Unit 4: Sensation and Perception

I. Introduction
   A. Some people can see perfectly, but cannot recognize members of their family. This person has what's called prosopagnosia, AKA "face blindness." This illustrates the difference between sensation and perception.
      1. Sensation is the ability to see in this case, but includes hearing, touching, tasting, and smelling.
      2. Perception is how we put the impulses received from our senses together so they make sense. Although a person may see perfectly, they cannot perceive or correctly process the impulses so that they make sense.
   B. Sensation is part of bottom-up processing where our senses send information to our brain.
   C. Perception is part of top-down processing where our brain assembles the info to make sense of the impulses being sent to it.

II. Selective attention
   A. We sense *a lot* of information. Scientists estimate we observe 11,000,000 bits of info per *second*. But we weed out all but 40 bits.
   B. The ability to screen out sensory information and focus on only a small portion of it is called **selective attention**. Think of a housewife telling her husband the things that need to be done around the house while he's watching a football game on TV oblivious to what's she's saying. He's got selective attention.
      1. The **cocktail party effect** is a person's ability to single out one voice amidst many others, then to "change channels" to another voice. A person in a crowded, talking room can weed out other voices and converse with one person. Then the first person can single out another voice and "tune in" on that person if desired.
      2. Selective attention is seen in car crashes. People that talk or text on the phone are distracted by the phone and are much more likely to crash (4 times more in one study for talking, 23 times more for texting). More specifically than "being distracted", they selectively put their attention on one task at a time, driving or texting, and the other suffers.
      3. Despite people's claim of "multi-tasking", as humans, we focus on one thing at a time.
   C. On the flip side is **selective inattention** or **inattentional blindness**. This is the ability to purposefully block out all but one bit of sensory input - to focus on one thing only.
      1. This was seen in an experiment where a person in a gorilla suit walked among people passing a basketball. The observers were to count basketball passes so they focused on that task. Most people never saw the gorilla.
   D. Similarly, there is **change blindness** which is where people won't notice a change in "scenery" after a brief interruption.
      1. This was seen in a scene where person A was getting directions from a bystander, then was interrupted by construction workers, then was replaced with person B. The bystander doesn't notice the switch from person A to person B 40% of the time.
   E. In **choice blindness**, people are unaware of the choices or preferences they make.
      1. This was seen in an experiment where women were shown two pictures and asked to choose the most attractive person. Then they were tricked and shown the one they'd rejected and asked, "Why'd you choose this person as more attractive."
      2. Only 13% caught the switcheroo. They explained why they chose that person.

3. When asked if they'd recognize a switcheroo, 84% said they'd catch a switch. This became known as **choice blindness blindness** – they can't see that they're choice blind.

F. In **pop-out**, something is noticeably different from the others and thus, pops out to the viewer. Imagine a picture of a hundred white cats and one black dog. The black dog would pop out to you.

III. Thresholds

A. We sense only a sliver of the info coming at us. We can't see everything (like X-rays or radio waves) or hear everything (the family dog can hear much more than us).

B. Take sound for example, at some point there is a point where we can't hear a frequency (but the dog still can). This cut-off point to sensation is called the **absolute threshold**. It's defined as the minimum stimulation needed to detect light, a sound, a pressure, taste or odor 50% of the time.

1. As an example, people lose the ability to hear high-pitched as they grow older.
2. Teens use this to set "mosquito" ringtones that adults likely won't hear. Businesses use this to shoo away loitering teens.
3. **Signal detection theory** is the idea that predicting whether or not we detect a stimulus depends not only on the stimulus, but also on our experience, expectations, motivation, and alertness.
    a. People in life-or-death situations, like war, often have heightened signal detection.

C. **Subliminal stimulation** (kin to "subliminal perception") is stimulation just below our level of consciousness. This occurs when we're subjected to a stimulus, but we just aren't aware of it. For instance, an image might be flashed so quickly we don't even know we saw it.

1. Can we sense these things? By definition, yes, because absolute threshold is 50% of the time. Thus, we might sense this 49% of the time.
2. Can these unconscious stimuli impact our behavior? We're not sure the answer to this question just yet.
    a. In one study, subliminal stimuli can **prime** or prepare responses. This means a subliminal stimulus prepared people for a response to a second stimulus.

D. A **difference threshold** or **just noticeable difference** (**JND**) is the minimum difference between two stimuli that can be detected at least 50% of the time.

1. For example, imagine picking up a 20 pound weight and then a 20 pound 1 ounce weight, you likely would not notice a difference. If you kept increasing the weight, you'd eventually say, "This is heavier." At some weight, you'd notice it 50% of the time, that's the JND.
2. **Weber's Law** says the difference between two stimuli must differ by a constant *proportion*, not necessarily a constant *amount*.
    a. Think about weight, weight must differ by 2% for a person to notice the difference.
    b. Think about sound, two tones must differ by 0.3% for a person to notice the difference.

IV. Sensory adaptation

A. **Sensory adaptation** is a person's diminishing sensitivity to a sensory stimulus. In other words, if a stimulus persists, you get used to it.

1. Think of a person spilling a bit of perfume in class. You smell it strongly at first, but by the end of the class, you don't really notice it. As soon as the next class walks in, students say, "What's that smell?"
2. This also works for vision. Normally our eyes scan everything to "take it all in". If you were forced to look at the same thing over and over, you'd eventually stop seeing it.

V. The stimulus input: light energy

A. The process where our eyes sense light energy and change it into neural messages that our brain can handle is called **transduction**.
B. Visual light makes up a very small portion of the electromagnetic spectrum. But, that's the part that we see.
C. Visible light has two important characteristics…
    1. **Frequency** – Frequency refers to the wavelength of the light wave, or like waves on the beach, how frequently they hit. Think of "FM" (frequency modulation) on the radio where a radio wave's wavelength is changed.
    2. **Amplitude** – Amplitude refers to the intensity of the light wave, or like waves on the beach, how strongly they hit. Think of "AM" (amplitude modulation) on the radio where a radio wave's amplitude is changed.

VI. The stimulus input: light energy

A. **Vision** is the dominant sense in human beings. Sighted people use vision to gather information about their environment more than any other sense. The process of vision involves several steps…
    1. Step 1: Gathering light
        a. The eyes **transduce** or convert light energy into neural messages.

VII. The eye

A. Step 2: Within the eye
    1. **Cornea** -The transparent protective coating over the front part of the eye.
    2. **Pupil** -small opening in the iris through which light enters the eye.
    3. **Iris** -colored part of the eye.
    4. Lens -transparent part of the eye inside the pupil that focuses light onto the retina.
    5. **Retina** -lining of the eye containing receptor cells that are sensitive to light. Transduction occurs here.
B. Step 3: Transduction
    1. **Transduction** – Process by which sensory signals are transformed into neural impulses.
    2. **Receptor cell** - Specialized cell that responds to a particular type of energy.
    3. **Rods** - Receptor cells in the retina responsible for night vision and perception of brightness.
    4. **Cones** - Receptor cells in the retina responsible for color vision.
    5. **Fovea** - Area of the retina that is the center of the visual field.
    6. **Optic nerve** - The bundle of axons of ganglion cells that carries neural messages from each eye to the brain.
    7. **Blind spot** - Place on the retina where the axons of all the ganglion cells leave the eye and where there are no receptors.
    8. **Optic chiasm** - Point near the base of the brain where some fibers in the optic nerve from each eye cross to the other side of the brain.

VIII. Visual information processing

A. Step 4: In the Brain
    1. The brain has specialized cells called **feature detectors**. These cells specialized in exactly what they say - they detect features like angles, lines, edges, and movements.
    2. Unlike computers that use "serial processing" (they do operations one-at-a-time), our brains handle **parallel processing** or handle several tasks simultaneously. For instance, while looking at a bird, we process its color, motion, form and depth all at the same time.

IX. Color vision

A. Theories of color vision…
    1. **Trichromatic theory** - Theory of color vision that holds that all color perception derives from three different color receptors in the retina.

2. **Opponent-process theory** - Theory of color vision that holds that three sets of color receptors respond in an either/or fashion to determine the color you experience.
3. Colorblindness - Partial or total inability to perceive hues.
4. **Trichromats** - People who have normal color vision.
5. **Monochromats** - People who are totally color blind.
6. **Dichromats** - People who are blind to either red-green or yellow-blue.

X. Hearing: The stimulus input: sound waves

A.

1. The ears contain structures for both the sense of hearing and the sense of balance. The eighth cranial nerve (vestibulocochlear nerve made up of the auditory and vestibular nerves) carries nerve impulses for both hearing and balance from the ear to the brain.
2. Terms relating to sound include…
    a. **Amplitude** – The height of the wave, which determines the loudness of the sound, measured in decibels.
    b. **Frequency** - The number of cycles per second in a wave; in sound, it's the primary determinant of pitch.
    c. **Hertz** (Hz) - Cycles per second; unit of measurement for the frequency of waves.
    d. **Pitch** - Auditory experience corresponding primarily to frequency of sound vibrations, resulting in a higher or lower tone
    e. **Decibel** -The magnitude of a wave; in sound the primary determinant of loudness of sounds

XI. The ear

A. **Ear canal** – Also called the auditory canal, carries sound waves into the ear.
B. **Eardrum** - A membrane at the end of the auditory canal. It vibrates due to sound waves.
C. **Hammer, anvil, stirrup** - The three small bones in the middle ear that relay vibrations of the eardrum to the inner ear.
D. **Oval window** - Membrane across the opening between the middle ear and inner ear that conducts vibrations to the cochlea.
E. **Round window** - Membrane between the middle ear and inner ear that equalizes pressure in the inner ear.
F. **Cochlea** - Part of the inner ear containing fluid that vibrates which in turn causes the basilar membrane to vibrate. For psychology, this may be the most important part of the ear because this is where sound waves are converted into neural impulses.
G. **Basilar membrane** -Vibrating membrane in the cochlea of the inner ear; it contains sense receptors for sound.
H. **Organ of Corti** -Structure on the surface of the basilar membrane that contains the receptors cells for hearing.
I. **Auditory nerve** -The bundle of neurons that carries signals from each ear to the brain.
J. **Pitch theories** - As with color vision, two different theories describe the two processes involved in hearing pitch:
    1. **Place theory** -Theory that pitch is determined by the location of greatest vibration of the basilar membrane.
    2. **Frequency theory** -Theory that pitch is determined by the frequency with which hair cells in the cochlea fire.

XII. Hearing loss and deaf culture

A. Hearing loss occurs when people lose all or some of their ability to hear because of loud noises, infections, head injuries, brain damage and genetic diseases. Hearing loss is common in older people. There are several types of hearing loss:
B. Conductive Hearing Loss: This occurs when sound vibrations from the tympanic membrane to the inner ear are blocked. This may be caused by ear wax in the

auditory canal, fluid buildup in the middle ear, ear infections or abnormal bone growth.

C. Sensorineural Hearing Loss: This occurs when there is damage to the vestibulocochlear (auditory) nerve. This type of hearing loss may be caused by head injury, birth defects, high blood pressure or stroke.
D. Presbycusis: This occurs because of changes in the inner ear. This is a very common type of hearing loss that happens gradually in older age.
E. Tinnitus: People with tinnitus hear a constant ringing or roaring sound. The cause of this ringing cannot always be found. Some cases of tinnitus are caused by ear wax, ear infections or a reaction to antibiotics, but there are many other possible causes of this disorder.

XIII. Touch

A. There are four types of touch sensation: pressure, warmth, cold, and pain.
B. Stimulating these spots produces these results…
    1. Adjacent pressure spots yield tickling.
    2. Stroking pressure spots yield itching.
    3. Touching cold and pressure spots yields a wet sensation.
    4. Touching warm and cold together yields a hot sensation.
C. The **rubber hand illusion** shows top-down influence.
    1. Here, a fake hand is stroked along with a person's other real hand which is hidden. In most people, they'll feel a sensation in their other non-stroked hand.
    2. This illustrates both the bottom-up influence of touch sensation, but also the brain's top-down expectation of feeling the stroking in both hands.
D. **Kinesthesis** is a person's ability to know the position and movement of your body parts. This why you're able to touch your nose with your eyes closed.
E. People have a **vestibular sense** that monitor's your head's position and movement (therefore it also monitor's your body's position and movement).
    1. This "gyroscope" is in your inner ear. The **semicircular canals** are arranged in a 3D fashion. **Vestibular sacs** are filled with fluid and connect the canals with the cochlea.
    2. When you move, the fluids activate hair cilia that tell your brain you're moving.
    3. Dizziness or motion sickness occurs when the fluids here keep moving.

XIV. Pain

A. Pain is the body's warning sign that something isn't right.
B. The sense of pain doesn't have one receptor cell, like vision. Instead, pain has three receptors, called nociceptors, that detect harmful temperature, pressure, and chemicals.
C. The **gate-control theory** of pain says there is a "gate" in the spinal cord that switches pain on and off.
    1. The spinal cord has small nerve fibers that conduct pain and large nerve fibers that conduct everything else. When you're hurt, the small fibers are activated and you feel PAIN! Then the large fibers block the sensation to the brain and you feel no pain.
    2. This theory is supported by things like massage and acupuncture that stimulate *other* areas (the large fibers) and thus cut down on pain.
D. Pain can also be stopped by **endorphins**, nature's pain-killer.
E. In **phantom limb sensation**, the brain can even produce pain in limbs that are not even there. Similarly, people with hearing loss often have **tinnitus**, a constant ringing in the ears.
F. Even though we use our eyes, ears, etc., these are just tools to get info to the brain. The brain is where things happen; it's where we feel, see, hear, taste, and smell.
G. Other factors influence pain…

1. There are psychological influences to pain like an athlete who's focused on the game and unaware of an injury, or the rubber hand illusion where a fake finger is bent backward and the person says they feel it in their real finger. Also, memories of pain tend to focus on the peak of the pain and the end of the pain.
2. There are socio-cultural influences to pain. People tend to feel more pain when they see others in apparent pain.

H. There are many ways that attempt to control pain.
1. Placebos can help reduce pain. Being given a placebo that the person *thinks* is real causes the body to release its natural pain-killers.
2. Distraction is a very effective way to reduce pain. Examples of this include chatting to a person while giving them a shot or MRI scans during a "virtual reality" session that reveal lower activation of pain in the brain.

XV. Taste

A. There are five basic taste sensations that our tongues can pick up: sweet, sour, salty, bitter, and the newcomer called umami (a meaty taste).
B. Taste buds on our tongue that sense the chemicals in our foods and drinks.
C. Expectations also play a huge role in taste. Before you bite into a lemon, your brain and body begin to prep you for what you expect to taste. Just *thinking* about biting into a lemon can make your mouth pucker.
D. **Sensory interaction** is two or more senses working together. Taste and smell go together – it's hard to taste anything while holding your nose.
1. As another example, there's the **McGurk effect** where sight and hearing go together. If we *see* a person say one thing but *hear* them saying something else, the result is that we will hear a *third* sound that's a blend of the two.

XVI. Smell

A. Smell, AKA "olfaction" is another chemical sense. There are 5 million receptor cells in the nose that pick up part of whatever is being smelled.
B. Like letters mixing to make words, our olfactory receptor cells mix and mingle with one another to create the myriad of possible smells.
C. Each person, except identical twins, has an identifiable scent, like a smell-fingerprint.
D. "Good smells" are often learned. If we smell something, then something good happens, we associate the smell with the good thing. Thus, the smell becomes good.

XVII. Form perception

A. When we sense something we do more than just take in light and sound etc. We process the info and turn it into something meaningful. For instance, a million leaves, some bark and branches are perceived as a tree.
B. A **gestalt** is a whole sum of multiple parts. The idea is that the whole, the sum of the parts, is greater than the individual parts. We're hardwired to look for the whole.
1. An example might be a bunch of small squares arranged in a circular pattern. If you asked a person, "What do you see?" they'll likely say, "A circle." They see the whole, not individual squares.
C. In a **figure-ground** situation, we can look at a figure against a background. Or we can switch the background to be the *figure* we're looking at, and the old figure becomes the new *ground*. Doing this can make us see different things.
D. When we look at things, we lump similar things into like groups and we like things complete. This is called grouping. There are several ways that we group things:
1. **Proximity** – things close to one another are grouped together.
2. **Similarity** – things alike are grouped.
3. **Continuity** – we like things that are unbroken.
4. **Closure** – we like to complete things that are not complete. We'll finish a circle only 90% complete.

5. **Connectedness** – we like things are linked or brought together.

XVIII. Depth perception

A. **Depth perception** is the ability to see things in 3D which helps us gauge distance.
B. Depth perception starts early. In the **visual cliff** experiment, babies would not crawl across a glass table because they perceived a drop-off.
C. Since our eyes are about 2 ½ inches apart, we get **binocular cues**. This means that while viewing close objects, we see things from slightly different angles. This is called **retinal disparity** which **enables our brain's to judge the distance of objects we're looking at**.
    1. This is seen in the "finger sausage" example where you hold fingers close to your nose then see a third "finger sausage" floating in the middle.
    2. 3D movies use retinal disparity by filming with two cameras a few inches apart.
D. We get **monocular cues** at greater distances because things are too far away for binocular cues to matter. There are several monocular cues:
    1. **Relative height** – things seen higher up are perceived as farther away.
    2. **Relative size** – things small are perceived as farther away.
    3. **Interposition** – when things are "stacked", the one that's covered up is farthest, the one that's not covered is closest.
    4. **Linear perspective** – parallel lines, like railroad tracks, converge in the distance; the more they converge, the farther away.
    5. **Light and shadow** – close objects reflect more light, farther ones appear dimmer.
    6. **Relative motion** – while we move, things close to us appear to move fast in the opposite direction; things farther away appear to move very slowly or not at all.

XIX. Motion perception

A. In the **stroboscopic effect**, we perceive a series of still photos (like a film) as having continuous motion.
B. In the **phi phenomenon**, two lights flashing alternately gives the perception one light moving back-and-forth. This is seen in neon lights or marquee signs that are "animated".

XX. Perceptual constancy

A. We expect things to retain constancy in terms of angles, distances, and illumination.
B. **Shape constancy** is our tendency to expect things to retain their shape. A door viewed from different angles actually looks like a trapezoid, but our expectations are that it's a rectangle.
C. **Size constancy** is our tendency to expect things to retain their size. A bus view from miles away looks small, but we expect it to be big enough for lots of people to fit inside.
    1. In the **moon illusion**, the moon on the horizon looks huge, but straight above, it looks small. This is because on the horizon, the moon has distance cues like a house or tree that fool us. Up high, there are no cues.
    2. In the **Ponzo illusion**, two equal-size lines appear different lengths if placed between two converging lines. The one in the back looks longer because the monocular cue of "linear perspective" fools us.
    3. An **Ames room** is a funky-shaped room with angular dimensions. Since we expect a room to be at 90° right angles, the room fools us. Two people of equal height seem very different in height depending on where in the room they stand.
D. **Lightness constancy** is our tendency to expect things to retain their lightness.
E. **Color constancy** is our tendency to expect things to retain their color. Yet we can be fooled because we perceive colors in relation to their surroundings. When the surroundings change, our perception of the color changes too.

XXI. Sensory deprivation and restored vision

A. On rare occasions, people are born without sight but then later gain it. The question is, can they recognize things they've come to know by touch only? The answer is mixed…
    1. These people could distinguish figure and ground.
    2. They could also sense colors. These facts suggest that we're born with these abilities.
    3. These people could not recognize by vision things they knew by touch.

XXII. Perceptual adaptation

A. **Perceptual adaptation** is <u>our ability to adjust to changes in our sensations</u>. For example, we eventually get used to new glasses that make the world look funky.
    1. This is seen via "inversion goggles". These goggles can skew our vision by a large degree, usually 40° to one side. At first, we're way off. After a while, we get accustomed to the skew and start to see normal.
    2. The same is true of inversion goggles that flip our vision upside down. After days, the world will flip back to normal (thanks to our amazing brain doing the work for us).

XXIII. Perceptual set

A. <u>What we've already seen and experienced (and thus expect) add up</u> to what's called a **perceptual set**.
    1. Once we have a perceptual set in place, we often have trouble seeing what's really there. For example…
    2. A log floated in Loch Ness, but people, expecting to see the "monster", indeed perceived the log as the monster.
B. The **context** also impacts our perception. When something is out of context, we often misperceive it.
    1. For example, if someone said, "It's wagging its tail, that cute little log," we'd likely hear "dog" because that's the context.
    2. The key to context is that everything is relative. A 6'9" basketball player is tall, until he stands beside a 7'9" basketball player.
C. Our emotions and motivations also influence our perceptions.
    1. The emotional state that you're in, positive or negative, can influence your perceptions. For instance, a hill looks huge to a tired person, not so big to a refreshed person.
    2. When a motivation is linked to a sensation, people are more likely to perceive the hoped-for perception.
        a. This was seen in an ambiguous picture of a horse/seal. If prompted with a reward to see one or the other, people quickly saw it.

XXIV. Claims of ESP

A. Half of all people believe in **ESP**, AKA "**Extra Sensory Perception**". ESP is <u>the belief that some people can sense things beyond our normal senses</u> (sight, sound, etc.). ESP believers feel people some are "psychic" or they can "feel it", read minds, are clairvoyant and the like.
B. Promonition or pretensions?
C. Putting ESP to experimental test