0%	3. Emersion
100%	4. Transduction
0%	5. Transformation

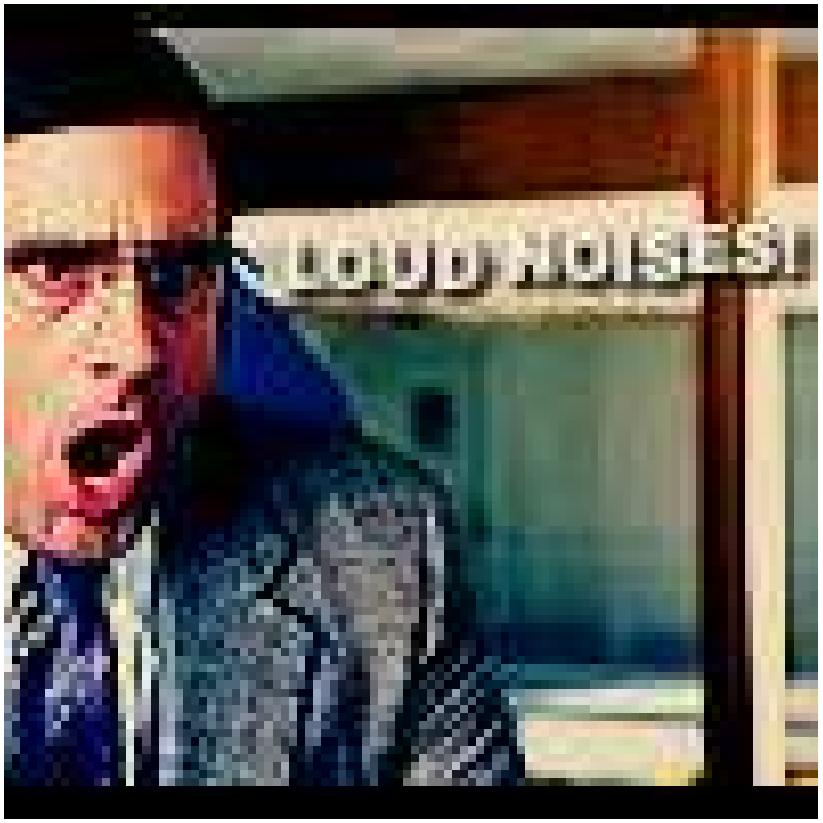
Locating Sounds:

- **Sound Localization** – the process by which you determine the location of a sound.
- There is a split second delay on sounds that are coming at you from the left or right side because both ears hear the sound differently.
- The brain then sorts out the difference (parallel processing)

Determining Pitch:

- Ever hear of someone with perfect pitch?
- **Place Theory** – The position on the basilar membrane at which waves reach their peak depends on the frequency of a tone. (structure)
- **Frequency Theory** – The rate of the neural impulse traveling up the auditory nerve matches the frequency of a tone, enabling you to sense it's pitch. (neural)

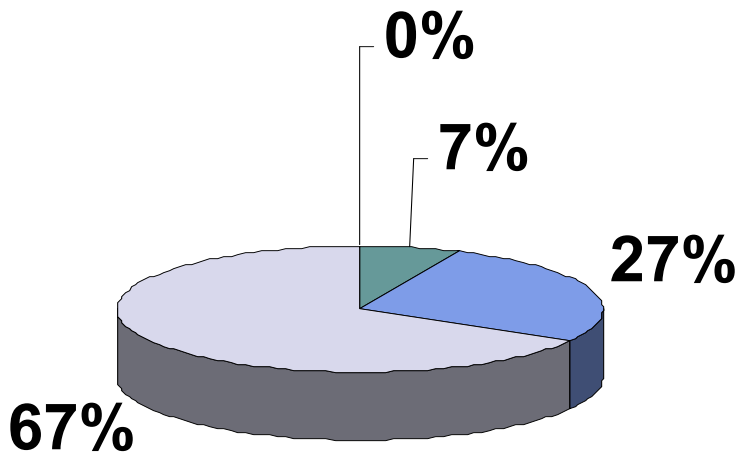
Loud Noises!! – Hearing Loss



- **Conduction deafness** - you damage your ear (physically) and you have trouble hearing because your ossicles have trouble vibrating.
- A conventional hearing aid can help
- **Nerve / Sensorineural deafness** – can occur from aging, disease, or continued exposure to loud noise – these all damage the hair cells in the basilar membrane
- cochlear implant can help

Seventy-five-year-old Claude has difficulty hearing high-pitched sounds. Most likely his hearing problem involves:

1. His eardrum
2. His auditory canal
3. The bones of his middle ear
4. The hair cells of his inner ear ✓



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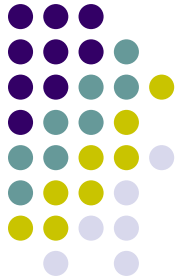
Cochlear Implant:

Lesson Two: Objectives (cont)



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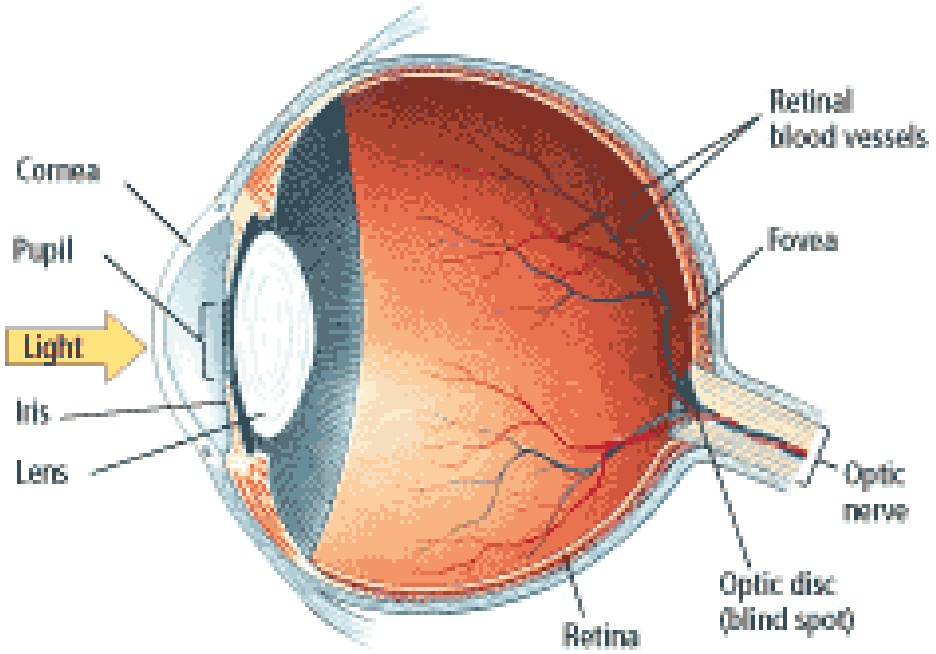
An Eye on the World



- Cornea
  - Protects eye and bends light toward lens.
- Lens
  - Focuses on objects by changing shape.
- Iris
  - Controls amount of light that gets into eye.
- Pupil
  - Widens or dilates to let in more light.

An Eye on the World

Robbie: You hit two cones back there. Those could have been people... they could have been guests at her wedding!
Sammy: They were *cones*!

- Retina
  - Neural tissue lining the back of the eyeball's interior, which contains the receptors for vision.
- Rods
  - Visual receptors that respond to dim light.
- Cones
  - Visual receptors involved in color vision.
  - Most humans have 3 types of cones.

Near and Far Sightedness:

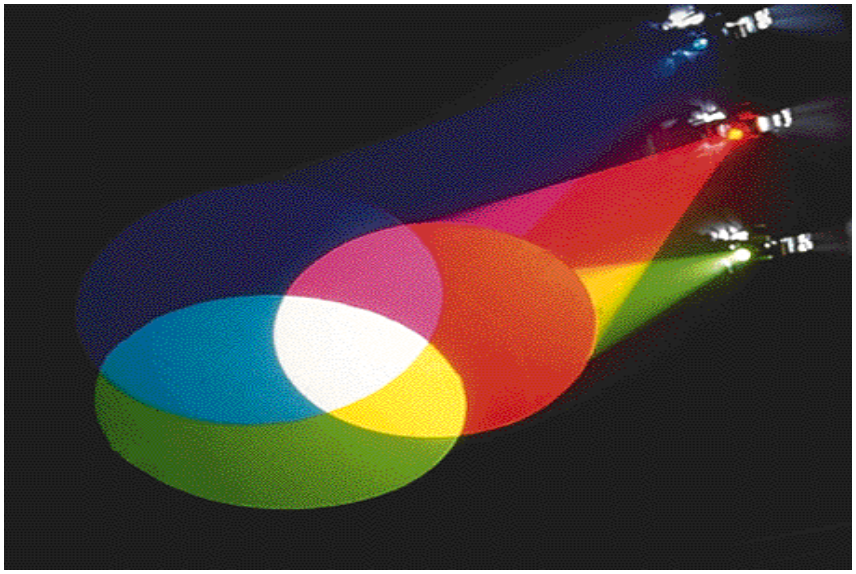
- Near and Far sighted people both have issues with the curvature of their cornea and/or lens and how the image is focuses on the retina
- **Near sighted** – too much curvature of the cornea and/or lens so nearby objects are seen more clearly than distant objects
- **Far sighted** – too little curvature of the cornea and/or lens so distant objects are seen more clearly than nearby ones
- Astigmatism – an irregularity in the shape of the cornea and/or lens which distorts and blurs the image at the retina

More about the eye:

- Many types of neurons help to transmit the images that you “see”
- Ganglion cells converge to form the optic nerve of each eye
- Where the optic nerve exits the retina, there are no rods or cones – this is your blind spot
- You also have special neurons called **feature detectors** that help you to distinguish contours, orientation, and basic shape
- Feature detectors are what is fooled by optical illusions

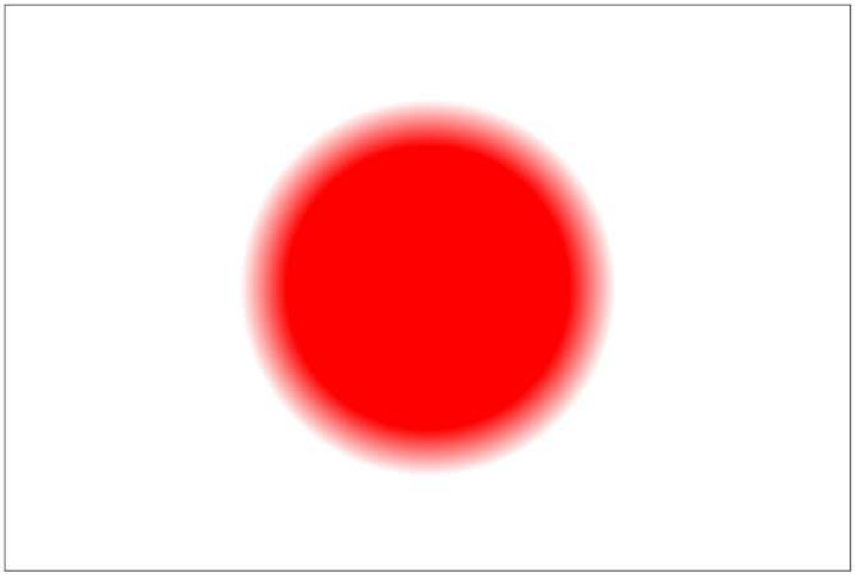

Discovery
EDUCATION

Trichromatic Theory



- Young (1802) & von Helmholtz (1852) both proposed that the eye detects 3 primary colors:
  - red, blue, & green
- All other colors can be derived by combining these three.

Opponent-Process Theory

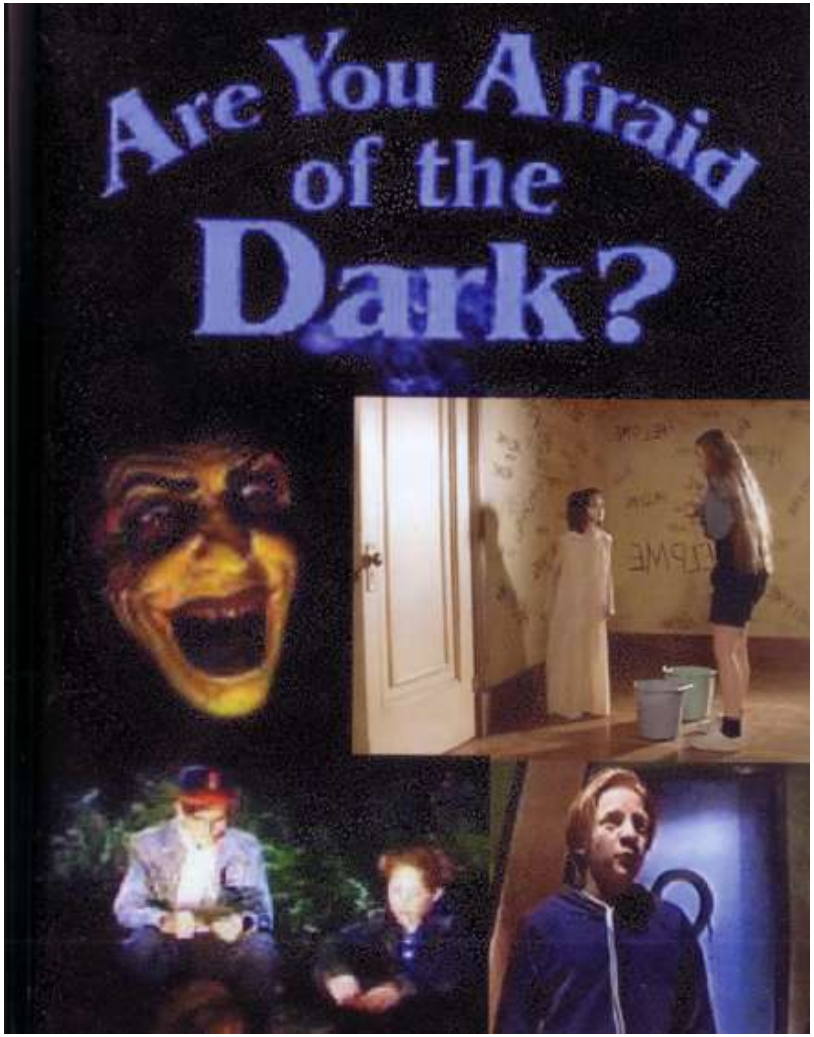


- Perception is controlled by the activity of two opponent systems (Ewald Hering)
- Certain neurons can either be excited or inhibited depending on the wavelength of light
- Complimentary wavelengths have opposite effects
- So – we can see a negative after image

Dark Adaptation:

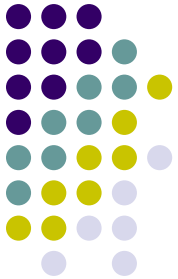
- Try and recall the last time you went from a very bright area to a dim one.
- Remember how difficult it was to see for several minutes just after you went indoors?
- This is an example of dark adaptation.

More about Dark Adaptation:



- As we enter a dark room, our photopigments are basically regenerating.
- This effect is most sensitive after 30 minutes of dark exposure.
- Also, all the rod pigments have been bleached out due to the bright light and the rods are initially nonfunctional.

Lesson Three Objectives:



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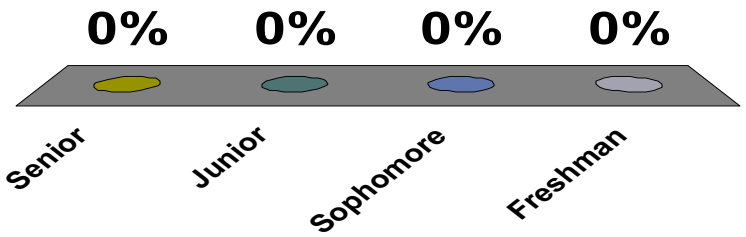
- 2. Discuss how experience and culture can influence perceptual processes (e.g., perceptual set, context effects).
- 3. Explain the role of top-down processing in producing vulnerability to illusion.
- 4. Discuss the role of attention in behavior.

The following has been my easiest year of high school:

1. Senior
2. Junior
3. Sophomore
4. Freshman



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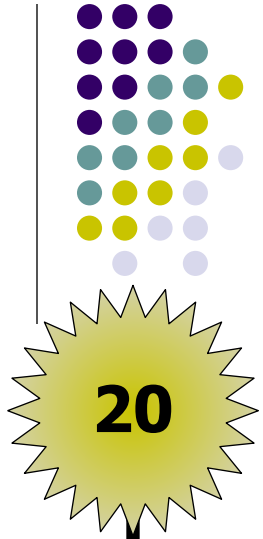
Perceptual Processes:

- When you see something, your brain looks for constancies and simplicity.
- **Schemas** – framework of basic ideas and preconceptions about people, objects, and events based on past experience and long-term memory.
- **Assimilation** – How we incorporate new information into our existing schemas (distorted guitar – Hendrix)
- **Accommodation** – How we modify our schemas to fit new information (babies – not all people fit the schema of “mommy”)

Little Susan has a dog at home. She visits a park and sees a deer. Last year when she saw a deer, she called it a dog. This year, she called it by it's right name. What process has occurred here?



0% 1. Assimilation

0% 2. Schematic Conversion

0% 3. Accommodation

0% 4. Perceptual shift

0% 5. None of the above

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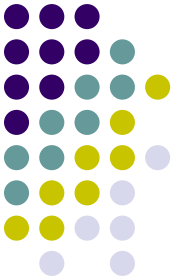
Attention!!

- **Attention** – you choose from the various stimuli bombarding your senses at any instant.
- **Selective attention** – You focus your awareness on only limited aspects of what you're capable of.
- Example 1 – Count the basketball passes
- Example 2 – Video clip and music playing at the same time – Sensory Overload!
- See if you can write down the lyrics to this song and also tell me what is happening in the movie.

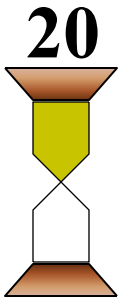
How does our brain decide what we "see?"

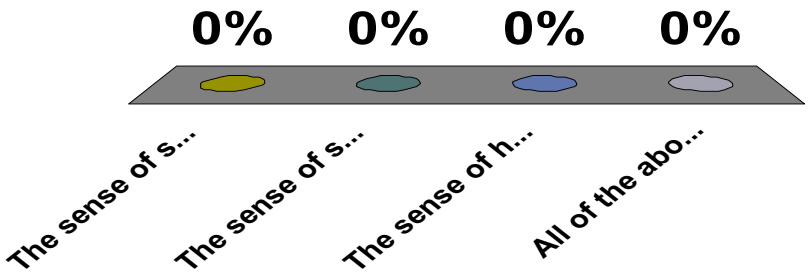


- Your expectations, previous experiences, interests, and biases give rise to different perceptions.
- When there you perceive a conflict among your senses, vision usually dominates (visual capture) –
- Ventriloquism is a classic example – you think the voice is coming from the doll when the puppets mouth moves.

During the process of visual capture, why does your sense of sight dominate over your other senses?

1. The sense of sight is the most powerful of the senses
2. The sense of sight is the most evolved of the senses
3. The sense of hearing is overloaded
4. All of the above





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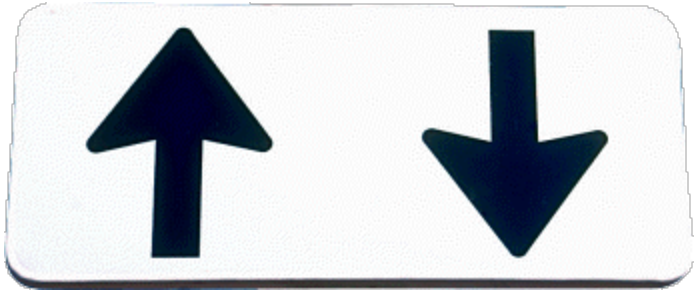
Attention: Bottom-up Processing and Top-down Processing

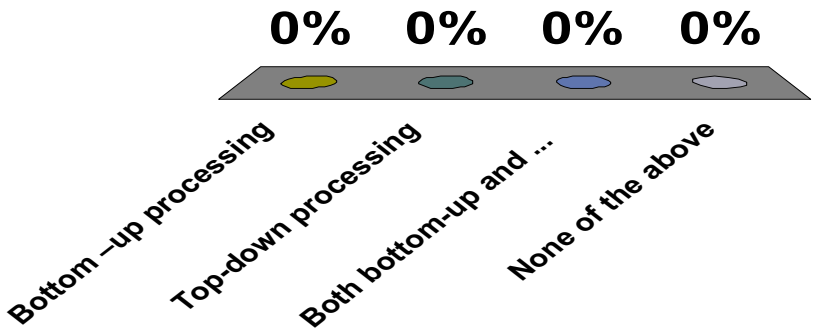
- **Bottom-up processing** is the processing of sensory information as it enters the sensory structures and travels to the brain



- **Example**: Send raw experience to brain for analysis.
- **Top-down processing** is the brain's use of existing knowledge, beliefs, and expectations to interpret the sensory stimulation
- **Example**: "big chunk" – make sense of situation based on what you already know.

A child seeing shoes with shoelaces for the first time instead of Velcro would be using this type of processing to understand her situation.

1. Bottom –up processing
2. Top-down processing
3. Both bottom-up and top-down processing
4. None of the above



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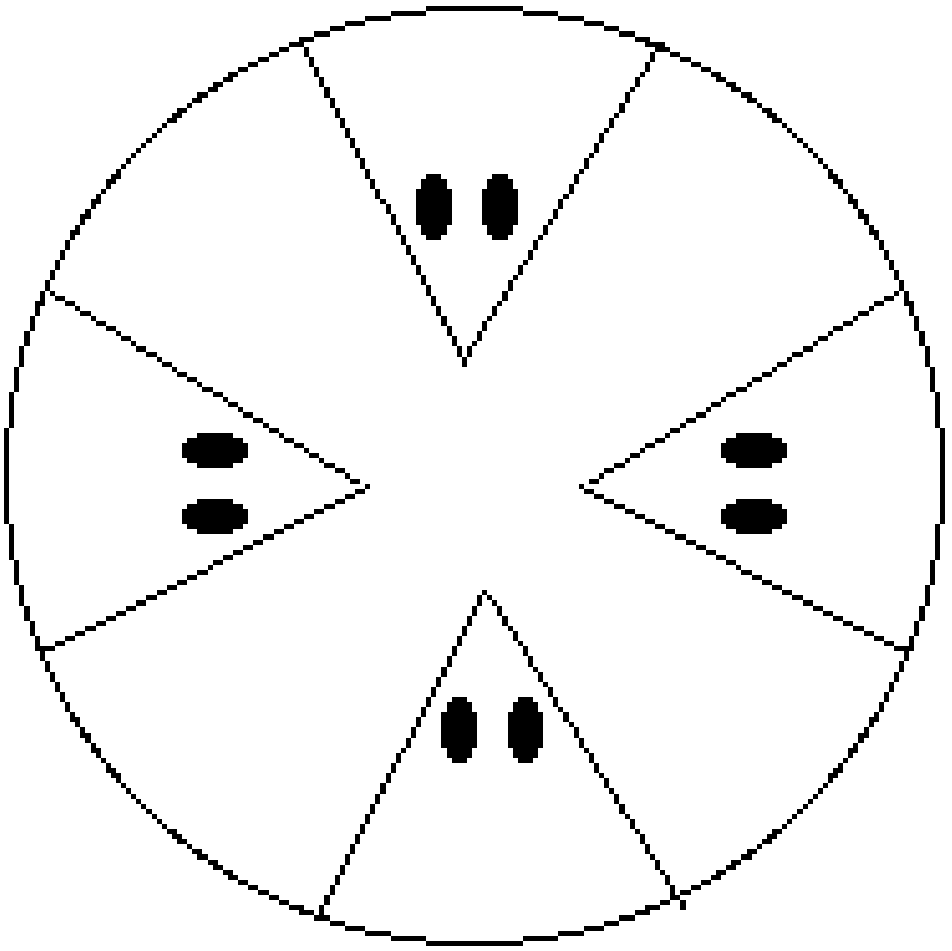
Perceptual Organization

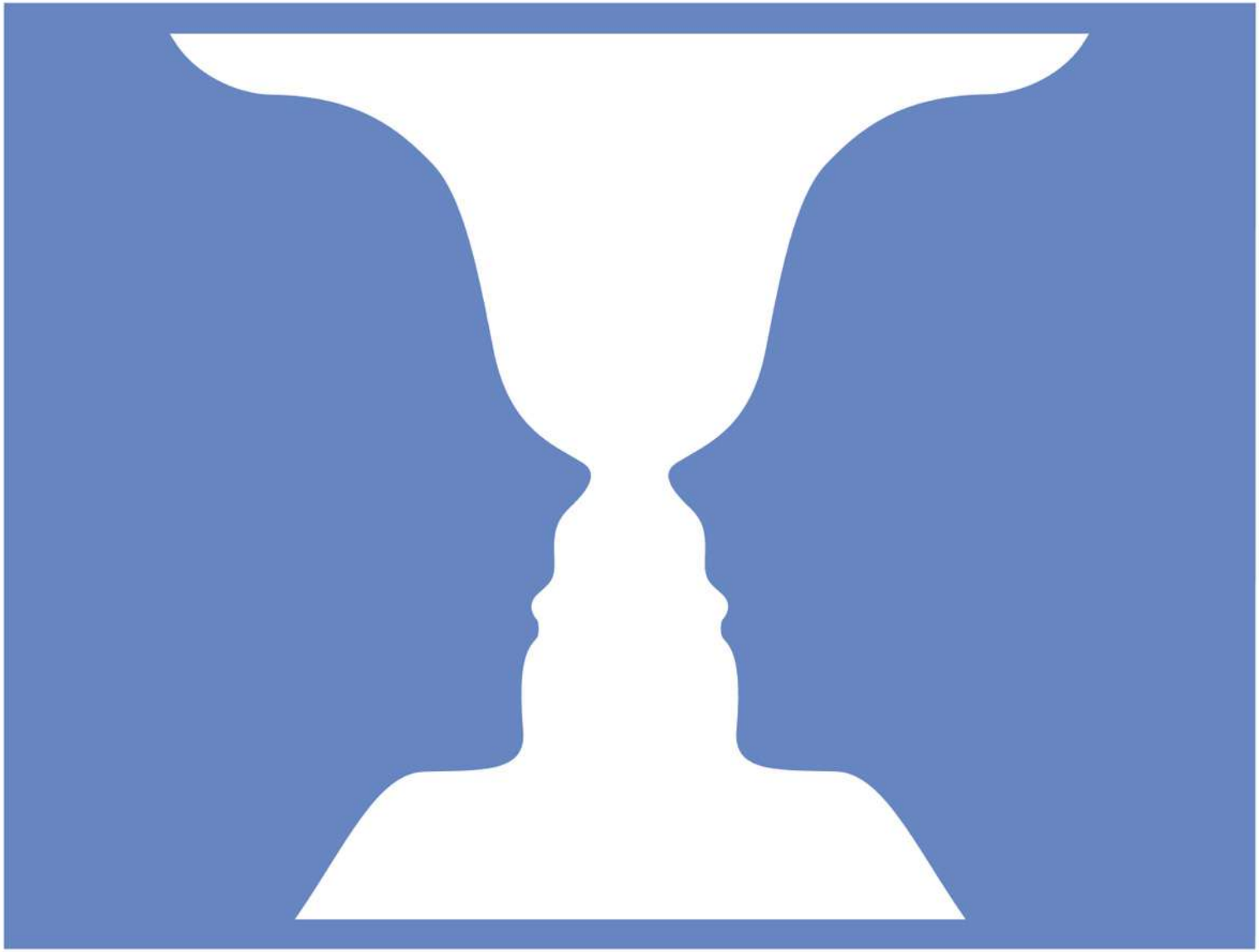
Gestalt means “organized whole”

- Gestalt psychologists believe that the organized whole is greater than the sum of its individual pieces of sensory information.
- **Example**: When you see this arrow sign on the highway it appears that the arrow “moves” - you perceive the lights a one unit, not individual parts.
- This is called the **Phi Phenomenon** –
- http://www.yorku.ca/eye/balls.htm

Figure and Ground:



- What do you see?
- How about three ghosts looking down at you?
- This diagram shows the difference between figure and ground.
- The dots are figures and the white background is the ground.
- Gestalt psychologists look at how we focus on either the figure or the ground and how our brains can be fooled.



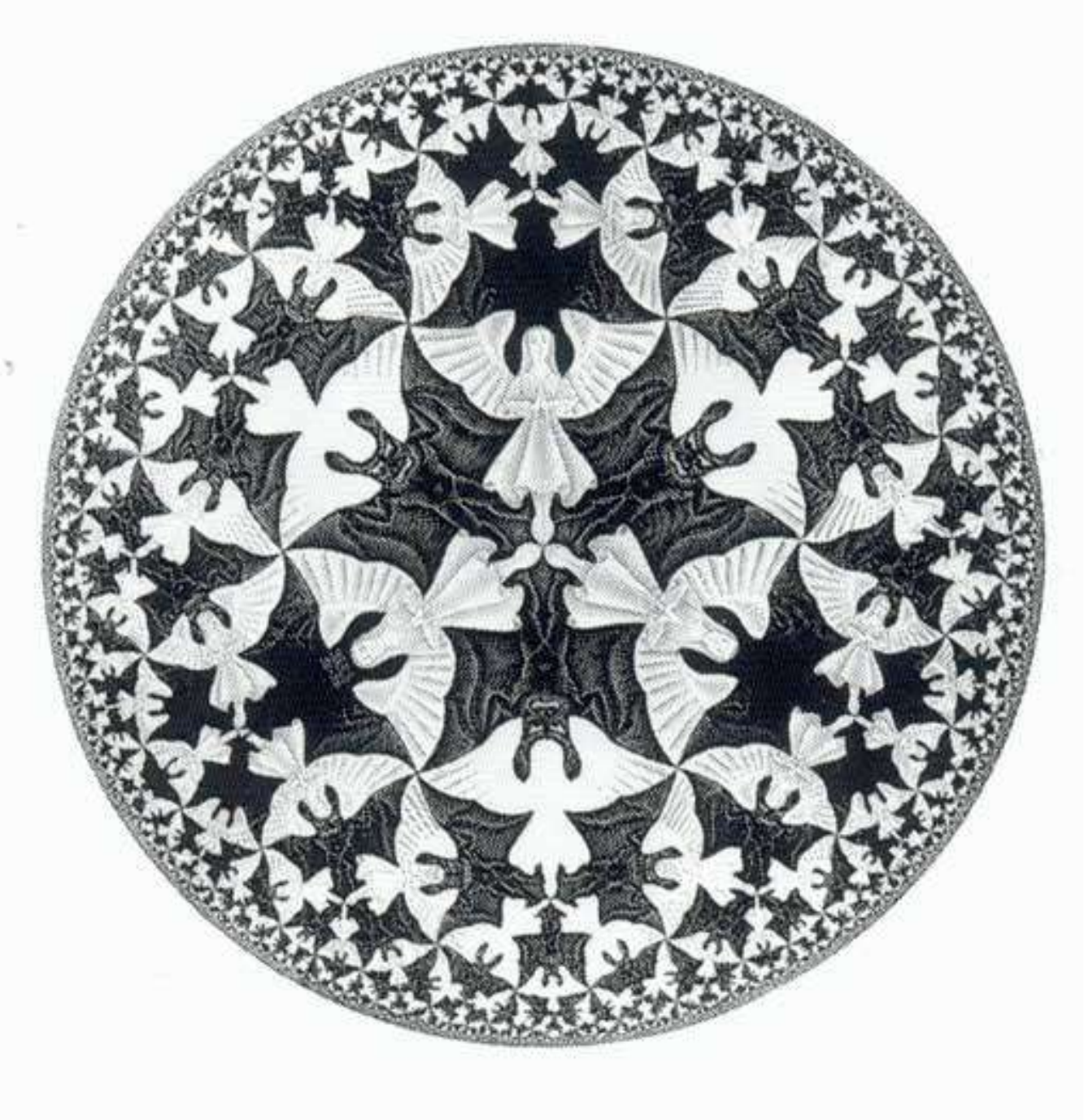
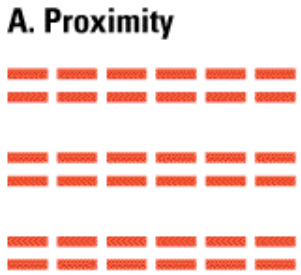
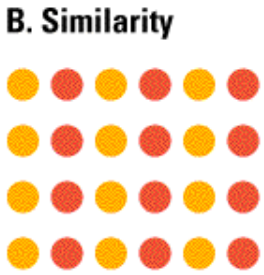
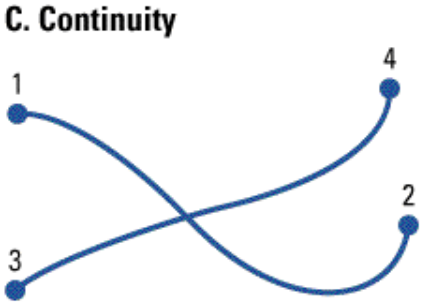


Figure and Ground Terms

- Proximity
  - Cafeteria example
- Similarity
  - The magician with the cube
- Continuity
  - Seeing lines that connect 1 to 2 and 3 to 4 in C.
- Closure
  - Seeing a horse in D / Singing Happy Birthday to …... (you'll fill it in)

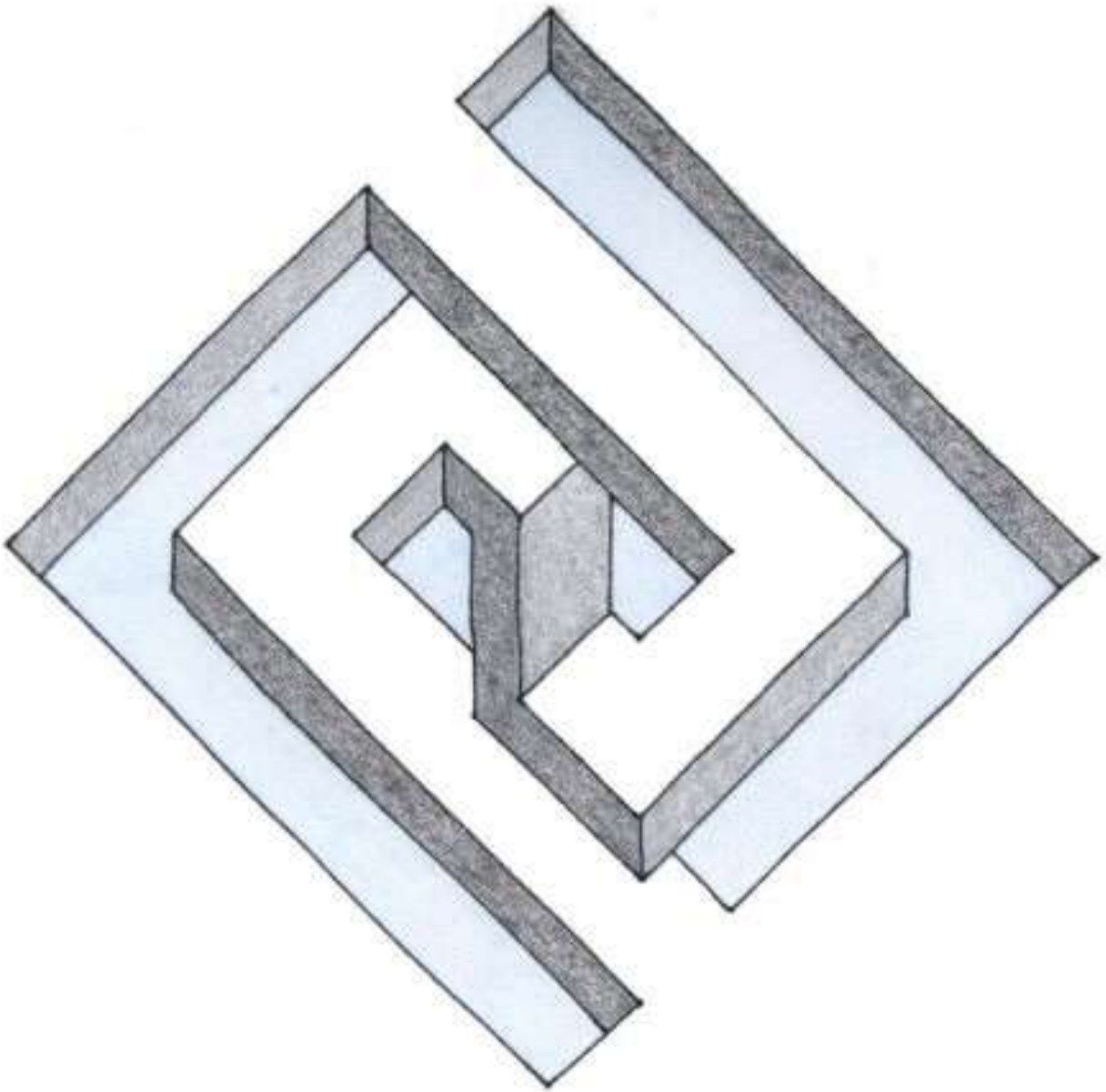


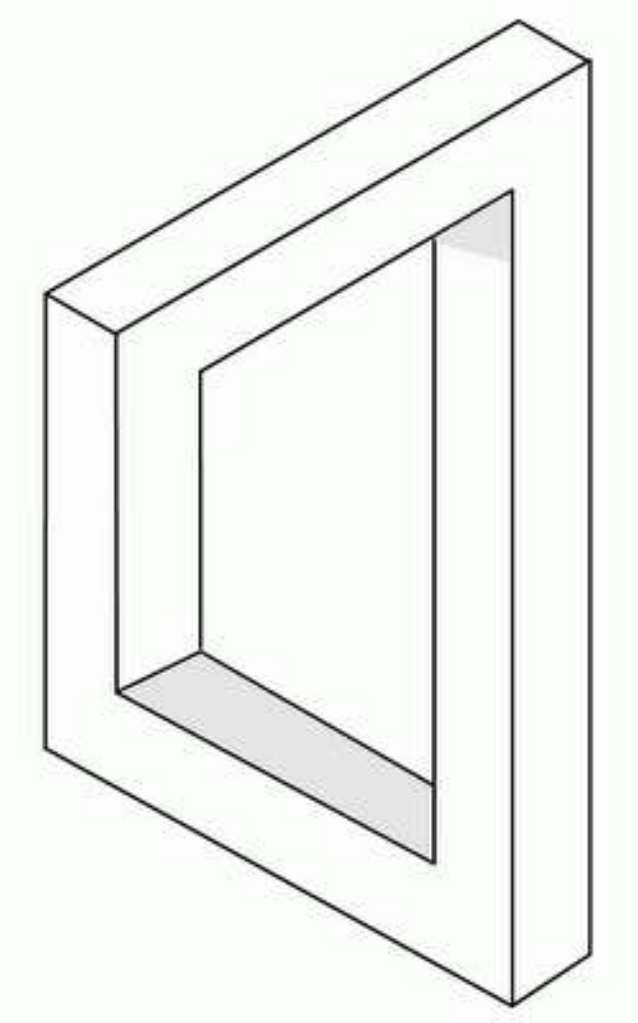


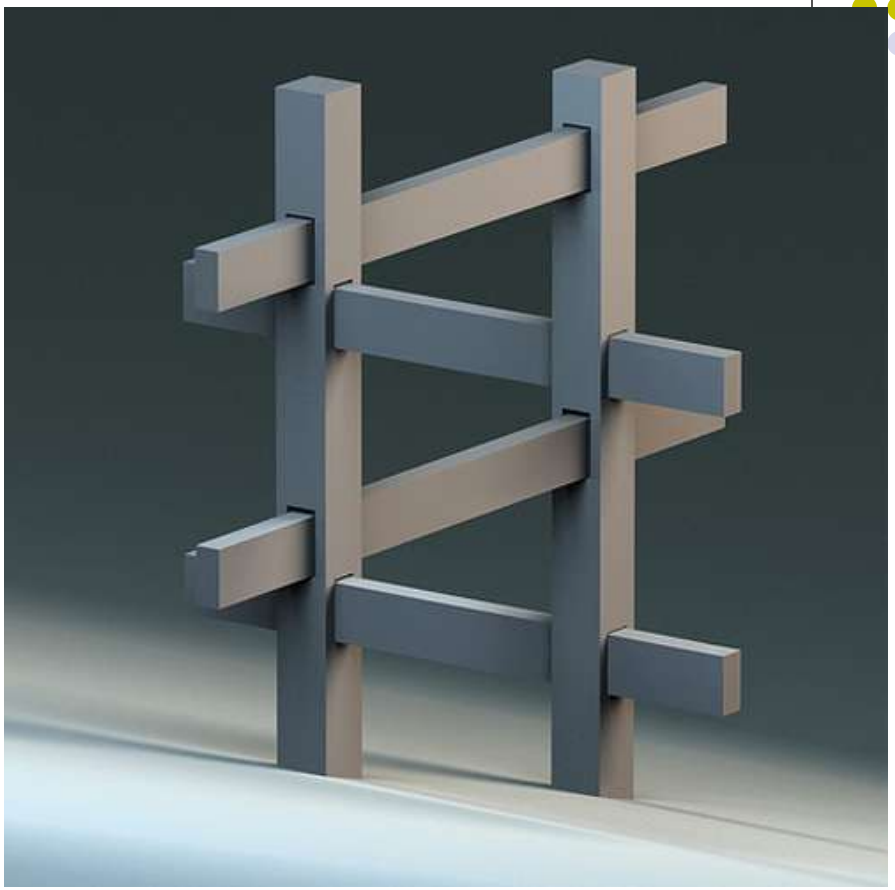


Optical Illusions:

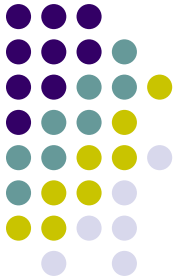
- **Optical Illusions** – discrepancies between the appearance of a visual stimulus and its physical reality.
- They trick your senses into trying to fill in the missing pieces to form a "big picture"
- Depth perception, figure and ground, contour are all deceived
- Let's look at some classic examples!







Lesson Four Objectives:

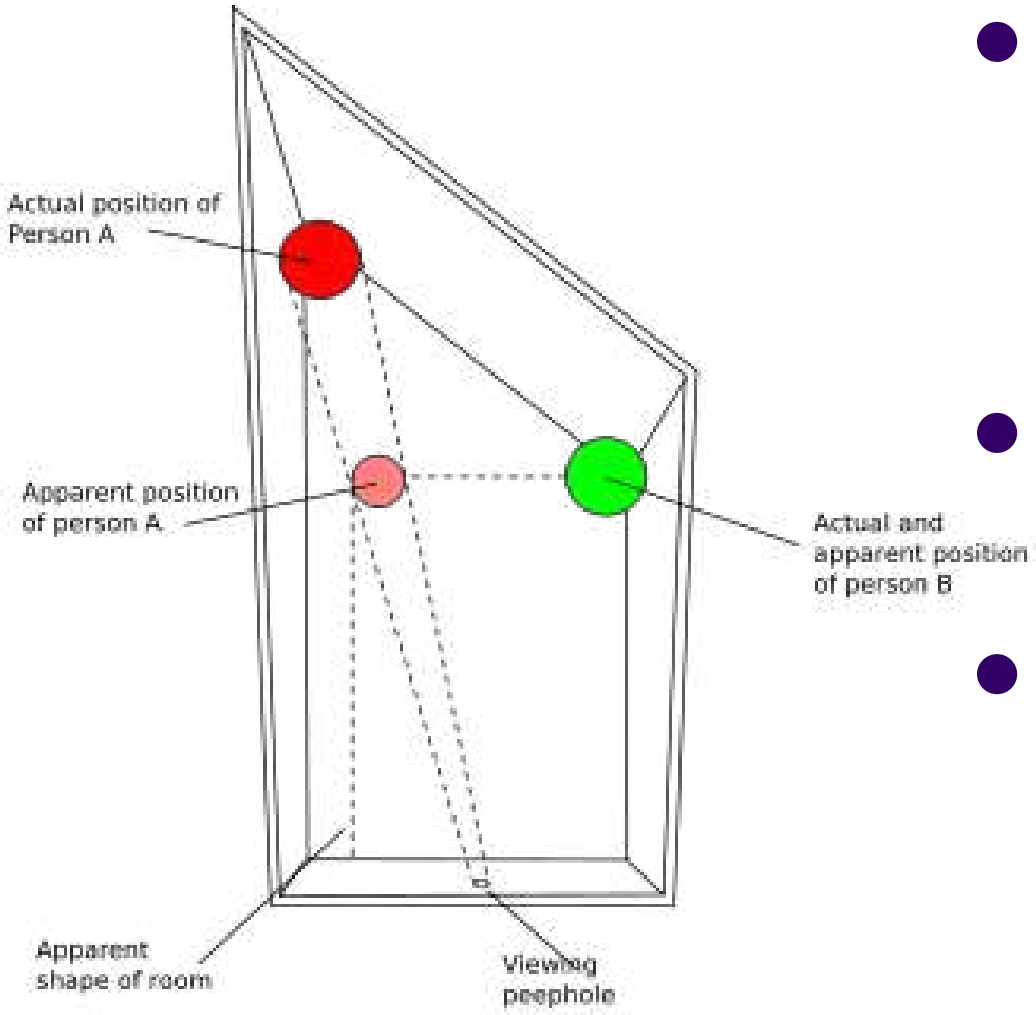


- **By the end of this lesson, I will be able to:**
- 1. Describe general principles of organizing and integrating sensation to promote stable awareness of the external world (e.g., Gestalt principles, depth perception).
- 2. Discuss how experience and culture can influence perceptual processes (e.g., perceptual set, context effects).

Depth Perception:

- **Depth Perception** – The ability to judge the distance of objects (babies are not good at this)
- We use cues to tell us how far or near objects are from us
- **Binocular Cues:**
- Each eye has a slightly different view of what you are seeing (**retinal disparity**) – Thumbs up!
- Retinal Disparity decreases with distance
- With both eyes open your brain fuses the images (depth perception)
- **Convergence** – look at the tip of your nose with both eyes)
- The closer the object the more convergence

The Ames Room

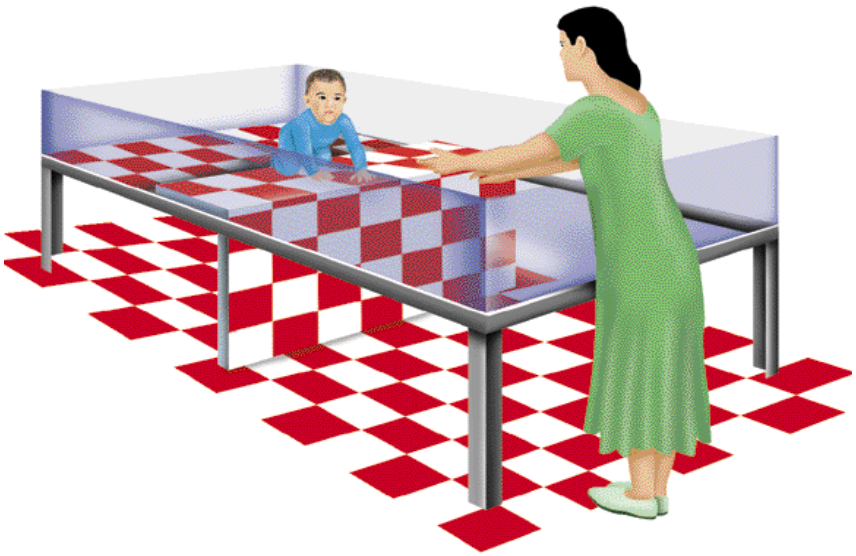


- A specially-built room that makes people seem to change size as they move around in it
- The room is not a rectangle, as viewers assume it is
- The room must be viewed from the correct angle for the illusion to work.

Depth Perception:

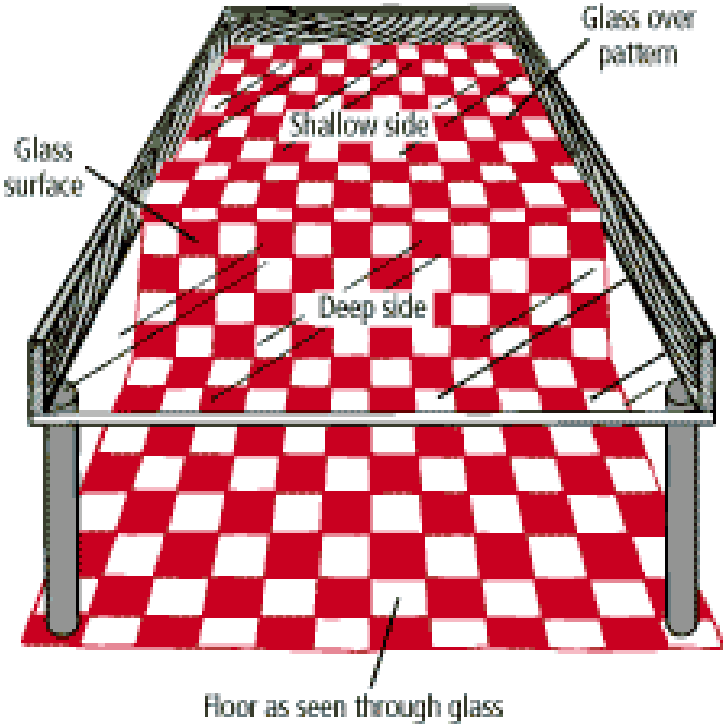
- **Monocular cues** – Involve the image that each individual eye picks up
- Examples:
- **Motion Parallax** – Closer objects seem to be moving faster than those further away - Driving in a car (distance of objects and speed at which they appear to move)
- **Relative Clarity** – Closer objects appear sharper than more distant, hazy objects (road signs)
- **Linear Perspective** – Parallel lines seem to converge in the distance (Ponzo illusion)

The Visual Cliff

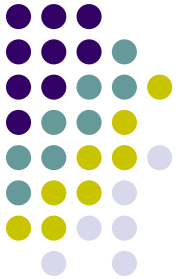


- Glass surface, with checkerboard underneath at different heights
  - Visual illusion of a cliff
  - Baby can't fall
- Mom stands across the gap
- Babies show increased attention over deep side at age 2 months, but aren't afraid until about the age they can crawl (Gibson & Walk, 1960)
- http://vimeo.com/77934

The Visual Cliff



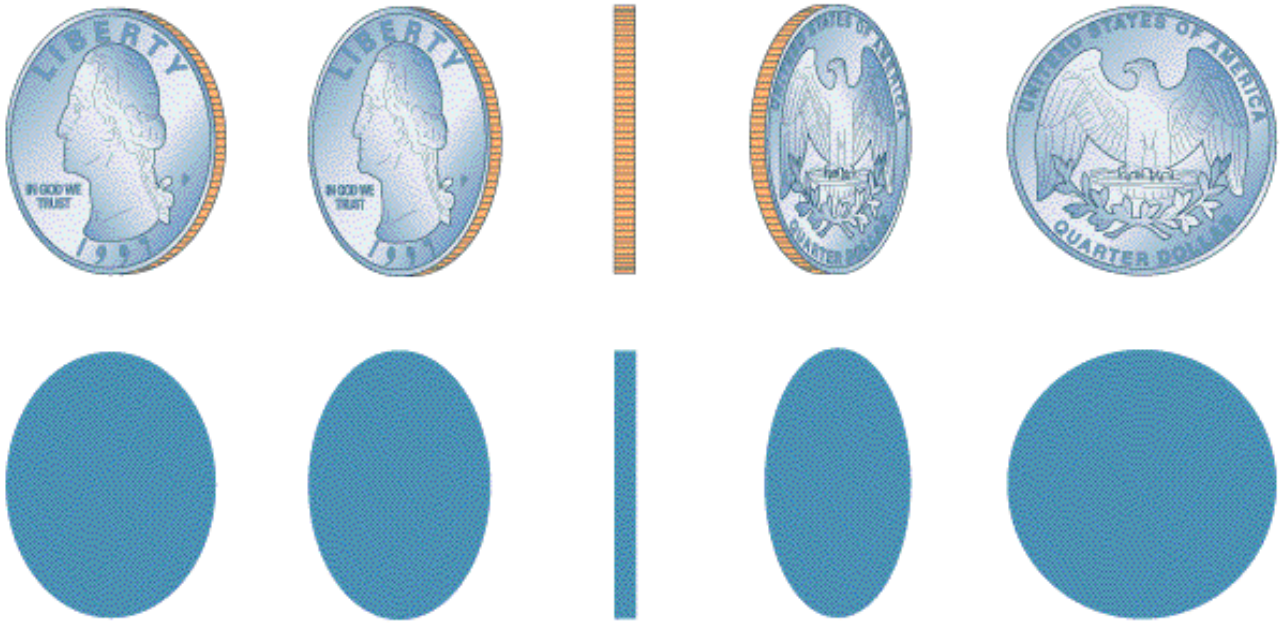
Perceptual Constancy:



- **Perceptual Constancy** – Images “grow” as they approach you even though you know they are the same size (hallway example)
- Example - **Shape Constancy** – object appears to retain normal shape even when viewed from different angles
- We do this with brightness and size as well
- This allows us to identify objects regardless of what our viewing angle is

Shape Constancy

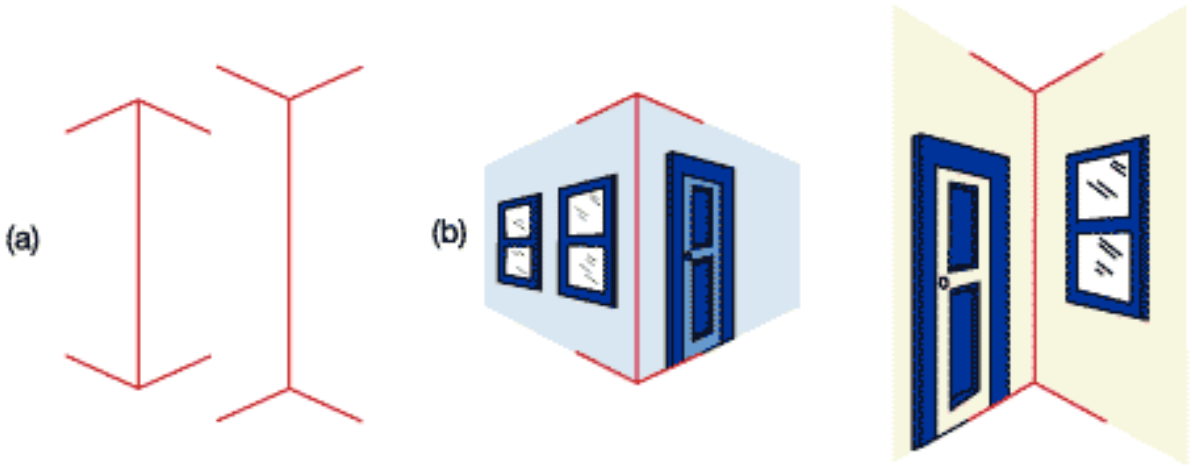
- Even though these images cast shadows of different shapes, we still see the quarter as round



Perceptual Set

- What you see in the center figures depends on the order in which you look at the figures:
  - If you scan from the left, see an old woman
  - If you scan from the right, see a woman's figure

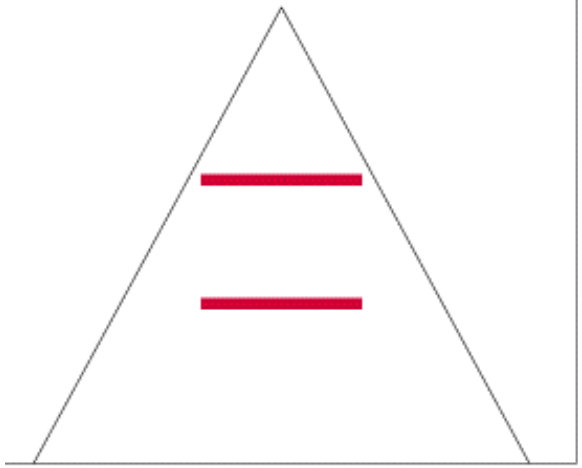
Visual Illusions



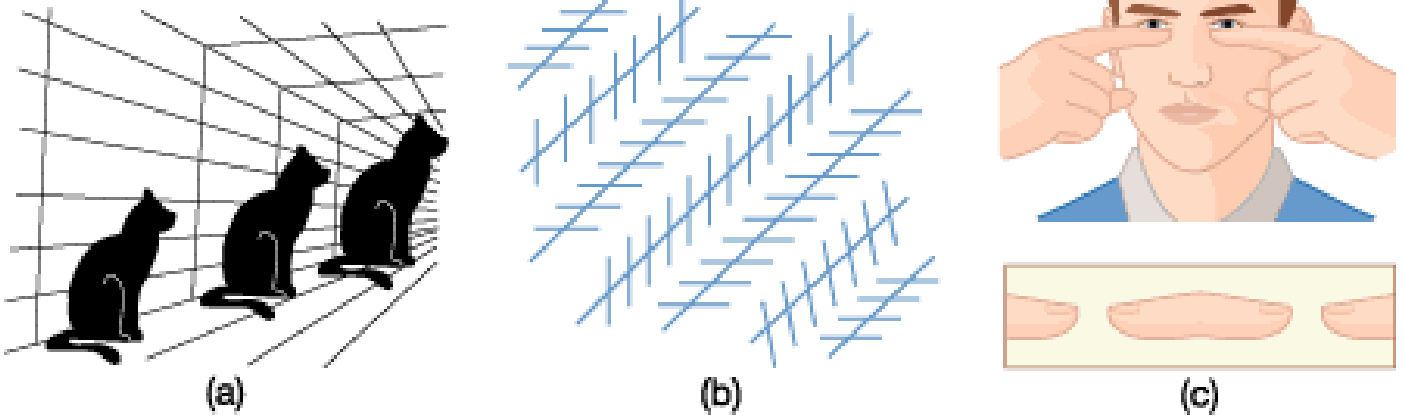
- Illusions are valuable in understanding perception because they are systematic errors.
  - Illusions provide hints about perceptual strategies.
- In the Muller-Lyer illusion (above) we tend to perceive the line on the right as slightly longer than the one on the left.

The Ponzo Illusion

- Linear perspective provides context
- Side lines seem to converge
- Top line seems farther away
  - But the retinal images of the red lines are equal!



Fooling the Eye

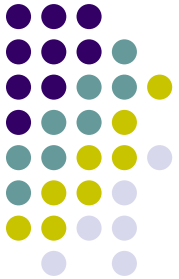


- The cats in (a) are the same size
- The diagonal lines in (b) are parallel
- You can create a “floating fingertip frankfurter” by holding hands as shown, 5-10” in front of face.

Julian Beever


Popular-Pics .com
HOTEL

Great Optical Illusion Website:



- http://www.michaelbach.de/ot/

Lesson Five: Objectives

- **By the end of this lesson, I will be able to:**
- 1. Describe sensory processes (e.g., hearing, vision, touch, taste, smell, vestibular, kinesthesis, pain), including the specific nature of energy transduction, relevant anatomical structures, and specialized pathways in the brain for each of the senses.

This is how I feel about the Cleveland Browns:

1. I love them!
2. I'd like to see them win
3. I don't really cheer for them
4. I'd rather cheer for the Steelers
5. Cleveland has a football team?
6. I loathe them

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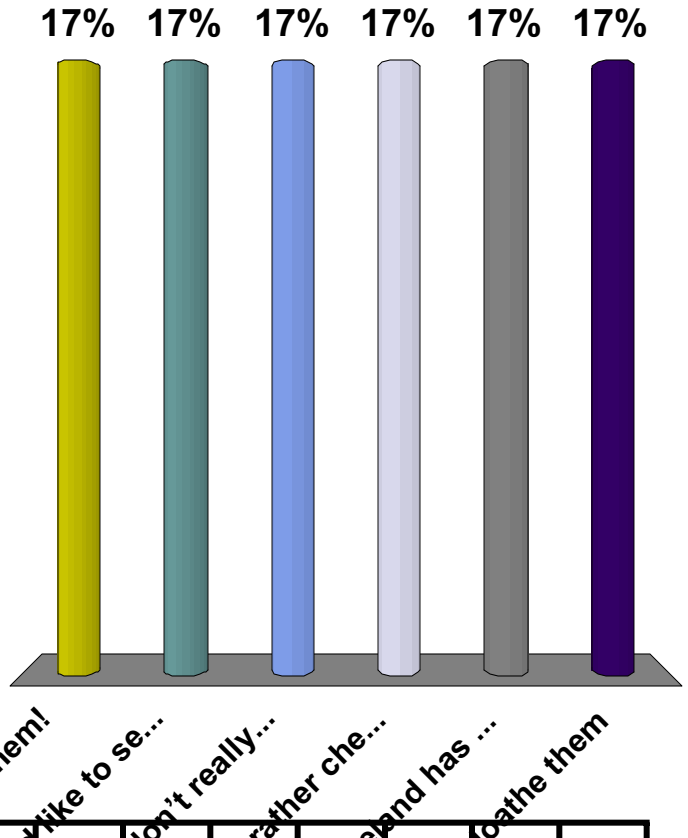

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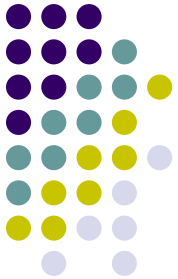
21	22	23	24	25	26	27	28	29	30										

Your sense of Touch:

- **Touch** – the sensitivity to pressure on the skin
- **Somotosensation** – general term used for the four classifications of tactile sensations:
- 1. Touch/pressure
- 2. Warmth
- 3. Cold
- 4. Pain

How does your sense of touch work?



- Transduction!
- Transduction of mechanical energy of pressure/touch and heat energy of warmth/cold occurs at sensory receptors located all over the body just below the skin's surface.
- Lips and fingertips have a greater concentration of sensory receptors.
- Neural fibers carry the sensory information to your spinal cord.
- Then, the info travels up your spinal cord → medulla → thalamus → parietal lobes.

How are your sense of touch and sense of hearing similar?

20

0% 1. They both have a long process of transmission

0% 2. They both involve transduction

0% 3. They can be unreliable

0% 4. Both 1 and 3

0% 5. None of the above

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30										

Pain:

- **Why is pain important**? – it alerts you to injury and often prevents further damage.
- Relief from pain results in secretion of endorphins.
- The experience of pain is extremely variable (pain threshold – Lance)

Pain: Part 2

- **Gate-control theory** (Ronald Melzack) – You have a “gate” within your spinal cord that allows you to experience pain.
- Anxiety, depression, and focusing on the pain keep the “gate” open.
- So…if you keep yourself calm, happy, and don’t think about it, your perception of pain will be lower than others.

Body Senses: Kinesthesis

- The body senses of kinesthesis and the vestibular system help us to make sense of the positioning of our bodies in our environments.
- **Kinesthesis** – The system that enables you to sense the position and movement of individual parts of your body.
- Sensory receptors for kinesthesis are nerve endings in your muscles, tendons, and joints.

The theory that best accounts for the experience of pain is:

20

0% 1. The opponent-process theory

0% 2. Weber's law

0% 3. The trichromatic theory

0% 4. The direct perception theory

0% 5. The gate control theory

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30										

Vestibular System (sense):

- **Vestibular System** (sense) – your sense of equilibrium or body orientation.
- How it works:
- Your inner ear has semicircular canals at right angles to each other
- Hair-like receptor cells are stimulated by acceleration caused when you turn your head and the vestibular sacs respond to linear movements.
- Then these calculations are sent to the eye and then the brain for processing.

Receptors for kinesthesis are located in the:

20

0% 1. Retina

0% 2. Joints

0% 3. Semicircular canals

0% 4. Olfactory epithelium

0% 5. Taste buds

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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Lesson Objectives

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Sense of Smell and Taste:

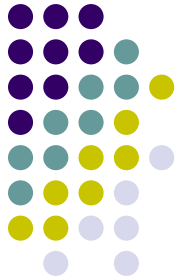
- **Gustation** – sense of taste
- **Olfaction** – sense of smell
- Both are chemical senses – stimuli are molecules
- We have developed adaptations using these senses for survival (smell of smoke, taste of rotten food)

Sense of Taste:

This pic was titled: “I relish the hamburger bed”

- Taste receptor cells are most concentrated on the tongue in **taste buds** – the roof of your mouth and the opening of the throat also help with taste
- Everyone has a different number of taste buds
- You have five types of taste receptors:
- Sweet, salty, sour, bitter, and umami (savory / flavor)
- Our tongues also have receptor cells that detect touch, pain, cold, and warmth
- The sensory interaction of taste, temperature, texture, and smell determine flavor

Cultural differences:



- Each culture consumes different foods (sometimes drastically different!)
- The United States consumes (by far) the most dairy, meat, and egg products of any country in the world.
- The United States also has (by far) the highest rates of diabetes, heart disease, cancer, and osteoporosis of any country in the world.
- Could it be our food choices? – think of what "American" food looks like

Sense of Smell:

- Odor molecules go high into your nasal cavity and nasal pharynx (links your nose and mouth)
- These odors bind to olfactory receptor sites triggering an action potential.
- Sensory information about smell is then transmitted to the hypothalamus and hippocampus (memory of smells), then to the amygdala to identify any emotional response.


Discovery
EDUCATION