How does the world out there get in?
How do we construct our representations of the outside world?

SENSATION & PERCEPTION
SENSATION & PERCEPTION

• SENSATION: The detecting of physical energy from the environment and the encoding of it as neural signals.

• PERCEPTION: The selecting, organizing, and interpreting of our sensations.

• Sensory analysis starting at the entry level (sensory organ) is known as **bottom-up processing**. **Top-down processing** is creating meaning beginning with our experiences and expectations.
• Bev Doolittle painting
• Bottom-up processing is seeing color, lines, etc.
• Top-down processing involves consideration of the title “The Forest Has Eyes” and finding deeper meaning in the picture.

http://www.firstpeople.us/pictures/art/odd-sizes/ls/The-Forest-Has-Eyes-800x409.html
THRESHOLD
The point of detecting stimuli

• **Absolute threshold**: the minimum stimulation necessary to detect a particular stimulus (light, sound, pressure, taste, odor). Established at a 50% detection rate. This depends not only on the signal’s strength but also our psychological state. (ex: parents of a newborn vs. siblings of a newborn, sentry during wartime vs. one during peace time)
Signal detection theory predicts when we will detect weak signals, measured as our ratio of “hits” to “false alarms.”

Signal detection theorists seek to understand why people respond differently to the same stimuli, and why the same person’s reactions may differ under different circumstances.

Signal detection can have life or death consequences...think about all of the studies having been done regarding talking/texting while driving...
SIGNAL DETECTION THEORY

• Studies show that people’s vigilance diminishes after about 30 minutes of judging a faint signal, but this varies according to time of day, the type of task, and whether the observer periodically exercises. (This information has significant impact on security situations...airports, military bases, etc.)
Other Sensory Constructs
(When math & physics meet psychology!)

• **Difference threshold**: minimum difference a person can detect between any two stimuli. Also known as **just noticeable difference (JND)**. The magnitude of the increase & its proportional relationship to the starting signal is relevant.

• 100g + 10g = detection, 1kg + 10g = no detection. **Weber’s law**: regardless of two stimuli magnitude, they must differ by a constant proportion for the difference to be perceptible. (Light difference by 8%, weight by 2%, and sound by 0.3%.) Related to “Fechner’s law” and “Weber-Fechner law.”
Other Sensory Constructs

• **Sensory adaptation:** diminishing sensitivity to an unchanging stimulus. After constant exposure to a stimuli, our nerve cells fire less frequently. Ex: smell in a room, hot shower, cold pool... If our eyes were not in constant motion, we would lose sight of images. (That’s why we perceive motion when there is none sometimes.) The beauty of this is that it allows us to attend to *informative* changes in our environment and to not be distracted by the uninformative. Once you have “adapted” you can’t return to your original state of sensitivity.

• **Habituation:** the weakening of a response to a stimulus, or the diminished effectiveness of a stimulus, following repeat exposure to the stimulus. You *can* return to original sensitive by consciously redirecting your attention. For example, if I tell you to listen to the air coming out of the vent, you can hear at any point you so choose.
FUNDAMENTAL LESSON IN SENSATION AND PERCEPTION:

• The fact that our sensory receptors are alert to novelty and if bored with repetition, free our minds to attend to different things means...We perceive the world not as it exactly is but as it is useful for us to perceive it!

• Our perception is our reality!
THE SENSES

• We look with our eyes but we see with our brains.
  – We can say the same about hearing, smelling, tasting, etc.

• TRANSDUCTION: the transforming of physical stimuli into neural impulses for our brains to interpret
Note guide instructions

• Identify basic structures of the primarily organ and pathway of the signal from stimulus to brain.
• Identify where transduction occurs**
• Identify basic malfunctions of the system
THE EYE, VISION

- [http://library.thinkquest.org/26111/howitworks1.html](http://library.thinkquest.org/26111/howitworks1.html)

- Vision: visible light component of the EM spectrum. **Wavelength** gives us **hue** (blue, green, etc.) and **amplitude** (a measure of energy) gives us **brightness**.

- Cool fact: The retina** is actually a piece of the brain that migrates to the eye during fetal development! Therefore the retina** encodes and processes some of the information as well as passes on neural impulses.

- **Cones** = **color**; **rods** = **brightness/dimness**
Through the eye to the brain

- Cornea > pupil > lens > fluid > retina** (consisting of rods & cones)
- Rods and cones of the retina convert energy into electrical impulse (transduction); **fovea**: area of high cone concentration
- The eye contains 91 million rods but only 4.5 million cones.
Through the eye to the brain

- Rods/cones > bipolar cells > ganglion cells > optic nerve (where it attaches to the retina, there are no receptors creating your **blind spot**) > thalamus > occipital lobe
Vision Experiment

• Shift your eyes to the left and close them.
• Gently rub the right side of your eye lid.
• Do you see the light image?
• Where do you see this light?
• Why does this happen?
• The receptors in your eye are so sensitive that they respond to touch but the signal is interpreted as light. You see the light to the left because your brain reads the signal as light coming from the left hand side since that is what would normally stimulate the cells on the right side of your retina.
Sensory Adaptation & Vision

• Our eyes are in constant motion to prevent sensory adaption (loss of sensation due to redundant stimuli) of our vision.

• These movements are called **saccades**. They are controlled by the cerebellum & the frontal lobe. (Finger to nose test...)
Vision Disorders

• Near-sightedness:

• Far-sightedness:
Vision Disorders

- Color blindness

http://www.colourblindawareness.org/colour-blindness/types-of-colour-blindness/

- Visual Agnosia (literally “lack of knowledge” describes someone who can not identify objects visual. May be able to describe.
Parallel Processing

• The taking in and processing of various sensory information simultaneously.

• Example: Visually we see color, depth, movement, and form and process this information all at the same time.

• Example: When a song we like comes on the radio we will sing the words, drum our fingers to the beat, and process emotional responses all at the same time.
Seeing Color

• Color: color is the brain’s interpretation of reflected wavelengths of light. The eye’s receptors (aka: cones) are designed to see red, blue, and green light which when alternately stimulated will allow for the seeing of different colors.

• Young-Helmholtz trichromatic theory (red, blue, green)
Negative Afterimages

- Opponent-process theory
  [http://www.exploratorium.edu/exhibits/bird_in_a_cage/bird_in_a_cage.html](http://www.exploratorium.edu/exhibits/bird_in_a_cage/bird_in_a_cage.html)

- Our vision system is an opponent (opposites) processing system. When one receptor site is exhausted from overuse, the other will kick in to high gear when given the opportunity.
Color Constancy

Ability to recognize color of an object despite changes in lighting.
Auditory Sense (Hearing)

• So, if a tree falls in the forest, and no one is around to hear it, does it make a sound?
THE EAR

- Hearing: the conversion of air pressure waves into neural messages that are interpreted as sound
- We hear sounds best within the range of the human voice. We are also highly sensitive to faint sounds and skilled at distinguishing from many similar sounds such as voices.
HEARING, AUDITORY

• Mechanics: the amplitude (energy) of the wave determines its loudness and the frequency of the wave determines its pitch. Prolonged exposure to sounds above 80-85 decibels can lead to hearing loss.

• General rule: If you cannot talk over a noise, it is potentially harmful to your hearing. Experiencing ringing after exposure is a sign of damage.
THE EAR

- Outer ear (ear canal to eardrum) > middle ear (bones: hammer, anvil, & stirrup > oval window > inner ear** (cochlea, basilar membrane, and hair cells**) ) > auditory nerve > thalamus > temporal lobe
Hearing Loss/Disruptions

• **Tinnitus**: ringing or sounds in the ear with no external source


• **Sensorineural hearing loss (never deafness)**: Loss of hearing due to age, heredity, and prolonged exposure to loud sounds. Hair cells are damaged and cannot repair themselves. In severe instances **cochlear implants** can be used to restore hearing.
Cochlear Implant
Hearing Loss/Disruptions

- **Conduction hearing loss**: Problems with the mechanical system (outer ear/middle ear) that result in the conduction of the sound waves. A punctured eardrum or damage to the tiny bones of the middle ear can result in this.
- A hearing aid, which amplifies sound, can help with this type of hearing loss.
More on sounds & hearing

• Study: People who live with continual noise in factories, in homes near airports, and in apartments near trains and highways suffer elevated rates of stress-related disorders: high blood pressure, anxiety, and feelings of helplessness...confounding variables???
Evans, et al, 1995
How we hear

- Placement of the ears allows us to detect location of sounds easily. Remember our click lab? When were people most likely to make a mistake?
How we hear

- **Place theory:** The idea that we detect different pitches because different sound waves trigger activity at different places along the cochlea’s basilar membrane.

- **Frequency theory:** The rate of nerve impulses traveling up the auditory nerve matches the frequency of the tone, allowing us to determine pitch.
TASTE, GUSTATORY SENSE

• Four Five basics sensations: sweet, sour, salty, bitter, and umami (meaty taste, MSG). Taste receptors reproduce themselves but the amount you have declines with age. Smoking & alcohol accelerate the decline. Receptors exist in the back and on the roof of the mouth, too.

• Smelling a food’s aroma will enhance the taste. Therefore, food doesn’t seem as flavorful when we have a cold. This is known as sensory interaction.

• Smell + texture + taste = flavor.
Taste buds/papillae**
SMELL, OLFACTORY SENSE

• Like taste, smell is a chemical sense. Sense peaks at early adulthood, and women typically have a heightened sense compared to men. Smell is also acutely attached to memories, especially good scents to good memories.

• Head trauma is the #1 cause of people losing their sense of smell.
SYNESTHESIA

- Synesthesia occurs when one sort of sensation produces another, for example, tasting a color or hearing a number.
TOUCH, TACTILE SENSE

• Touch is a combination of at least 4 distinct skin sensations: pressure, warmth, cold, and pain.
• Only pressure has identifiable receptors.
• Other skin sensations are variations of the basic 4 mentioned above. For example: stroking adjacent pressure spots creates tickle.
• Repeated gentle stroking of a pain spot creates an itching sensation.
• Skin with no hair (palms of hands, soles of feet are more sensitive)
TOUCH, TACTILE SENSE

• Touch sensations involve more than tactile stimulations, hence you cannot tickle yourself easily...top-down processing plays a role. Also, our brain knows to be sensitive to “surprise attacks!” (hand illusion video...)

• http://www.youtube.com/watch?v=sxwn1w7MJvk
PAIN PERCEPTION

• Pain is the body’s way of telling you something is wrong. It tells you to change your behavior immediately.

• Pain is a property of the sensory neurons in the region and the brain as well. Pain has been documented in body parts that don’t exist in the case of amputees. (*Phantom sensations* have been documented with all of the senses.)

• There is no one stimulus that causes pain and there is often other sensations that go along with pain.

• Pain can also be turned on and turned off by distractions, relaxation, drugs, endorphins, other stimuli like ice, electrical impulses or acupuncture. *Gate-control theory*
VESTIBULAR SYSTEM:
BALANCE/EQUILIBRIUM

Balance/equilibrium: Within the inner ear, in the semicircular canals, connected to the cochlea by the vestibular sacs, contain fluids that move when the head moves. This stimulates hair-like receptors sending messages to our brain about our position and balance. Since the fluids don’t stop moving as quickly as you do, this leads to a dizzy sensation following spinning in a circle.
KINESTHESIS: WHERE ARE MY FEET?

• **Kinesthesia** is our sense of body parts’ position and movement through sensors all of our body in muscles, tendons, and joints. Loss of this sensation leads to a sense of disembodiment.

• Remember the finger to nose test? You can do this almost as easily with your eyes closed due to KINESTHESIS!
PERCEPTION

• **PERCEPTION:** The selecting, organizing, and interpreting of our sensations.

• **Selective attention:** at any moment our awareness focuses on only a limited aspect of all that we experience...by one estimate, our collective senses take in 11,000,000 bits of information per second, of which we consciously process about 40.

• **Cocktail party effect**

• When vision competes with other senses, it usually wins, this is known as **visual capture.** (Boomerang cartoon voices.)

http://www.youtube.com/watch?v=vJG698U2Mvo
PERCEPTION

• **INATTENTIONAL BLINDNESS**: The inability to see/notice things due to attention being redirected. (Think about the gorilla test!)

• When distracted, either our sensory system is not activated or our perception system is not activated making it impossible to detect the stimulus.
Perceptual Organization: GESTALT

- German for “whole” or “form”
- In perception the whole may exceed the sum of its parts.
- It describes how we organize our sensations into perceptions

http://www.at-bristol.org.uk/Optical/NeckerCube_main.htm
http://graphicdesign.spokanefalls.edu/tutorials/process/gestaltprinciples/gestaltprinc.htm
http://www.thepsychfiles.com
Perceptual Organization: GESTALT

• To make sense of our world, our brain is built to organize the information automatically.
• Gestalt principles of CLOSURE, PROXIMITY, SIMILARITY, CONTINUITY, etc. can all be used to explain ambiguous stimuli
Figure-Ground

- http://www.lewport.wnyric.org/JWANAMAKE\ R/illusions_plus/illusions_figureground.htm

- Stereogram, 3-D

- http://www.netaxs.com/~mhmyers/rdsjpsgs/eagle.jpg
PERCEPTUAL SET

• A mental predisposition that influences what we see. (Police prepped for violence.)

• Once we have formed the wrong idea about reality it is difficult to see the truth

• Loch Ness monster, UFOs, man in the moon, Jesus on toast...it’s not just what we see or hear, but what our mind’s eye perceives.

• Where does our perceptual set come from: schemas and accommodation and assimilation
Words to Know

- **Schema**: a concept or framework that organizes and interprets information. Ex: Erin knows what dogs are because we have two.

- **Assimilation**: interpreting one’s new experience in terms of one’s existing schemas. Ex: Erin saw horses for the first time this weekend, she called them dogs.

- **Accommodation**: adapting one’s current understandings (schemas) to incorporate new information. Ex: Erin’s understanding of domesticated animals will eventually include separate categories for dogs and horses.