

Van Selst

# **Introductory Psychology**

## **Chapter 4: Sensation & Perception**

### **Winter 2014**

Sensation and Perception

Chapter 4 of Feist & Rosenberg *Psychology: Perspectives & Connections*

## Chapter 4: Sensation & Perception

**Sensation:** receiving physical stimulation, encoding the input into the nervous system; The processes by which our sensory organs receive information from the environment.

**Perception:** the process by which people select, organize, and interpret (recognize) the sensory information, the act of understanding what the sensation represents

**Transduction:** Physical energy → neural impulses

## Chapter 4: Sensation & Perception

**Absolute threshold:** the minimum amount of stimulus required for a percept (note: “sub-liminal” perception is perception below the threshold of consciousness); the amount of stimulation required for a stimulus to be detected 50% of the time.

**Jnd:** just noticeable difference: smallest difference between stimuli that people can detect 50% of the time.

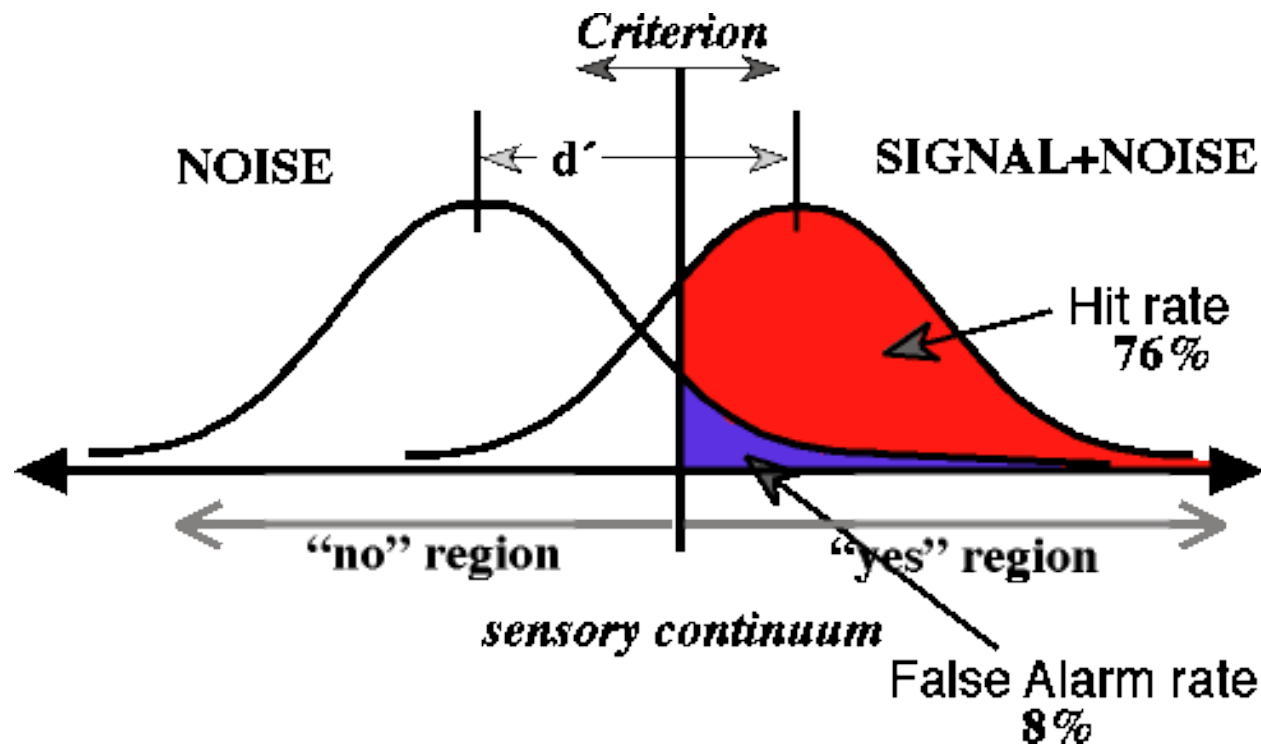
**Weber’s law:** physical intensity vs perceptual (psychological) experience; the idea that the jnd of a stimulus is a constant proportion despite variations in intensity. (2% change for weight; 10% change for loudness; 20% for taste of salt)

**Sensory adaption:** a decline in sensitivity to a stimulus that occurs as a result of constant exposure.

e.g., the perceived loudness of a nightclub or a plane

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**Signal-Detection Theory:** statistical model of decision making (Sensitivity & Bias)



# Chapter 4: Sensation & Perception

## The five classic senses:

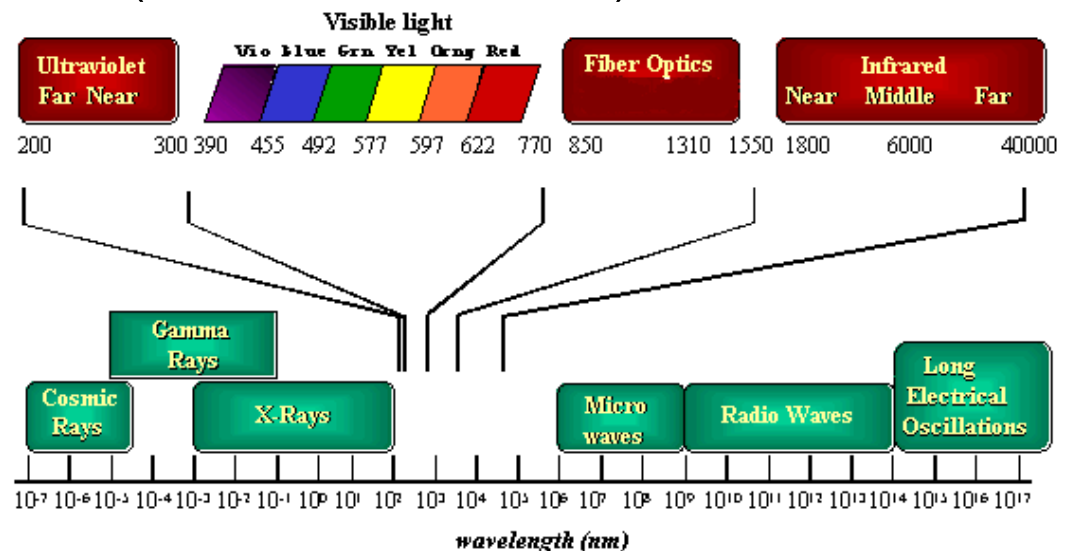
- Vision (day, night)
- Hearing
- Taste
- Smell
- Touch (pressure, pain, warmth, cold);
  - in general there is very little “cross-talk” across the different sensory systems, although some rare cases of synesthesia (stimulation produces a cross-modal percept) are reported.
- + Kinesthetic
- + Vestibular

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Light:

- Wavelength:

- Cosmic rays
- Gamma rays
- x-rays
- 200-400 nm = ultraviolet
- 400-700 nm visible spectrum (RGBIV from 700-400)
- 700-1500 nm infrared
- microwaves
- TV
- Radio



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## Visual System

**Path of incoming light:** Cornea, (aqueous humor), pupil (the hole in iris), lens, (vitreous fluid), past blood vessels & vision neuron support structures, then to receptor at retina. (info ultimately through the support cells then out axon at optic disk (blindspot) into the optic nerve...)

**Rods:** scotopic vision: (poor acuity), good for low luminance, primarily peripheral; very sensitive to light

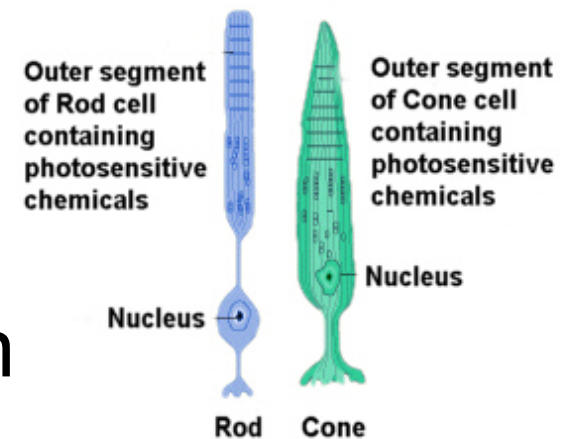
**Cones:** primarily at Fovea (good acuity), require substantial luminance (not very sensitive to light), Photopic vision (color vision).

**Contralateral:** (opposite side of head): visual processing at the occipital lobe for input from the right visual field is processed in the Left Hemisphere

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### Rods & Cones:

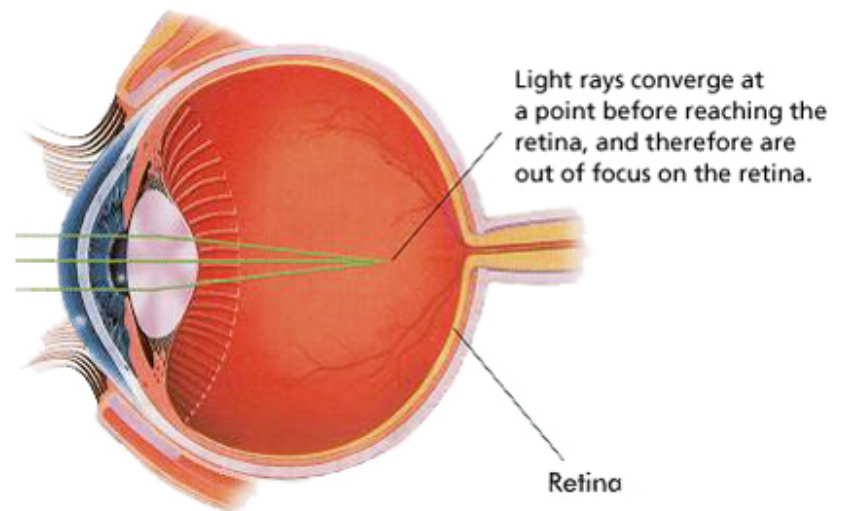
- Scotopic & Photopic vision
- Monochromatic vs color vision
- Poor vs good acuity
- Different functions and different amounts of data collapsing (and thus acuity) depending on location within visual field.





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**Myopic:** near sighted – cannot see far objects clearly; a failure of **accommodation**, which is the visual process by which lens become more rounded for viewing nearby objects and flatter for viewing remote objects.



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Visual field inputs to contralateral hemisphere  
(occipital lobe, V1)

Hubel & Weisel (1979): single-cell recordings  
(cats, monkeys, ..)

Simple Cells: highly particular target cells  
(e.g., center-surround; oblique edge; etc.)

Complex Cells: receive input from many simple cells  
(combine for target)

Hypercomplex cells: receive input from many complex cells  
(combine for target)  
(example: “Pandemonium model of pattern recognition”)

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## LIGHT & DARK ADAPTATION

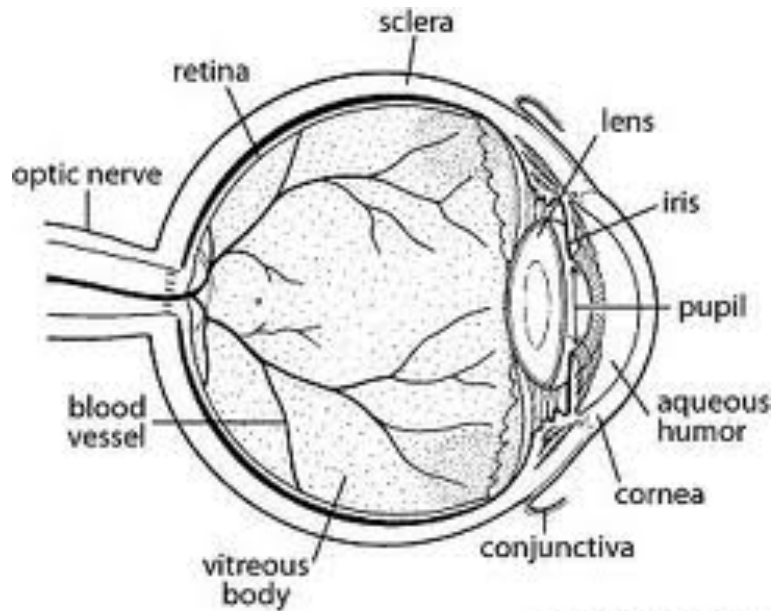
- Dark Adaptation (20 minutes): e.g., to/from washroom at night
- Light Adaptation (sensory adaptation): e.g., “bright outside” (initially)...

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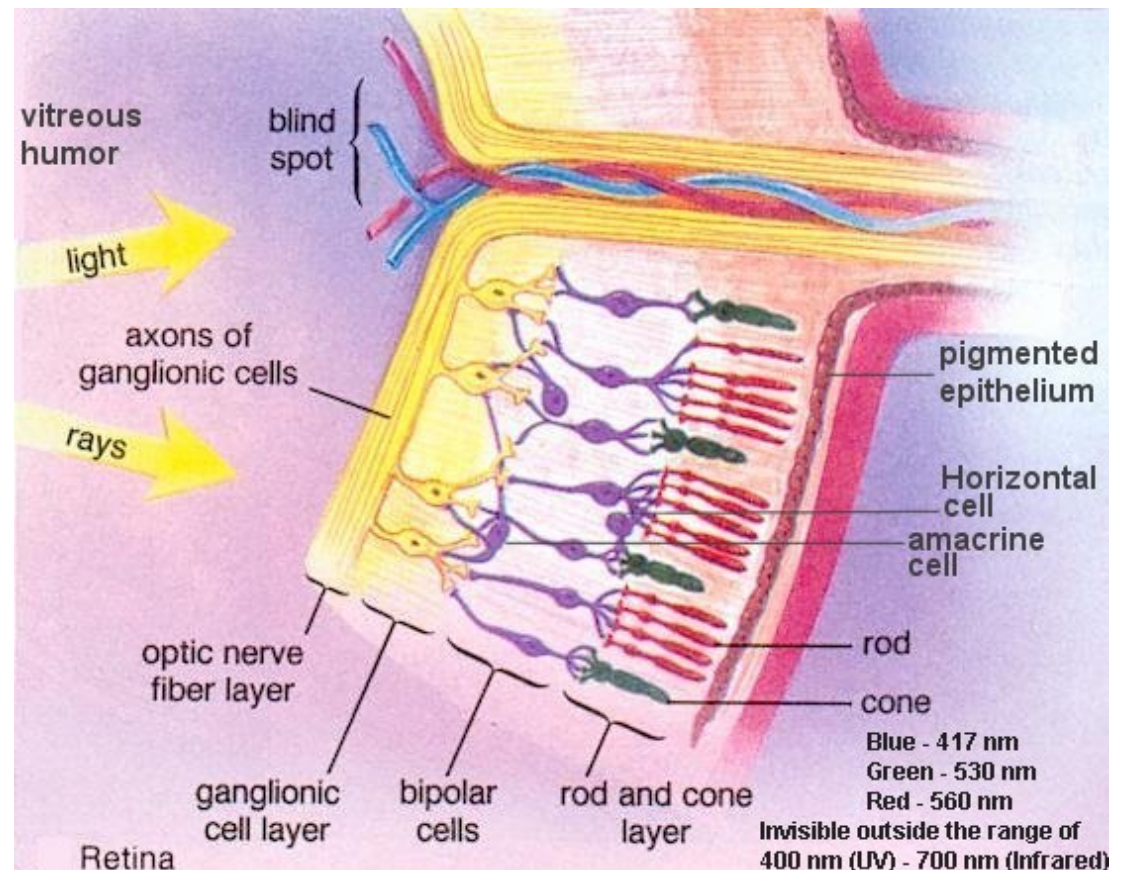
## COLOR VISION

- Young-Helmholtz (1802, 1852) Trichromatic theory of color vision: human eye is receptive to three primary colors (red, blue, green).. all other colors are derived from combinations of these primaries.
- Hering (1878) opponent-color theory of color vision: the theory that color vision is derived from three pairs of opposing representations: Blue vs. yellow, red vs. green, and black vs. white.
- At the retina: trichromatic theory; at the thalamus (relay station to cortex): opponent-process.

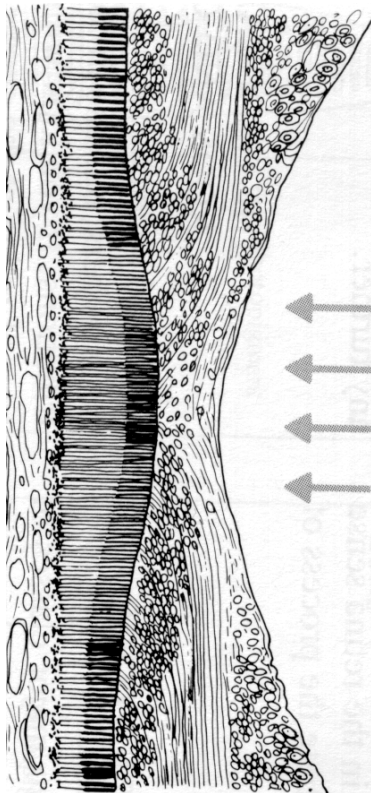
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Laurel Cook Howe



## Chapter 4: Sensation & Perception



### Rods & Cones:

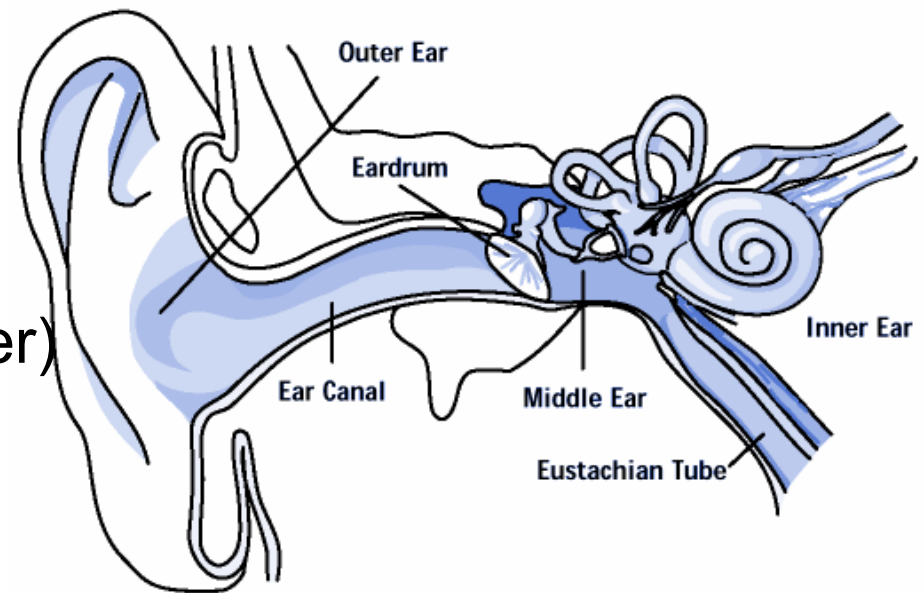
- Scotopic & Photopic vision
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## Chapter 4: Sensation & Perception

### Auditory Sensory/Perceptual System

- Shape of the ear
- Outer ear / middle ear / inner ear
- Location based
  - (Basilar Membrane)
- Timing based
  - (auditory nerve cross-over)



## Chapter 4: Sensation & Perception

- **Outer ear:** Pinnae (shape helps relevant frequencies and adds localization), Auditory canal
- **Middle Ear:** Eardrum, Hammer, Anvil, Stirrup. Translates mechanical air movement through mechanical advantage into hydraulic movement (stirrup sits on oval window).
- **Inner Ear:** Cochlea contains basilar membrane (short waves close)
- Auditory cortex (temporal lobe)



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## SENSORY DIMENSIONS OF PHYSICAL ASPECTS OF SOUND WAVES

- Frequency (wavelengths of 20Hz to 20,000 Hz) → sensory dimension = pitch
- Amplitude (height of wave) → sensory dimension = Loudness
- Complexity → sensory dimension = Timbre

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DB (decibel) scale: “orders of magnitude” 20db has ten times as much energy as 10dB, etc... log scale...

- 140 = gunshot. Single extreme exposure (loud rock concert amplifier, etc) can lead to permanent hearing loss.
- 85 = heavy traffic noise (jackhammer, etc). Continuous exposure can lead to hearing loss (flight attendants, construction workers, ..).
- 70 = normal automobile
- 60 = normal conversation
- 40 = quiet office
- 20 = whisper at five feet
- 10 = leaves in a very gentle breeze

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- Consumer reports estimates 10% of adult population suffer from hearing loss (this percentage is increasing [personal walkmans, ear bud music, etc]).
- Conduction hearing loss: damage to eardrum or bones
- Sensorial hearing loss: damage to structure of the inner ear.

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### SMELL (OLFACTORY SYSTEM)

- A chemical sense (lock & key fit with receptors).
- The structures responsible for the sense of smell (olfactory bulb) is directly routed to the cortex and limbic system structures that control memory and emotion (only sense not gated through thalamus).
- Anosmia: without the sense of smell
- Smell as “the fallen angel of the senses” (Helen Keller)

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## TASTE (GUSTATORY SYSTEM)

- A chemical sense (lock & key with receptors)
- Taste buds replenish (10 days or so..)
- Sweet, salty, sour, bitter, savory.
- “flavor” seems to rely on the contribution of smell
  - vanilla without smell = ??
  - apple vs. potato
- Specific taste receptors are NOT unevenly distributed across the tongue (it is an often replicated error in intro psych textbooks)

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## TOUCH

- Largest sensory organ
- Pressure + (Warmth, Cold, Pain)
- Pressure: unique and specialized nerve endings; differential sensitivity
- Gate-control theory of pain: creation of competing sensations can reduce the psychological experience of pain (acupuncture, etc).

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### **KINESTHETIC SYSTEM**

- Monitors the positions of various body parts in relation to each other.

### **VESTIBULAR SYSTEM**

- Monitors head tilt and location in space (inner ear semicircular canals and vestibular sacs)

## Chapter 4: Sensation & Perception

**Perception:** the process by which people select, organize, and interpret (recognize) the sensory information, the act of understanding what the sensation represents



# Perception

Gestalt principles of organization

Proximity      00 00 00

Similarity      ---+++

Continuity

Good form (closure)

Common fate

Making sense of what you see:

Top-down organization (THE CAT, context driven; WORK\*; "\*eel")

Bottom-up organization (recognize Dalmatian w/out knowledge?)

- Marr's 2 1/2-D sketch
- Ullman's visual routines; ...

PERCEPTUAL CONSTANCIES

Size: (Ames Room; Distance)

Shape: (Spinning Coin)

## CUES TO DEPTH

### **Binocular:**

- Convergence
- Binocular disparity

### **Monocular**

- Relative Image Size
- Texture Gradient
- Linear Perspective (ponzo illusion)
- Interposition
- Atmospheric Perspective (blur)
- Relative Elevation
- Familiarity



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