

Psychology 1010

Unit 3

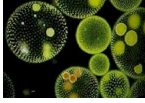
Week 8

Consciousness

- What is consciousness?
- Difficult to define!
- In general, a state of awareness:
 - Awake vs. asleep/anesthetized.
 - Content of thought (I am conscious of the sound of the air conditioner).
 - _____ – knowing oneself as an individual separate from others.

Consciousness

- We assume that single-celled organisms are not conscious, but humans are.
- When did consciousness arise evolutionarily?
- What is the adaptive value of consciousness? Or unconsciousness?



Consciousness

- Why be unconscious (sleep)?
 - _____.
 - Keep out of sight during light/dark (depending on adaptation), assuming a safe place to hide.
 - Less overall energy expenditure.
 - But... still could be dangerous.



Consciousness

- Advantages of consciousness?
 - Behavioral flexibility (not just instinct)
 - Greater drive to survive?
 - Navigating a complex social environment

Consciousness

- How do we test for consciousness?

- Rouge test. Individuals that pass:

- Humans over 18 months
 - Bonobos
 - Chimpanzees
 - Orangutans
 - Asian elephants
 - Bottlenose dolphins
 - Killer whales
 - _____



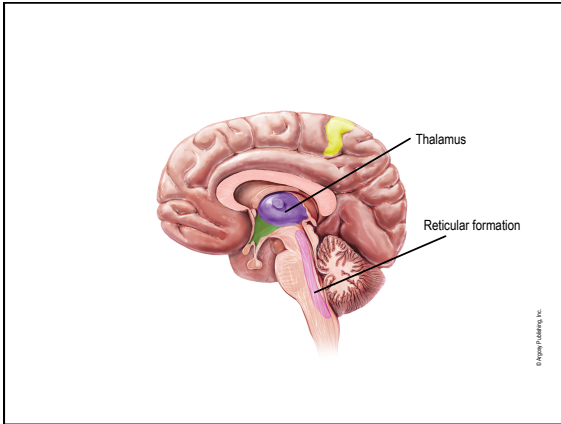


Rubbing one's own face instead of the mirror is taken as a sign of self-awareness.

Consciousness

- Which brain areas are involved in consciousness?

- _____ (relay station of the brain)
 - Reticular formation (in the brain stem).
Regulates sleep/wake cycles, stimulus filtering.



Sleep

- Why do we sleep?
- Strangely, we don't have a firm answer!
- Most people think it's to let the body and especially the brain rest and restore itself.
 - There is no relationship between vigorous activity and sleep.
- Sleep may have evolved to keep individuals quiet, inconspicuous, and out of trouble.

Sleep

- Sleep also appears to be important for learning and development.
 - Individuals that have missed a night of sleep have impaired _____.
 - Medical residents make more serious mistakes after periods with little sleep compared with well-rested residents.
 - Work accidents are more common during night shifts compared with day shifts.

Sleep

- Even a shift of one hour during daylight saving can make a difference.
 - In Canada, traffic accidents:
 - Increased after “_____” (i.e. losing an hour of sleep).
 - Decreased after “_____” (i.e. gaining an hour of sleep).

Sleep

- Traveling quickly across time zones can result in _____, or a disruption in the daily sleep cycles.
- Traveling _____ is generally easier with regard to jet lag than traveling _____, but the more time zones that are crossed leads to a greater likelihood and severity of jet lag.

Sleep

- Symptoms of jet lag can be lessened with brief exposures to bright light.
 - Bright light around _____ will delay the circadian rhythm, allowing sleep to occur later.
 - Bright light in the _____ will advance the circadian rhythm, allowing sleep to occur earlier.

Sleep

- The amount of sleep a person needs varies from individual to individual.
- Sleep requirements change over the lifespan (more sleep needed when younger, less when older).
- Hormones released at puberty cause a temporary _____ in circadian rhythms, leading teenagers to stay up late and sleep late.
- As people age, they tend to have more difficulty with sleep.

Sleep

- There are many individual differences in sleep patterns in humans.
 - “_____” – people that prefer to stay awake at night and sleep later in the morning.
 - “_____” – prefer to go to bed early, and get up early.
- Genes play a role.



Sleep

- _____: biological processes that are on a 24 hour cycle.
 - circa = around or about
 - diem = day
- _____: external stimulus that serves to entrain internal biological rhythms.
 - Zeit = time
 - geber = giver

Sleep

- Common zeitgebers:
 - Light! When on a schedule without light, most people have a cycle that is a few minutes longer than 24 hours.
 - _____
 - Mealtimes
 - Exercise patterns
 - Social interactions



Sleep

- Things we experience today that can seriously interfere with daily rhythms were not common/possible in the past.
 - Working night shifts
 - Jobs/school that are on a strict schedule
 - _____

Sleep

- _____ (SAD) – symptoms of depression associated with shorter days of winter.
- More common in northern latitudes of the U.S.
- Treated with bright light exposure.

Sleep

- _____ – hormone secreted by the pineal gland at night which helps regulate the sleep/wake cycle.
- Changes in melatonin production have been linked to health problems:
 - Sleep/mood disorders
 - Cancer
 - Cardiovascular diseases

Sleep

- Light destroys melatonin.
- Blue wavelength light (like produced by computer screens) is particularly harmful to melatonin production.
- _____ is best at preserving melatonin.

Sleep

- A nucleus in the _____ is responsible for circadian sleep cycles (hypothalamus signals pineal to release melatonin).
- Rats with lesions to this nucleus sleep the same amount as normal rats, but just at random times throughout the day and night, as opposed to one long bout during the day (rats are nocturnal).
- There is a direct pathway from the retina to the _____, which provides it with information about ambient light and allows entrainment.

Sleep

- Sleep is often studied in a sleep lab, where participants are hooked to a number of electrodes to record their EEG, muscle activity, and eye movements.



Figure 26.9

Sleep-Laboratory Protocol Readouts from electrodes attached to a sleeping subject record (A) brain-wave activity, (B) muscle activity, and (C) eye movements. (Photograph from Hank Morgan/Rainbow.)

Sleep

- Sleep can be divided into stages, depending on brain activity.
 - Awake:
 - _____ – when resting quietly, especially with eyes closed.
 - _____ – when a person is alert and attentive.
- Characterized by _____ of brain activity, since multiple circuits are actively processing information.

Awake



Alpha activity

Beta activity

Carlson

Sleep

- Sleep is divided into _____ (rapid eye-movement) and _____ (N-REM).
- 4 stages of N-REM sleep:
- _____ – characterized by _____ waves, which indicate a greater synchrony of neuronal firing (larger, slower waves).
- Transition between sleep and wakefulness.
- If awakened in stage 1, you might report not having been asleep at all.

Awake



Stage 1 sleep



Carlson

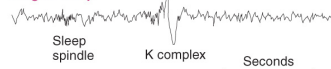
Sleep

- _____ – characterized by theta activity with interspersed _____ and _____.

Stage 1 sleep



Stage 2 sleep



Seconds

Carlson

Sleep

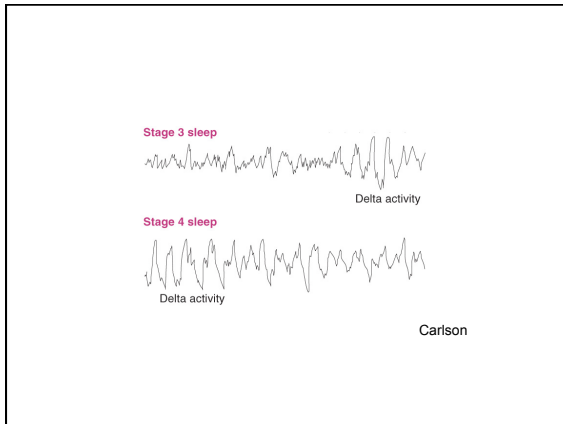
- _____ – short burst of brain activity during stage 2 sleep.
- Perhaps a way for the brain to inhibit activity and continue with sleep.
- Occurs with muscle twitching, and might be a way for growing children to learn how to move muscles.

Sleep

- _____ – spontaneously occur 1x per minute during stage 2 sleep, but are also triggered by noises.
- Inhibitory mechanism to prevent waking.
- Forerunner of delta activity, seen in deepest levels of sleep.

Sleep

- _____ - 20 – 50% large amplitude _____ activity.
- _____ - > 50% delta activity.
- _____ – stages 3 and 4. Most difficulty awakening someone in SWS, and people feel most groggy when awakened.

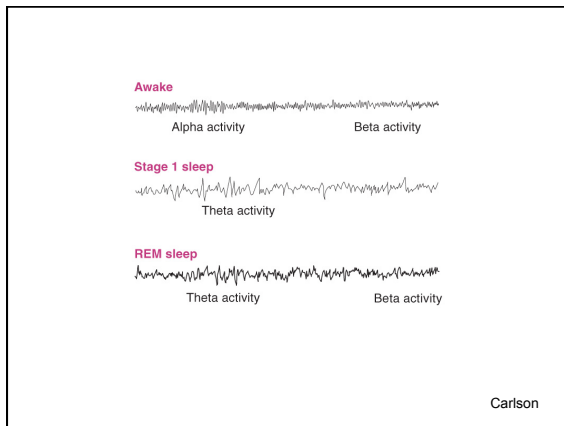


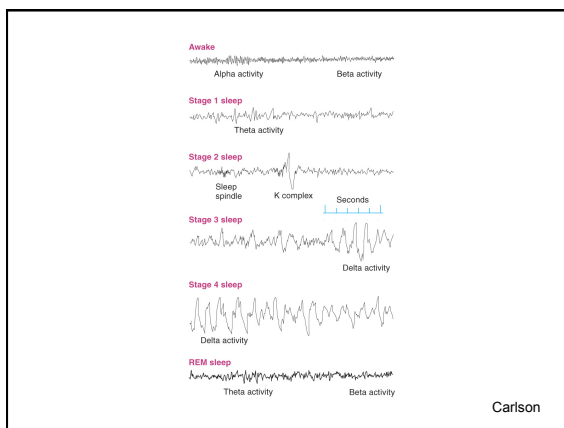
Slow Wave Sleep

- Eye movements are slow or absent.
- Moderate muscle tone.
- Slow wave sleep brain metabolism is ____% of waking metabolism.
- The brain regions with the highest activity while waking have the lowest metabolic activity during slow wave sleep.

Sleep

- **REM (rapid eye movement) sleep** – EEG becomes _____ (like the waking pattern) with beta and theta activity, eyes dart around rapidly, and dreaming occurs.





REM Sleep

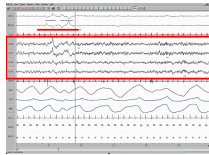
- Called “_____ sleep,” since brain waves resemble waking.
- If a person is awakened during REM sleep, they are relatively alert.
- Muscles are paralyzed during REM sleep, though sexual arousal can occur.

REM Sleep

- The highest proportion of REM sleep occurs during the most active phase of brain development for the species.
- ____% of a newborn infant's sleep is spent in REM (____% if immature), but only ____% by 6 months of age. By adulthood, it's around ____%.

REM Sleep

- If we don't get enough REM sleep, we experience _____, where we "catch up" on REM sleep.
- REM sleep is related to mood:
 - People with depression spend more time in REM sleep than normal.

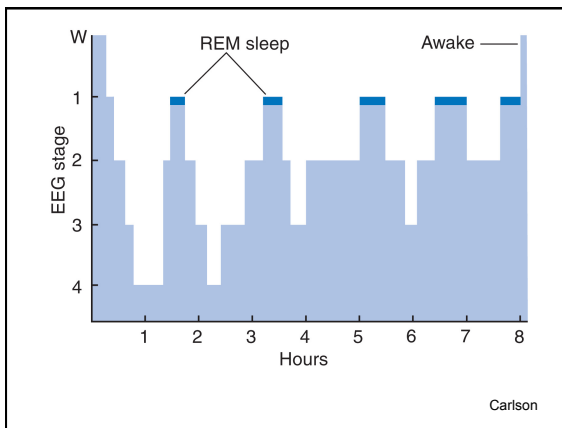


Sleep

- Bedwetting, sleepwalking, and night terrors happen during slow wave sleep (stages 3 and 4, not REM sleep).
- People who are sleepwalking are not acting out dreams, but can still exhibit complex behaviors.
- Night terrors are accompanied by screams, trembling, and a rapid pulse with no memory of the cause.
- Talking during sleep happens during phases _____.

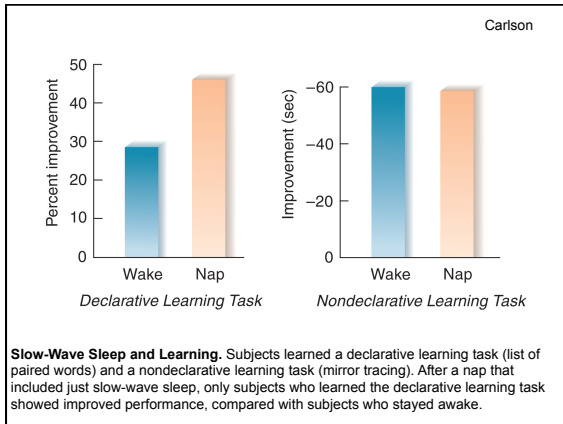
Sleep

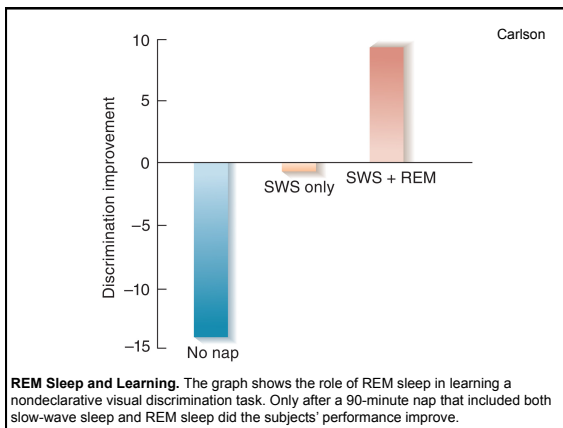
- Over the course of a night:
- _____ sleep becomes less common.
- _____ sleep becomes more common.
- People are easier to wake up during the second half of a night's sleep.
- If we wake up on our own, it's often from REM sleep (dreams).



Sleep

- Two major types of long-term memory:
 - _____ – memories that are consciously recalled, such as past life events, or facts.
 - _____ – memories that include procedural memories, such as how to catch a ball.
- Slow wave sleep appears to be important to declarative memory, while REM sleep is important to non-declarative memory.



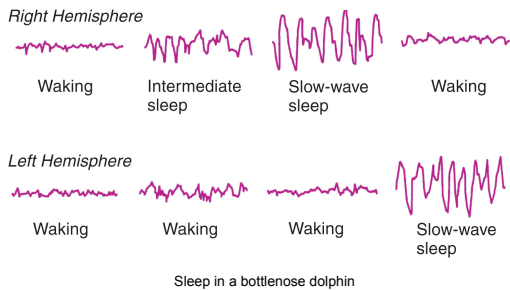


Sleep

- _____ sleep appears to be important to body restoration.
 - Ultramarathoners spend more time in slow wave sleep after a race.
 - People deprived of slow wave sleep report muscle and joint pain.

Sleep

- All vertebrates sleep, or at least enter quiet periods that are similar to sleep.
- Only birds and mammals exhibit REM sleep.
- Some animals can sleep _____ !
- Bottlenose dolphins, porpoises, and some birds (e.g. mallard ducks) sleep with one hemisphere at a time, allowing them to always be vigilant with the other side of the brain (and corresponding eye). It also allows dolphins and porpoises to keep moving in the water so as to not drown.



Dreaming

- Why do we dream?
- _____ – dreams are the brain's way of making sense of what's going on in the brain during sleep.
 - Dreaming of being paralyzed might reflect actual paralysis during REM sleep.
 - Dreaming of sexual situations might reflect actual arousal during REM sleep.
 - Dreaming of falling might reflect activation of the vestibular system during REM sleep.

Dreaming

- Why do we dream?
- _____ – dreams are a way of simulating situations and coming up with plans of action.
 - Up to _____ % of dreams contain a negative situation that would require a plan.

Sleep - disorders

- _____ – dreams with scary or disturbing content. Training in _____ might help people to be able to consciously control dreams to an extent.
- _____ – difficulty getting to sleep or staying asleep.
 - _____ – difficulty falling asleep (often caused by stress or anxiety).
 - _____ – difficulty staying asleep (often caused by stress, substance abuse, psych disorders).

Sleep - disorders

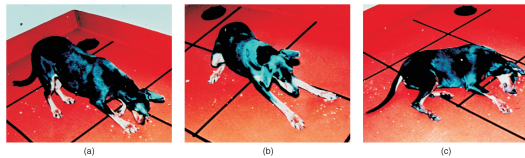
- _____ – characterized by sudden daytime “_____” of REM sleep which last a few to 15 minutes.
- Narcoleptics reach REM sleep after about 10 minutes, while for others it takes 90 minutes.
- Sleep is fragmented.

Sleep - disorders

- _____ – another symptom of narcolepsy that is an inability to move just before or after normal sleep.
- Not uncommon among people without narcolepsy. It's a side effect of the actual paralysis that happens during REM sleep.
- People can be “snapped out” of sleep paralysis by a light touch or by hearing a sound.

Sleep - disorders

- _____ – sudden muscle weakness or paralysis while awake.
- Individuals with cataplexy are fully conscious for up to a few minutes while being unable to move.
- The muscular paralysis of REM sleep happens at inappropriate times.
- A cataplectic attack is often brought on by strong emotions.
- Cataplexy is related to a lack of the neurotransmitter _____.



Cataplectic attack in a dog brought about by the excitement of finding food on the floor.

Carlson

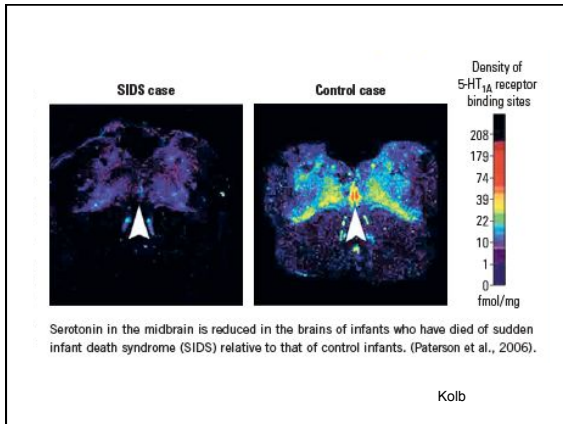
Sleep - disorders

- – individuals experience pauses in breathing during sleep. Can lead to increased levels of carbon dioxide in the blood, and disrupted sleep.
 - – due to collapse of pharynx during paralysis of REM sleep. More common in overweight people.
 - – failure of the diaphragm to move.
- Continuous Positive Airway Pressure (CPAP) machine – uses pressurized air to keep the airway open.



Sleep - disorders

- – one of the leading causes of infant death in the U.S.
- Approx. 2,000 infant deaths annually (US).
- Risk is highest between 1-3 months.
- More common for children that are low birth weight, exposed to cigarette smoke, or sleep in soft bedding.
- Less likely among children that sleep on their backs, or sleep with a pacifier.
- Appears to be correlated with reduced serotonin in the midbrain.



Sleep - disorders

- _____ – individuals fail to exhibit paralysis during REM sleep, and consequently act out their dreams.
- _____ – people eat in their sleep, then wake up without any realization of what happened.

Sleep - disorders

- _____ (FFI) – a rare autosomal dominant disorder found in about 40 families worldwide.
- Symptoms don't appear until people are in their 30s, with an average age of 50.
- Children have a 50% chance of inheriting the gene.

Sleep - disorders

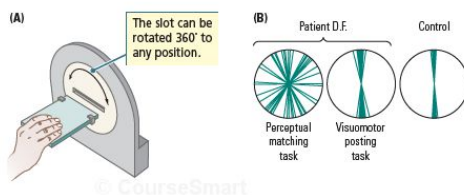
- FFI is due to improper protein folding (also with prion diseases like mad cow disease) in the thalamus.
- Begins with insomnia, until eventually patients can't sleep at all. Generally leads to death within 12 months.
- Attempts to "force" people to sleep with drugs might prolong life slightly, but are not a cure.

Consciousness

- People with brain damage can give us insight into consciousness.
- Blindsight – people with lesions in the occipital lobe can't see, but can still make better than average "guesses" about visual stimuli.

Consciousness

- One patient was unable to say the orientation of a slot (image on left), but was able to "post" a card through the slot.

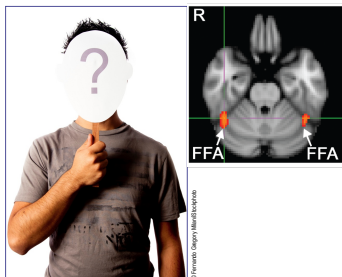


Consciousness

- _____ – inability to recognize specific faces.
- Patients know they are looking at a face, but not whose face it is, even close friends and relatives (or themselves!).
- Individuals often use voice, movement, clothing, or hairstyle of the person to recognize them.

Prosopagnosia

- Due to damage in the temporal lobes, specifically in the _____ (FFA).
- Despite being unable to consciously recognize faces, people with prosopagnosia have an increase in _____ (electrical conductivity of the skin – indicates arousal) when seeing family and friends.
- They are responding emotionally, but have no conscious awareness.



Consciousness

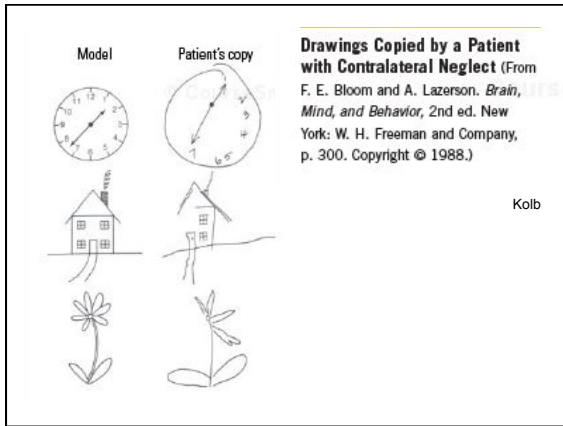
- _____ - the “opposite” of prosopagnosia.
- Individuals recognize their relatives or close friends, but do not believe they are actually a relative or friend. They’re “_____.”
- Could be due to a disconnect between the fusiform face area and the amygdala (emotional center).
- When looking at familiar faces, individuals with _____ delusion do not show an increase in GSR.

Consciousness

- _____ (_____) – occurs with right parietal lobe damage.
- Everything on the left is ignored.
- Patients might only groom (put on makeup, brush teeth, hair arranging) and clothe the right half of the body.

Consciousness

- Individuals with unilateral neglect are not blind or numb, they simply don’t care about things on the left.
- Even a dog with the same type of damage will eat only the food in the right side of the dish!







Week 9

Perception

- _____ – when a sensory system detects a stimulus. Light strikes the retina, sound vibrates the inner ear, etc.
- _____ - when the brain processes and interprets a sensation.
- _____ – the process of translating a stimulus into a neural signal.
 - Sensory systems change physical energy into physiological activity.

Perception

- Different species sense things in different ways, and have different sensory capacities.
 - Dogs have fewer color receptors in their eyes compared with humans (but birds have more!).

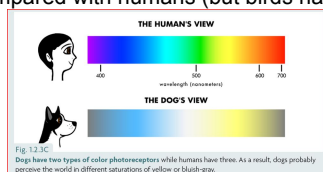
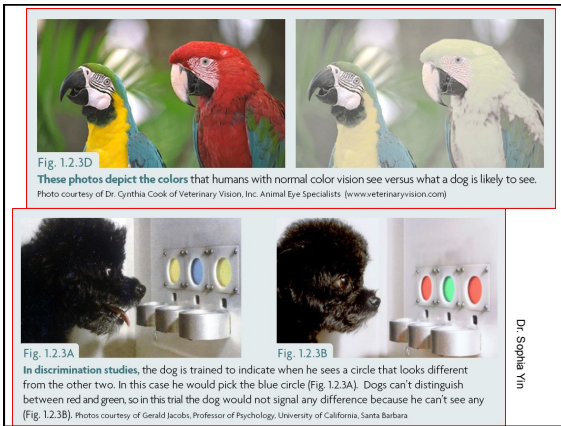


Fig. 12.10c
Dogs have two types of color photoreceptors while humans have three. As a result, dogs probably perceive the world in different saturations of yellow or bluish-grey.

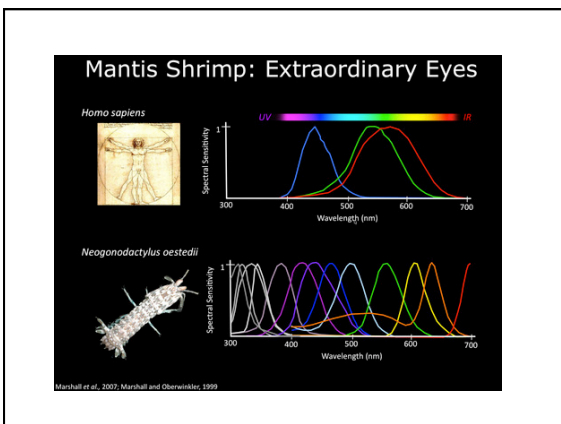
Dr. Sophia Yin



Perception

- Mantis shrimp have between ___ and ___ photoreceptors, some of which are for ultraviolet and polarized light.





Perception

- Why are sensory systems different among species?
- They were shaped by natural selection to help individuals survive/reproduce in a particular environment.

Perception

- Seeing ultraviolet light is an advantage for insects, but not for humans.



Perception

- _____ – narrow focus of consciousness.
- At any given time, we're only conscious of a fraction of the sensory input we're receiving.
- What do we tend to pay attention to?
 - Things important for survival/reproduction.
 - Novel stimuli
 - High-intensity stimuli
 - Changing stimuli

Perception

- _____ - focusing on some information while excluding other information.
 - Sometimes we don't perceive things, even if they might be important (_____).
- _____ – reduction in response to a repeated stimulus. Helps us to sense changes in our environment

-
-
-
-
-
-


Perception

- _____ – use of incoming signals to construct perceptions.
- “Data-driven” processing.

- [illegible]

Perception

- _____ – use of prior knowledge to perceive information.



-
-
-
-
-
-



What's this?



Perception

- Because of top-down processing:
 - We actively construct many of our perceptions.
 - There can be a _____.
 - Perceptions sometimes conform to brain's expectations.

Measurement

- _____ – least possible stimulus that can be detected.
- _____ – smallest difference between stimuli that can be detected.
 - As the size/strength of a stimulus increases, so does the difference threshold.
 - Slight differences between 2 really bright lights are difficult to detect, not as much between 2 dimmer lights.

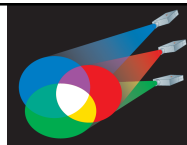
Perception

- _____ – determining whether a sensation was real when there is some uncertainty. Involves:
 - Actual stimulus intensity
 - Judgment of perceiver

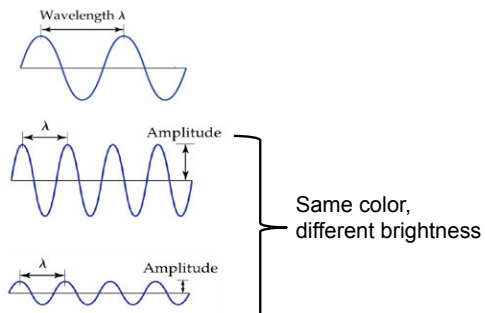
Possible Outcomes in Signal Detection

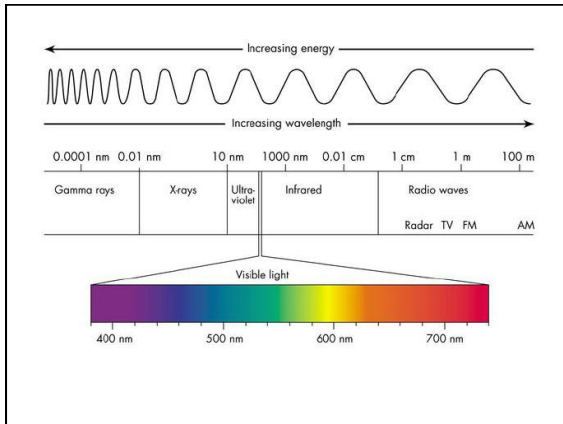
Participant response	Stimulus present	Stimulus absent
Yes	Hit	False alarm
No	Miss	Correct rejection

Vision



- In humans, more cortex is devoted to vision than any other sense.
- Visible light moves in waves.
- Properties of the waves determines what we see:
 - Taller waves (higher _____) = brighter light.
 - Differences between peaks of the waves (_____) determines the color we see.



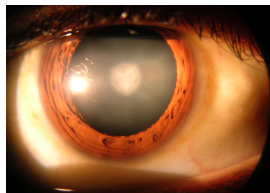


Vision

- _____ – clear outer covering at the front of the eye.
- _____ – muscle controlling the amount of light entering the eye. What gives us our eye color.
- _____ – opening in the iris through which light passes.
 - Pupils get larger in dim light or when aroused, and get smaller in bright light.

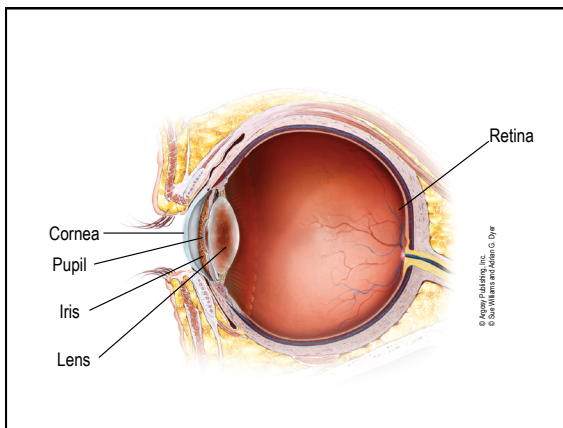
Vision

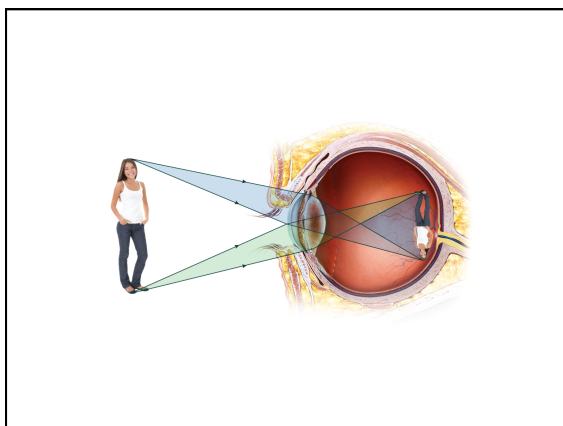
- _____ – structure behind the pupil that can change shape.
 - Allows for focusing up close or at a distance.
 - Clouding of the lens is the cause of cataracts.
 - The lens becomes less elastic as we age (some people require bifocals).



Vision

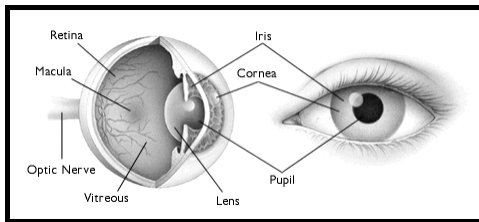
- _____ – light-sensitive layer of tissue at the back of the eye.
 - _____ – receptors in the retina that specialize in color and detail.
 - _____ – receptors in the retina that specialize in light.
- Image on the retina is upside down and flipped left to right.



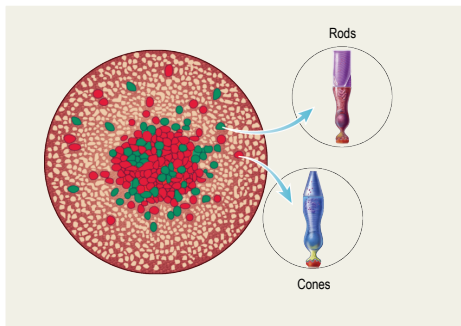


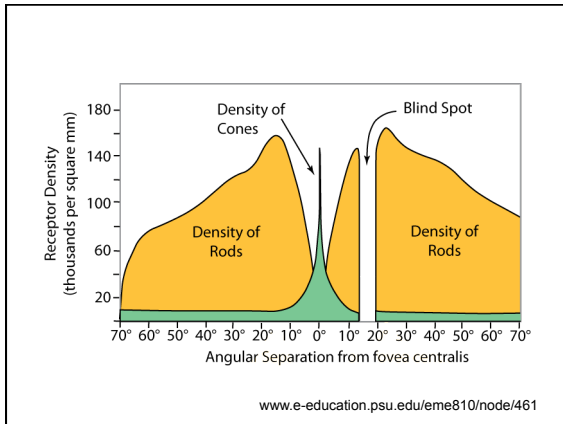
Vision

- _____ – area in the center of the retina used for sharp, central vision.
 - Cones more concentrated in fovea.
 - Rods more concentrated in periphery of retina.
 - Peripheral vision is better at night than central vision. To see something at night, look to the side of what you want to see.



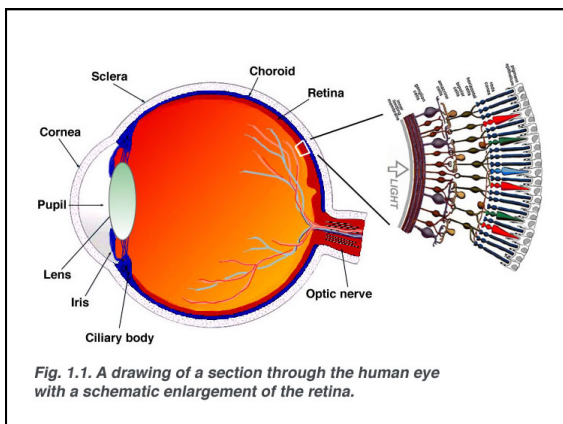
Fovea is in the center of the macula.

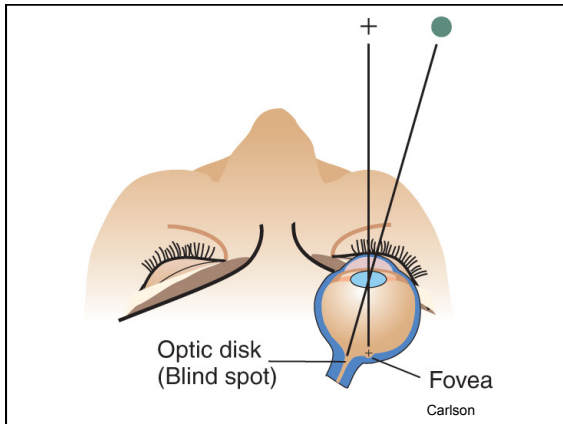




Vision

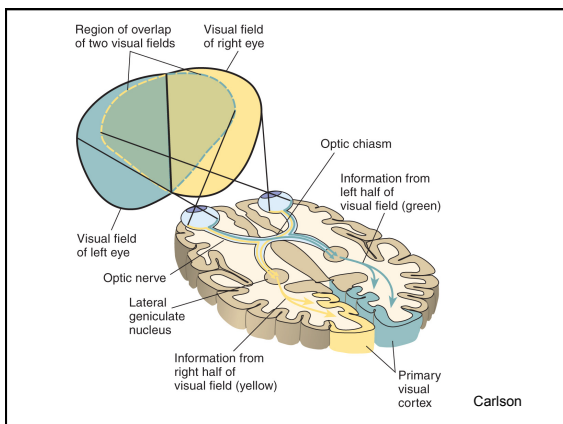
- Human eyes are built “_____,” with the light sensing cells facing the back of the retina.
 - This is a vestige of our evolutionary history.
- _____ – where all backward-facing light-sensing cells bundle together and exit the eye at one central point. Leads to a _____ where the _____ leaves the back of the retina.

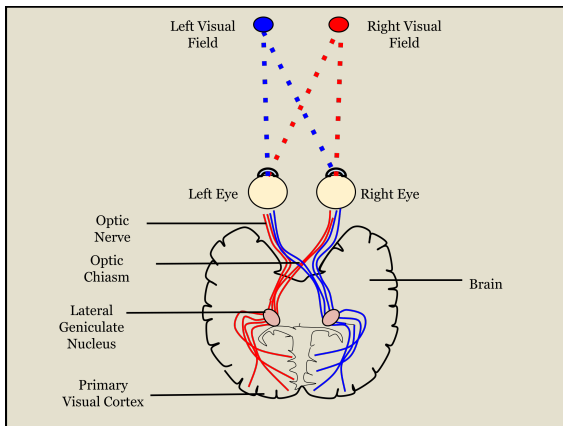




Vision

- Optic nerves from both eyes come together at a central point, and some cross to the other side of the brain at the _____.
- _____ – visual pathways after the optic chiasm.
- Most (90%) axons of the optic tract lead to the thalamus, the rest go to the hypothalamus or midbrain.



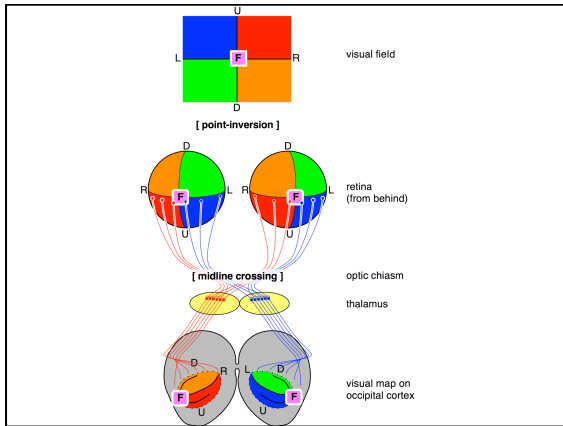


Vision

- Visual information from the thalamus goes to the amygdala (emotional judgments, especially fear), and the primary visual cortex, where vision “begins.”
- Pathways go from the visual cortex to the:
 - Parietal lobe – movement. The “_____” or “_____” pathway.
 - Temporal lobe – shape and color. The “_____” pathway.

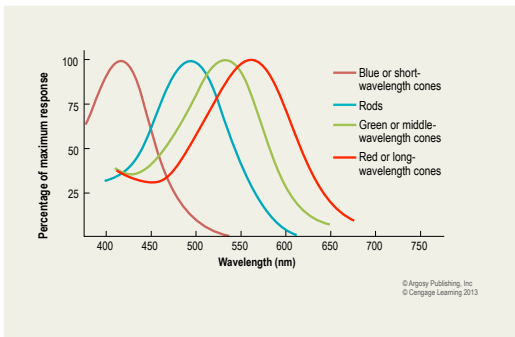
Vision

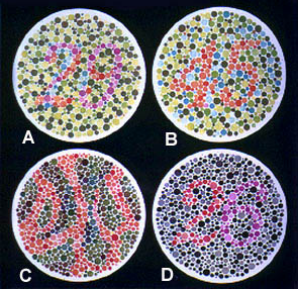
- Information from the left *visual field* (not left eye!) goes to the right visual cortex, and information from the right *visual field* (not right eye!) goes to the left visual cortex.
- The visual field is directly represented in area V1, though the cortical representation is upside down and reversed.



Color Vision

- _____ – we have 3 types of cones, each tuned to a different wavelength (red, green, blue).
- People with fewer than 3 types of cones are _____. They still see color, just differently.
 - About 10% of males and fewer than 1% of females have red/green colorblindness.



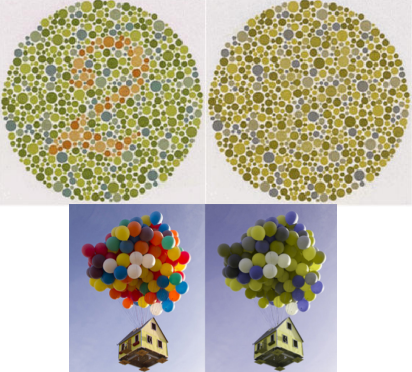


Types of colorblindness	
1. Normal Color Vision:	A: 29, B: 45, C: --, D: 26
2. Red-Green Color-Blind:	A: 70, B: --, C: 5, D: --
3. Red Color-blind:	A: 70, B: --, C: 5, D: 6
4. Green Color-Blind:	A: 70, B: --, C: 5, D: 2

Behavioral differences as a result?


Normal

Colorblind



Color Vision

- _____ – in low light, color vision shifts toward the blue end of the spectrum.
- Rods respond best to blue-green light.
- As light dims, brightness from red objects (cones) fades, and objects from the blue/green spectrum become brighter.



Color Vision

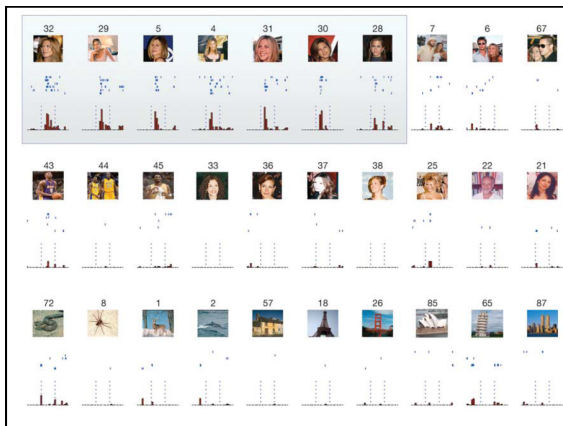
- Rods take around 30 minutes to function best when going from light to dark (_____).
- Since rods are not sensitive to long wavelengths, red lights are used when people need to be able to see detail (e.g. for writing or manipulating instruments), but want to remain dark adapted (in submarines, stargazing etc.).

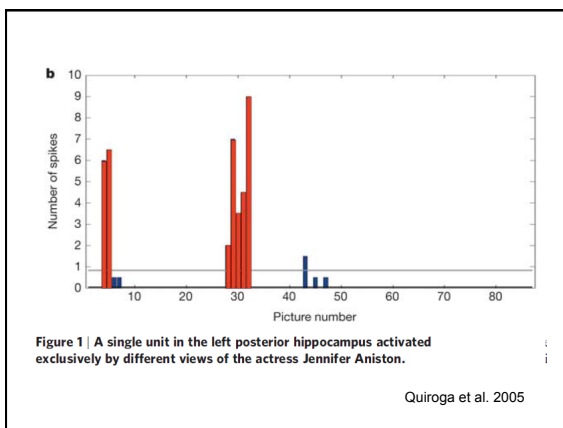
Color Vision

- _____ – there are opposing color channels (red/green, blue/yellow) in the brain.
- Seeing one color suppresses the opponent color (we can't see "reddish green" or "yellowish blue").
- Staring at a color fatigues the cells for that color, leading to a rebound effect of an opposite-colored afterimage.

Vision

- How do we recognize what we see?
- There are areas in the brain that recognize certain categories of objects
- _____ – cells in the brain that respond to one, specific visual stimulus.
- In a study (Quiroga et al. 2005), people had individual cells that responded to a particular person.





Vision

- Faces need to be upright to activate the facial recognition system.
- An inverted face is processed by the same areas as other visual stimuli.



The Thatcher Illusion

Kolb



The Thatcher Illusion

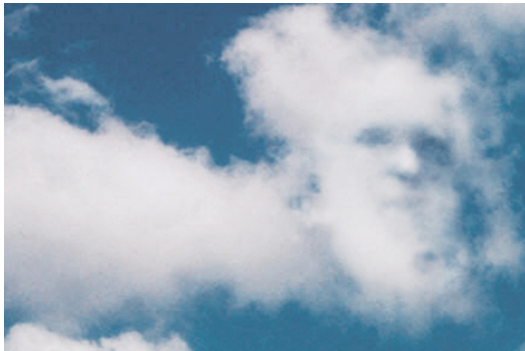
Kolb

Vision

- _____ – when a vague stimulus is perceived as being important or relevant, even when it's not.



Todd Terwilliger



Neil Usher

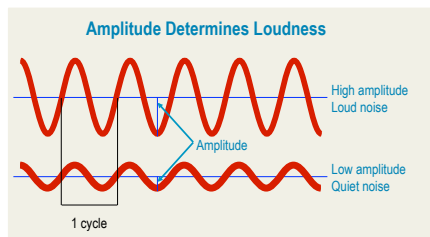
Pareidolia

- Our brains are constantly looking for patterns – adaptive!
- Animals and faces are commonly seen when they're not really there.
- Better to see patterns that are not significant than to ignore patterns that are significant.



Hearing

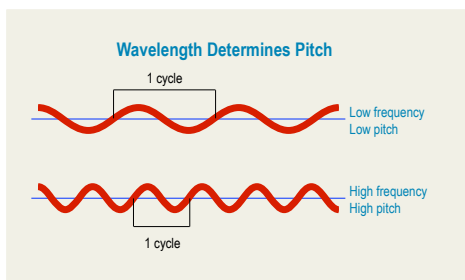
- Sound waves (like light waves) have a wavelength and amplitude.
- Larger amplitude sound waves are louder, smaller amplitude sound waves are quieter. Measured in _____ (dB).
 - When the intensity of a sound increases by 10 times, we perceive a sound to be twice as loud.



Loudness of Common Sounds	
Source of sound	Intensity (measured in decibels, or dB)
Threshold of hearing	0 dB
Rustling leaves	10 dB
Whisper	20 dB
Normal conversation	60 dB
Busy street traffic	70 dB
Vacuum cleaner	80 dB
Water at foot of Niagara Falls	90 dB
iPod with standard earbuds	100 dB
Front rows of rock concert	110 dB
Propeller plane at takeoff	120 dB
Threshold of pain/Machine gun fire	130 dB
Military jet takeoff	140 dB
Instant perforation of eardrum	160 dB

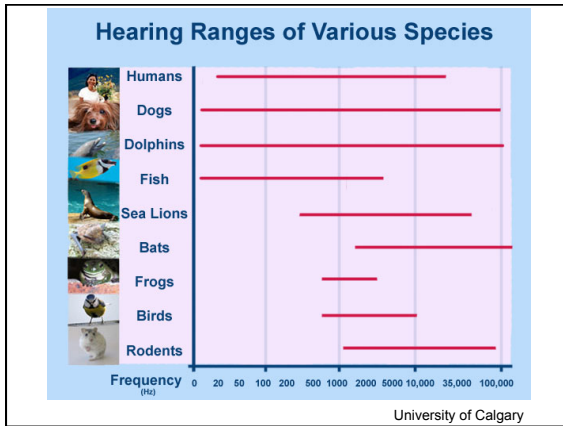
Hearing

- Higher-frequency wavelength sounds are higher in pitch.
- Lower-frequency wavelength sounds are lower in pitch.
 - Measured in Hertz (Hz).



Hearing

- _____ – sounds above the frequency of human hearing.
- _____ – sounds below the frequency of human hearing.
 - Even though we can't hear it directly, infrasound has been known to cause feelings of fear or anxiety.
- Humans can hear frequencies of approximately 20 to 20,000 Hz.



Hearing Pathway

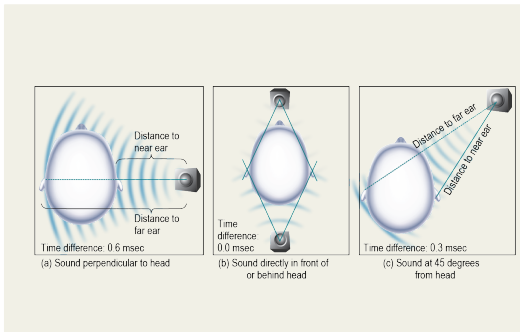
- Signals travel from the auditory nerve to:
 - Midbrain – reflexive responses to sound, sound localization.
 - Thalamus – relay station.
 - Primary auditory cortex – first processing of sound.

Hearing

- – Allows integration of information from both visual and auditory inputs.
- – when people see a person's mouth make the movements of pronouncing a particular syllable, but they actually hear a different syllable, it is often interpreted as yet another syllable.
 - Both visual and auditory stimuli are utilized when interpreting speech.

Hearing

- We tend to group sounds together as though they were coming from the same source:
 - If they come from the same direction.
 - If they begin and end at the same time.

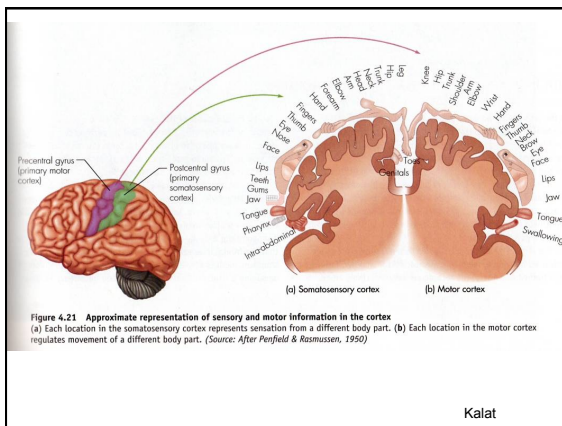


Touch

- Receptors in the skin sense pressure, vibration, or pain.
- Other receptors are located in blood vessels, internal organs, and joints.
- No receptors in the brain! No evolutionary advantage to “_____” your brain.

Parietal Lobe

- The touch receptors of the body can be directly mapped onto the primary somatosensory cortex.
- The more cortical tissue that is devoted to an area, the more sensitive it is (more receptors).
- A “map” of the region indicating relative proportions of each body part is called a _____.
- Notice that the body parts are not arranged “in order.”



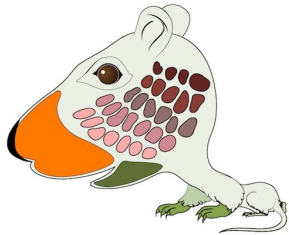
Kalat

Homuncular Man The sculpture represents the relative sensitivity of body parts by size. (The British Museum, Natural History.)



Kolb

Mouse Homunculus



Zembrzycki et al. 2013

A

ANATOMICAL PROPORTIONS



Eastern mole



Naked mole rat



Star-nosed mole

CORTICAL MAGNIFICATION



Eastern mole



Naked mole rat



Star-nosed mole

Carl Zimmer 2013

Phantom Limbs

- After a limb has been amputated, many people still feel as though the limb is present and can move.
- Often there are painful sensations in phantom limbs, especially if the limb was in pain shortly before it was lost.
- It's sometimes possible to avoid phantom limb pain by anesthetizing the limb prior to amputation.
- After a limb is lost, parts of the brain can "cross wire."

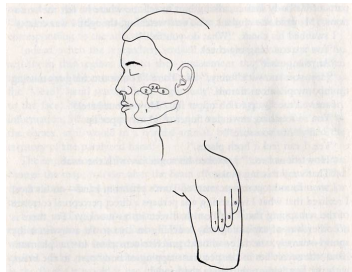


Figure 2.2 Points on the body surface that yielded referred sensations in the phantom hand (this patient's left arm had been amputated ten years prior to our testing him). Notice that there is a complete map of all the fingers (labeled 1 to 5) on the face and a second map on the upper arm. The sensory input from these two patches of skin is now apparently activating the hand territory of the brain (either in the thalamus or in the cortex). So when these points are touched, the sensations are felt to arise from the missing hand as well.

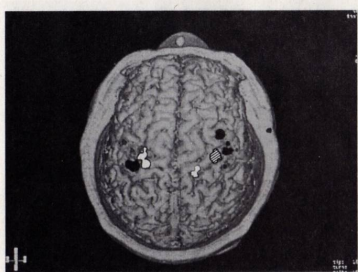
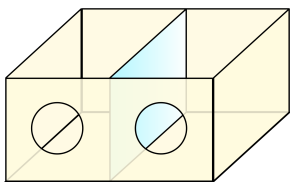


Figure 2.3 Magnetoencephalography (MEG) image superimposed on a magnetic resonance (MR) image of the brain in a patient whose right arm was amputated below the elbow. The brain is viewed from the top. The right hemisphere shows normal activation of the hand (hatched), face (black) and upper arm (white) areas of the cortex corresponding to the Penfield map. In the left hemisphere there is no activation corresponding to the missing right hand, but the activity from the face and upper arm has now "spread" to this area.

Ramachandran

Phantom Limbs

- Part of phantom pain might be a lack of sensory feedback from a real limb.
- The brain can sometimes be "_____ " by using a mirror box.



Cortical Reorganization

- Increased somatosensory input can increase the corresponding representation in the brain.
- If you use a particular hand or finger a lot, it will become more represented in the somatosensory cortex.

Pain

- Pain receptors:
 - Mechanical damage (paper cut).
 - Temperature or chemicals (capsaicin in peppers).

Pain

- Brain areas involved with pain:
 - _____ – direct perception of pain.
 - _____ – immediate emotional reaction to pain.
 - _____ – long-term emotional component of pain.
- The same regions become active when a person sees someone else get hurt (except for the primary somatosensory cortex).

Pain

- Fast tract of myelinated axons delivers initial sharp pain of an injury.
- Slower unmyelinated axons are responsible for a dull ache.

Pain

- _____ – input from touch fibers interferes with input from pain receptors, helping to mitigate pain.
 - This is why we rub an area just after an injury.
- Activation of brain areas can also mitigate pain (e.g. periaqueductal gray of midbrain).

Pain

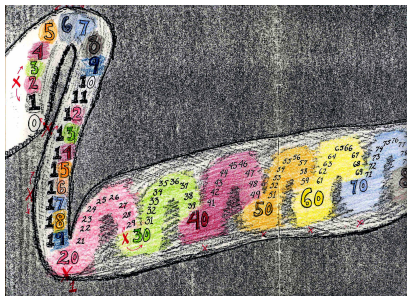
- Other things that have been shown to mitigate pain:
 - High stress
 - Placebos
 - _____
 - Physical contact with a loved one

Pain

- _____ – congenital problem leading to non-functional pain receptors.
 - Leads to an inability to feel pain or cold (not just indifference).
- These people often die early because they can't tell what activities are harmful.

Synesthesia

- _____ – when a person receives sensory input in one sensory modality and perceives a sensation in another. A few types:
 - _____ - written letters or numbers are perceived as a color.
 - **Sound-color** - musical notes or particular keys (e.g. C minor) might be perceived as a color.
 - **Lexical gustatory** - spoken words are perceived as a taste.
 - **Mirror touch** – individuals feel the sensations another person feels while watching them.
 - **Number form** – a mental “map” of numbers (see next slide).



Number form synesthete drawing

Cytowic & Eagleman 2009

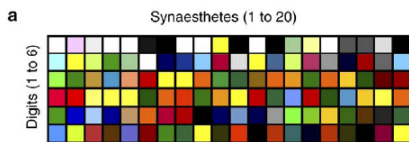


Australian Tapestry Workshop

The architect of the Sydney Opera House (Jørn Utzon) made this tapestry with the Hamburg Symphonies of C.P.E. Bach as inspiration. He's rumored to have had synesthesia.

Synesthesia

- Synesthesia tends to run in families, and there appears to be a biological basis to synesthesia (connections in the brain).
- Synesthesia is more common among artists.
- Synesthetic perceptions tend to appear in early childhood, and are stable across time.



The colors individual synesthetes associate with the numbers 1 through 6. Perceptions were stable across time.

Knoch et al. 2005

Synesthesia

- In tests of people with synesthesia compared with non-synesthetes, subjects were asked how they would group displays of numbers (see next slide).
- Non-synesthetes tended to group the numbers in horizontal rows due to similarity of shapes.
- Synesthetes tended to group the numbers into columns, based on their perceived color.

Image all subjects were shown	How a synesthete might view the same image																																																																						
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Controls grouped this image in horizontal rows	Synesthetes grouped the same image by color columns																																																																						
Ramachandran & Hubbard 2001																																																																							

Week 10

Motivation

- _____ – a process that guides behavior toward a goal, and dissipates once the goal is reached.
- Motivation and emotion give impetus to behavior.

Motivation

- Motivation maintains _____, or internal equilibrium. E.g. temperature, nutrient content, etc.
- _____ – individuals are motivated to maintain a certain set point to maintain equilibrium.

Motivation

- Clark Hull felt that an internal state called _____ motivates organisms to seek or avoid important things.
- When the important stimulus is obtained, individuals experience _____.
- Drive reduction theory doesn't take into account behaviors not directly related to immediate biological needs.
- Other psychologists feel external _____ can pull an organism toward performing a behavior.

Motivation

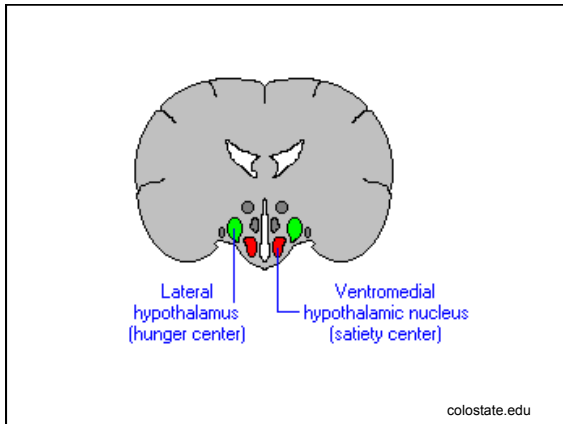
- _____ – rewards that are inherent in an activity, e.g. pride in a job well done, fun of a sport.
- _____ – rewards that are external to a task, e.g. money, praise.
- Extrinsic rewards can sometimes undermine intrinsic rewards.
- In a study, children that already enjoyed playing with markers played with them less if they were told they would get a certificate.

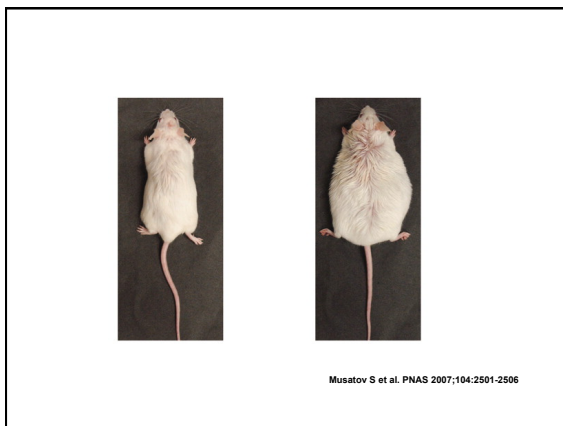
Hunger

- How much and when do we choose to eat?
- Internal cues – feelings of hunger, stomach grumbling or contracting, low blood glucose.
 - Stomach contractions alone don't lead to hunger... individuals who have had their stomach removed still feel hunger!
- External cues – time of day, social cues, sight and smell of food.

Hunger

- _____ **hypothalamus** – the gas pedal. If it is electrically stimulated, rats will overeat and become grossly overweight. If it is destroyed, rats eat and drink very little.
- _____ **hypothalamus** – the brake pedal. If it is electrically stimulated, eating and drinking are suppressed. If it is destroyed, rats overeat.





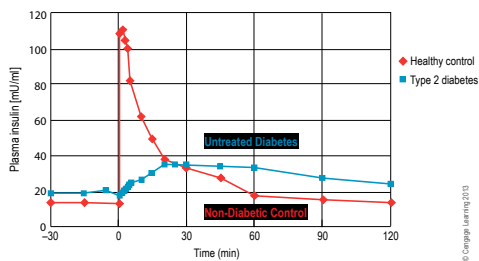
Hunger

- _____ – simple sugar that enters the blood during digestion.
- We tend to feel hungry when we have low blood glucose (not the whole story...).
- _____ – hormone secreted by pancreas that assists with transfer of glucose from the blood into cells.

Hunger

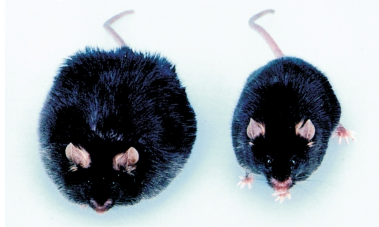
- People with diabetes either don't produce enough insulin, or their cells are immune to it.
- Despite high blood sugar, diabetics still report feeling hungry.
- Hunger might result from how available glucose is to cells, rather than simply how much is in the blood.

Amount of insulin in the blood after a meal for a diabetic and non-diabetic



Hunger

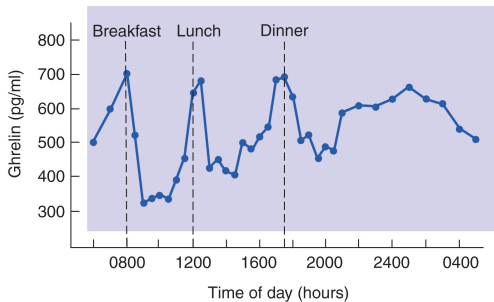
- _____ – a hormone secreted from well-nourished fat cells that increases metabolism and decreases eating.
- Mice with a genetic mutation that prevents fat cells from secreting leptin have low metabolisms, overeat, become obese, and tend to develop diabetes.
- If given leptin injections, their weight returns to normal.



Carlson

Hunger

- _____ – a hormone released by the gastrointestinal system when the stomach is empty.
- Ghrelin increases when fasting, decreases after a meal.
- In a study with humans, an injection of ghrelin increased appetite and elicited vivid images of preferred foods (Schmid et al. 2005).



Hunger

- Ghrelin administered to laboratory animals causes them to eat more than usual and gain weight.
- Ghrelin is controlled by the contents of the digestive system. When nutrients are infused directly into the blood, it does not influence ghrelin secretion.
- _____ – hormone also involved with sleep that leads to increased appetite.

When fat stores are low, leptin levels are low, and ghrelin and orexins are active:

Eating behavior

Initiated.

Autonomic nervous system

Parasympathetic nervous system is activated: Body stores nutrients.

Lowered metabolic activity

Hypothalamus

Lateral hypothalamus stimulates eating behavior.

Result: Stored fat levels increase and feeding stops.



Illustration: © Cengage Learning 2013; photo: © kate_ssp2004/istockphoto

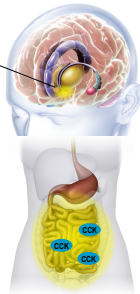
Satiety

- _____ – feeling full. We feel full long before nutrients reach their destination.
- Fullness can literally be felt in the stomach.
 - Gastric bypass surgeries decrease the size of the stomach to stimulate feelings of fullness.
- Simply inflating the stomach with a balloon, however, leads to feeling bloated, not full.

Satiety

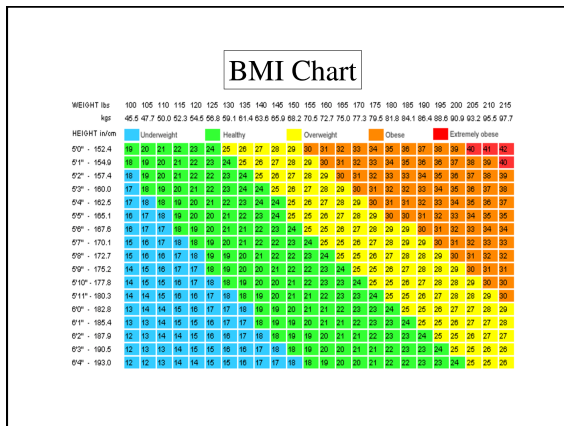
- _____ (CCK) – hormone released by the digestive system due to food ingestion.
- CCK stimulates the ventromedial hypothalamus, also triggering a sense of “fullness.”

Hypothalamus



Obesity

- _____ – height to weight ratio used to determine healthy/unhealthy weight.
- A healthy BMI is considered to be between 18.5 and 24.9.
- BMI is not always indicative of health! Some people are built differently, and are healthy with a higher BMI.



Obesity

- Around 67% of men and 62% of women are considered overweight in the U.S., and obesity has doubled in the last 30 years.
- Why?
- Genetics. The propensity to be overweight runs in families (not the whole story!).
- The “_____” – certain groups of people have a greater propensity to become overweight due to having a more efficient metabolism.

[illegible]

Obesity

- Obviously, environmental conditions also contribute to obesity.
- Types and amounts of food, sedentary lifestyle etc., but also...
- _____ – a compound used to make plastics and epoxy resin. Found in water bottles, dental sealants, CDs, food can linings, and carbonless copy paper and thermal paper (receipts).
- Exposure to BPA, especially in fetuses and young children, can lead to obesity as adults.

Obesity

- In developed countries, calorically-dense food is readily available, and generally preferred.
- In the past, a preference for high fat, high calorie food would have been an adaptation.
- Having obese friends also increases the risk for obesity.

Eating Disorders

- People with eating disorders often think they look overweight, when they're very underweight.
- _____ – eating disorder characterized by maintenance of very low body weight. More common in females (1% of female adolescents are anorexic, 90% of anorexics are female), though prevalence in males is rising.

Eating Disorders

- Characteristics of anorexia:
 - Refusal to maintain weight that is 85% normal BMI.
 - Strong fear of _____.
 - Distorted body image.
 - Absence of menstruation (in women).
 - Sometimes obsessive exercising.
 - Between 4-18 percent of those with anorexia die from the disease or complications with it.
 - Only 50% of anorexics fully recover.

Eating Disorders

- Other characteristics of anorexia:
 - Pale skin
 - Brittle, discolored nails
 - Fine hairs all over the body (lanugo)
 - Extreme sensitivity to cold
 - Shrinkage of heart muscles
 - Kidney failure
 - Brain damage (irreversible)
 - Loss of bone mass

Eating Disorders

- Bulimia – eating disorder characterized by binge eating, then purging by vomiting or use of laxatives. More common in females (2-4% of teenage girls are bulimic), though becoming more common in males. Characterized by:
 - Bingeing and purging at least once a week for three months.
 - Uncontrollable urges to overeat.
 - Distorted perception of body size.
 - Relatively normal weight compared to anorexics (more difficult to detect).
 - Impulsivity, lack of self control.
 - Feelings of guilt, depression.

Eating Disorders

- Cultural factors play into whether a society is likely to have members with eating disorders.
- In the past, and still in many places presently, being larger was considered beautiful, and a status symbol.
- Propensity of developing an eating disorder is heritable.

Mating

- In most species of animals, females have to invest more in offspring.
 - Larger gametes (eggs)
 - Internal gestation in mammals
 - Lactation in mammals

Mating

- Due to constraints on reproduction for females, males:
 - Can potentially make more offspring in a lifetime compared with females.
 - Tend to have greater variance in lifetime number of offspring compared with females.
- Because of these considerations, males and females tend to have different behaviors and preferences with regard to mating and reproduction.

Mating

- All other considerations aside, who would do better in an evolutionary sense...
 - A female that has a mate that sticks around and helps raise offspring, or
 - A female that has a mate that runs off as soon as she's pregnant?
 - A male that stays with one female and helps her raise offspring, or
 - A male that mates with multiple females, investing little in each?

Mating

- On average:
- Females tend to be choosier about mates compared with males.
- Males tend to compete with one another for access to females.

Mating

- A study looking at 37 cultures worldwide (Buss 1989), trends in mate preferences are apparent.
- Both men and women agree upon and think the same general traits are important in a mate, e.g. kindness, dependability etc. However...
- Women tend to find the financial prospects of a mate to be much more important than men (even wealthy women...).
- Men tend to find physical attractiveness in a mate to be much more important than women.

Mating

- Women tend to be more concerned with “emotional” fidelity compared with men (commitment).
- Men tend to be more concerned with sexual fidelity than women.

Mating

- Females of many species of mammal have _____, or a period of sexual receptivity around the time of ovulation.
- Female humans have concealed ovulation, and are sexually receptive throughout their menstrual cycle.

Mating

- Despite concealed ovulation, women show subtle changes around the time of ovulation:
 - Slightly more interested in sex.
 - Dress more “_____.”
 - Subtle changes in skin and voice.

Mating

- Women's interest in sex correlates with testosterone (men have 10x more testosterone than women).
- Absolute amount of testosterone does not appear to predict sexual interest in males, but high or low testosterone compared to a particular male's average does correlate with sexual interest.
- Men with NO testosterone have very low sexual interest.

Mating

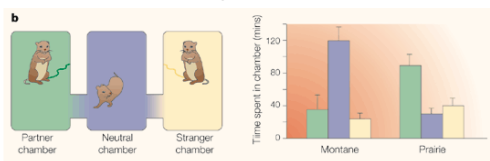
- _____ in men tends to:
 - Go up after winning or even watching a favorite team win a competition.
 - Go down after losing or watching a favorite team lose a competition.
 - Be lower when in a monogamous relationship (causality?).

Mating

- _____ – hormone that facilitates bonding (expressed more by females). Released during:
 - Orgasm
 - Birth
 - Breast feeding
 - A hug
- _____ – hormone that facilitates bonding primarily in males. Released during orgasm.

Mating

- Prairie voles tend to be monogamous, and males prefer to be with their mate.
- Montane voles tend to be promiscuous, and males tend to prefer to be alone.



Insel & Young 2001

Mating

- Prairie voles have higher levels of oxytocin and vasopressin (and higher levels of the receptors in the brain for these hormones) compared with montane voles.

- _____
- _____ – stable pattern of attraction to a particular sex (note: behavior not implied).
 - Both genes and environment affect _____.

Sexual Orientation

- _____ (CAH) – results in excessive release of male hormones before birth. Leads to:
 - Ambiguous genitalia.
 - Tomboyishness: dress, play, even draw like boys!
 - More likely to be homosexual than non CAH girls (most are still heterosexual).
 - More facial hair, menstrual irregularity, deep voice.
 - Affects males too, but not as noticeable (due to already large amounts of androgens).

Sexual Orientation

- If one identical twin is gay, the other is also gay _____% of the time (20% for fraternal twins).
- Environmental factors also play a role, otherwise there would be 100% concordance among identical twins.
- Homosexuality appears to run in families – more common on the maternal side, so it may be X-linked.
- The more _____ a male has, the more likely he is to be gay.

FIGURE 2. Relation Between Number of Older Brothers and Percentage of Probands Who Were Homosexual for 302 Homosexual Men and 302 Matched Heterosexual Men

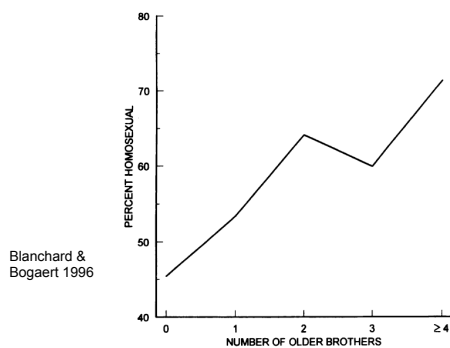


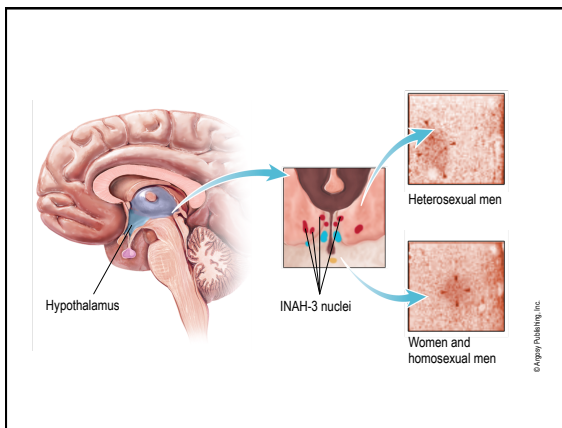
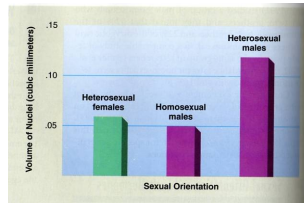


Fig. 1. Maternal immunization hypothesis. When a mother is carrying her first son, the placental barrier protects each from exposure to the other's proteins. But inevitable mixing of blood upon delivery will expose the mother for the first time to male-specific proteins (blue triangles), including those encoded on the Y chromosome. If her immune system produces antibodies to these proteins, then the placenta may actively transport those antibodies (indeed, all IgGs) to subsequent offspring *in utero*, potentially affecting development of later-born sons, but not later-born daughters.

Puts et al. 2006

Sexual Orientation

- The third interstitial nucleus of the hypothalamus (INAH-3) is different in heterosexual men vs. homosexual men and women.
- The same pattern was found in domestic sheep.



- _____ – automatic responses to situations. Can be:
 - Subjective – I feel happy, sad, afraid.
 - Physiological – rapid heartbeat, sweating, decreased digestion.
- Not the same as mood, which is an overall, general state. You can be in a good mood, but feel other emotions at the same time.

Emotion

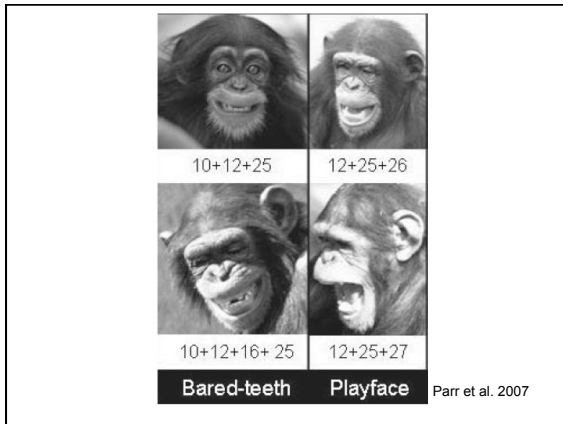
- Emotions tend to produce arousal, which tends to lead to behavior.
- _____:
 - For simple tasks (e.g. running away from something), more arousal = better performance.
 - For complex tasks (e.g. performing brain surgery), moderate arousal leads to the best performance. Too much arousal interferes with performance.

Emotion

- Emotional facial expressions allow us to communicate with others.
- Primates tend to have similar facial expressions to our own, indicating that expressions evolved.

Emotion

- Chimps have a “bared teeth” display that looks like a human smile. This may function as a threat or appeasement display.
- Chimps also have a play face and an accompanying vocalization that is similar in appearance and function to human smiles and laughter.



Emotion

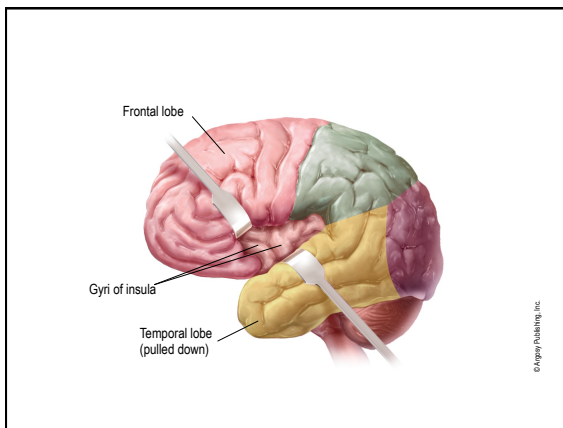
- We experience more autonomic nervous system responses to negative emotions compared with positive emotions.
- Strong negative emotional reaction leads to action when something is dangerous or threatening.
- _____ is involved in most motivated behavior.

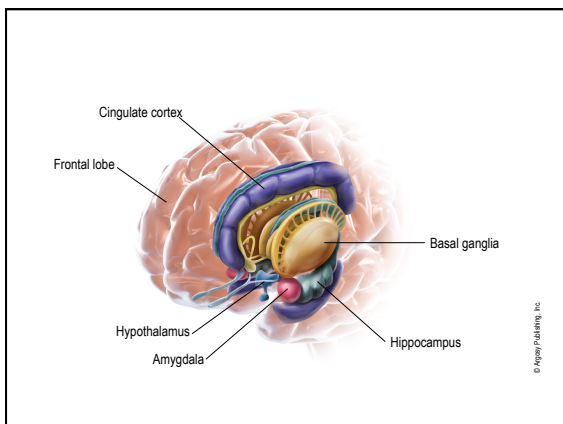
Emotion

- Amygdala is the most important brain structure with regard to fear.
 - Amygdala is activated when looking at people who have a fearful facial expression.
 - More intense facial expression = more activation of amygdala.
 - Animals with amygdala damage show no fear around normally fear-inducing stimuli.

Emotion

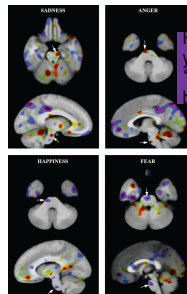
- A circuit including the cingulate cortex, frontal cortex, basal ganglia, insula, and amygdala identifies and classifies emotional stimuli.
- _____ – is activated to both physical and emotional pain.
- _____ – involved with movement, but also emotion, particularly disgust.





Emotion

- Right hemisphere processes negative emotion, and processes emotion faster and more accurately than the left.
- Left hemisphere processes positive emotions.
- However... different emotions produce different patterns of cortical activation. The same brain area can be involved in multiple emotions.



Researchers have not yet found an "emotion" area of the brain.

Emotion

- Expression of emotion appears to have innate and universal components.
- If part of a person's emotional brain isn't functioning properly (e.g. basal ganglia) they can make voluntary facial expressions, but have difficulty with spontaneous, emotional ones.
- If part of the motor cortex is damaged, spontaneous emotional expressions appear unchanged, but voluntary expressions are difficult.

voluntary

A B C

spontaneous

Asymmetrical genuine smile (C) to damage in emotional areas of the left hemisphere.

Ross & Mathiesen 1998

voluntary

spontaneous

Asymmetrical voluntary smile (left) to damage in motor areas of the right hemisphere.

Emotion

- People regardless of culture recognize major emotional expressions.

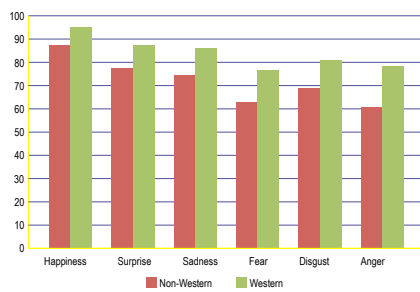
Figure 10.4 Photographs shown simultaneously to tribesmen in New Guinea during stories about her ("She is afraid the pig will bite her"), happiness ("Her friends have come and she is happy"), and anger ("She is angry and is about to fight"). The pictures in the left, middle, and right panels were selected as the best for the surprise story, happiness story, and anger story, respectively. (From Ekman, 1973.)

Emotion

These photos were used in early studies of emotion expression recognition by Paul Ekman.



© Paul Ekman, Ph.D./Paul Ekman Group, LLC



Emotion

- Emotional facial expressions tend to emerge at the same point in development, even if individuals are blind.
- Nonhuman primates also show emotional responses at the same points in development.
- There are considerable individual differences in the propensity to display emotion, even from a young age.

Emotion

- Culture and individual environmental experiences influence expression of emotion.
- Cultures have _____, or norms that indicate when and where emotional expression is appropriate. Can vary by gender.
- Culture can also influence the interpretation of emotion in others.

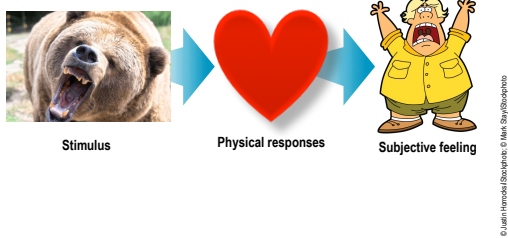
Emotion

- _____ - ability to perceive and understand emotions in others.
- Most people are fairly good at reading emotions in others, but variation exists!
- People with certain disorders (schizophrenia, autism) have more difficulty than control subjects identifying emotional facial expressions.

Theories of Emotion

- Several theories attempt to explain the relationship between a subjective feeling and the physical sensations of emotion.
- _____ – states that a stimulus leads to a physiological response. We then interpret the physiological response as an emotion.
 - “We feel sorry because we cry, angry because we strike, afraid because we tremble.”

James-Lange Theory



Theories of Emotion

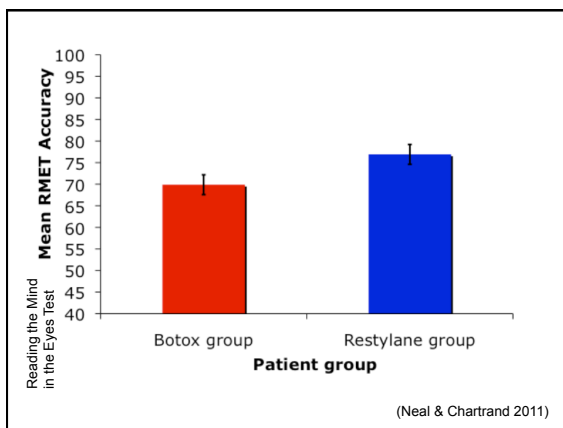
- _____ - the idea that expressing an emotion can help “let out” that emotion, thus reducing it.
- Implications are opposite than James-Lange theory.
- Which is correct?

Theories of Emotion

- In a study, subjects that were instructed to form their faces in a particular way reported taking on the emotion of the facial expression they made (though they weren't specifically instructed to make a facial expression).
- A pencil held horizontally in the teeth (smile) made people feel happy compared with when they held it straight out (O-shape).

Theories of Emotion

- Apparently, losing the ability to mimic the facial expression of others leads to deficits in determining the emotions of others.
- Paralyzing a person's facial muscles with Botox reduced their ability to interpret the facial expression of others!



Theories of Emotion

- Studies have shown that when people “get their emotions out” by hitting inanimate objects (e.g. a punching bag), it actually makes them more angry, and more likely to act out in the future.
- Catharsis appears to actually make us feel _____!

Theories of Emotion

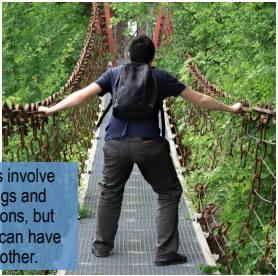
- However, physical states might not be specific enough for us to interpret correctly...
- In a study (Dutton & Aron 1974), men crossing a scary suspension bridge provided more sexual content in an interview with a female researcher, and tried to contact the researcher for a date more often than men crossing a more solid, less scary bridge.

Theories of Emotion

- The study on the previous slide implies that we sometimes confuse the physical sensations in our bodies... fear was interpreted as sexual arousal.

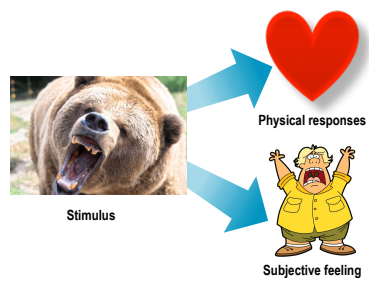
Theories of Emotion

- _____ **Theory of Emotion** – physical sensations and subjective feelings occur simultaneously and independently.
- According to Cannon-Bard, physical sensations might lead to no subjective feeling, and subjective feeling is not dependent on physical sensation.



Strong emotions involve subjective feelings and physical sensations, but sometimes you can have one without the other.

Canon-Bard Theory



Stimulus

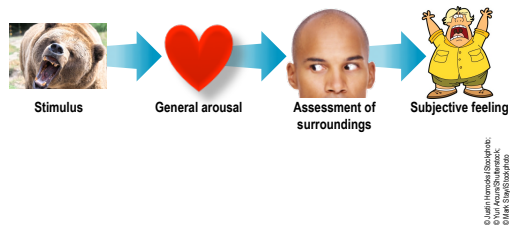
Physical responses

Subjective feeling

Theories of Emotion

- **Two-Factor Theory** – general arousal leads to assessment of surroundings, which leads to subjective feelings.
- Emotions sometimes feel the same in the body, and cognitive assessment would allow us to determine what emotion we're feeling.

Schachter-Singer Two-Factor Theory



Theories of Emotion

- None of these early theories appears to have support in all situations.
- _____ **Model of Emotion (SAME)** – physical sensations can be precise or general. More general sensations require more cognitive processing, more precise sensations require less cognitive processing.
- Middle ground between James-Lange and Schachter-Singer.
