9.00 EXAM 1 NOTES
<u>KOSSLYN CHAPTER 3 – *Sensation and Perception: How the World Enters the Mind*</u>

The processes of sensation and perception lie at the root of our experience of feeling alive, serving as the foundation for most of what we know and do.

<u>Sensation</u> – the result of neural responses that occur after physical energy stimulates a receptor cell (such as those at the back of the eye, in the ear, on the skin) but before the stimulus is organized and interpreted by the brain

Once receptor cells are sufficiently stimulated, that physical energy is transformed to neural signals that are sent to parts of the brain for:

<u>Perception</u> – the result of neural processes that organize (such as by specifying a particular shape) and interpret (such as by identifying the object) information conveyed by sensory signals

The process of sensation and perception allow us to see, hear, smell, taste, experience touch, and know where we are in space.

VISION

Phases of Vision

Visual sensations are triggered when strong enough light waves cause specialized receptor cells at the back of the eye to send neural signals to the brain. These signals specify fundamental characteristics of the stimulus (ex: color); most of the processes that underlie visual sensation occur in the eye and in subcortical structures of the brain, before the neural signals reach the cerebral cortex. Perceptual processing occurs in the cerebral cortex and organizes the neural signals of sensation, deriving a particular shape, texture, and other features, and then identifies the observed object and its position in space.

2 phases of processing:

1. *Organization into coherent units* – to get sensations from surfaces and shapes, the brain must organize patches of color, textures, edges, and other fundamental visual characteristics into units… brain gets to specify sizes and locations of objects
2. *Identifying what and where*

Visual Sensation: More Than Meets the Eye

Psychophysics: A World of Experience

<u>Psychophysics</u> – founded by GT Fechner; studies the relation between physical events and the corresponding experience of those events

Thresholds: "Over the Top"

Stimuli cross a <u>threshold</u> when they activate receptor cells strongly enough to be sensed

<u>Absolute threshold</u> – the magnitude of the stimulus needed on average, for an observer to detect it half the time it is present

<u>Just-noticeable difference</u> – the size of the difference in a stimulus characteristic needed for a person to detect a difference between two stimuli or a change in a single stimulus

- Depends on the overall magnitude of the stimulus
- <u>Weber's Law</u> – the same percentage of a magnitude must be present in order to detect a difference between two stimuli or a change in a single stimulus
    - Ex: greater magnitude of light = greater the extra amount must be in order to be detected

Detecting Signals: Noticing Needles in Haystacks

<u>Signal detection theory</u> – theory of how people detect signals, which distinguishes between sensitivity and bias; the theory is based on the idea that signals are always embedded in noise, and thus the challenge is to distinguish signal from noise

9.00 EXAM 1 NOTES
KOSSLYN CHAPTER 3 – *Sensation and Perception: How the World Enters the Mind*

- Noise – extraneous information that interferes with detecting a signal
    - arises from:
        1. other stimuli in the environment
        2. random firings of neurons

How signals are detected or missed:
- sensitivity – corresponds to the amount of information required to detect a signal, with greater sensitivity indicating that less information is required (you have a lower threshold for distinguishing between a stimulus (the "signal") and the background (the "noise"))
- bias – the willingness to decide that you have detected a target stimulus
    - very biased → you will decide that you have seen the target with only a minimal difference between signal and noise
    - You change your bias by adjusting your criterion – the threshold the signal must exceed before you are willing to decide that you have seen the target
        - If you set the criterion too low, you will decide that you've seen the target even when it's not there because noise alone exceeds this threshold.

Psychologists assess sensitivity and bias by comparing the occasions when people *say* a stimulus is or is not present with the occasions when the stimulus is *in fact* present or not.

How Do Objects Enter the Mind? Let There Be Light
The eye registers light that is reflected from, or is produced by, objects in the line of sight.
Properties of light:
- Electromagnetic radiation
- Waves
    - Amplitude – height of the peaks in a light wave or sound wave
    - Frequency – the number of light waves or sound waves that move past a given point per second
    - Wavelength – distance between the arrival of peaks of a light wave or sound wave
        - Shorter wavelengths correspond to higher frequencies

We only see a narrow band within the electromagnetic spectrum, but within this band, our eyes are sensitive to slight differences in wavelength.
- We perceive different wavelengths as different colors
    - Red: lower frequencies, longer wavelengths
    - Violet: higher frequencies, shorter wavelengths

The Brain's Eye: More Than a Camera
Transduction – process whereby physical energy is converted by a sensory receptor cell into neural signals
Pupil – opening in the eye where light enters / passes
Iris – circular muscle that adjusts the size of the pupil to let in more or less light
Cornea – transparent covering over the eye, which (along with the lens) focuses light onto the back of the eye
Lens – fine-tunes focusing of light; muscles can adjust the lens into a more or less round shape to focus light from objects that are different distances away
- With age, the lens thickens and becomes less flexible, does not focus light as effectively
    - Ex: old people have trouble seeing nearer objects

Accomodation – automatic adjustment of the eye for seeing at particular distances, which occurs when muscles adjust the shape of the lens so that it focuses incoming light toward the back of the eye (the retina)

Transduction: From Photons to Neurons
Retina – sheet of tissue at the back of the eye containing cells that convert light to neural signals
Fovea – small, central region of the retina with the highest density of cones and the highest resolution

- Gives rise to the sharpest images

The density of receptor cells drops off toward the periphery of the retina, and thus images that are transduced form peripheral portions of the retina are not as sharp as those transduced from the central region. But, the world looks sharp and clear because we are constantly moving our eyes to focus object in different locations s that they each land on the fovea at some point in time.

2 kinds of receptor cells in the retina important for transducing light to neural signals:

1. Rods – rod-shaped retinal receptor cells that are very sensitivity to light (respond to all wavelengths of light), but register only shades of gray
    a. Each eye contains 100 – 120 million rods
    b. Not in the fovea
    c. Night vision is based on the firing of the rods alone
2. Cones – cone-shaped retinal receptor cells that respond most strongly to one of three wavelengths of light; the combined signals from cones that are most sensitive to different wavelengths play a key role in producing color vision
    a. not as sensitive to light as the rods; allow us to see color
    b. Each eye contains 5 – 6 million cones
    c. Densest in the fovea

Axons from rods and cones connect to *retinal ganglion cells*, whose axons in turn are gathered into the optic nerve – large bundle of axons carrying neural signals from the retina into the brain
Blind spot – place where the optic nerve exits the retina; there are no rods or cones here

Dark Adaptation – process that leads to increased sensitivity to light after being in the dark
After about 30 minutes in the dark, you are about 100,000 times more sensitive to light than you are when you are in full daylight.

- Part of this increased sensitivity to what light there is arises because your pupil enlarges when you are in darkness. In addition, darkness causes the rods to release *rhodopsin*, which makes the rods more sensitive to light.

More than Rods and Cones
Mice genetically modified so that their eyes had no rods or cones still shifted their circadian behavior when light was shine on them. Removing their eyes eliminated the mice's responses to light. Animals have some way to detect light that does not depend on rods and cones, but this mechanism does lie in the eyes.
Berson et al. (2002) – the third type of light receptor is a special type of ganglion cell in the retina

Color Vision: Mixing and Matching
Colors vary along 3 different dimensions:

1. *Hue* – different wavelengths of light produce sensations of different colors (ex: whether something looks red, blue, etc.)
2. *Saturation* – deepness of the color, how little white is missed in with it
3. *Lightness* – amplitude of the light waves (how much light is present) produces the perception of lightness (if the light is reflected from an object) or brightness (if the object produces light)

Different combinations of values on these 3 dimensions produce the rich palette of colors we see.

Color Mixing
Young & Helmholtz – mixing of colors to produce new colors

- We see hue when the eye combines responses to separate wavelengths
- Trichromatic theory of color vision - the eye contains 3 kinds of color sensors, each most sensitive to a particular range of wavelengths: long (red); medium (green); short (blue). The particular mix of responses of these sensors produces the sensation of a given hue

Although each type of cone responds maximally to a particular wavelength, it also responds to some degree to a range of similar wavelengths.

The brain responds to the mixture of the responses from the 3 types of cones, not to isolated individual cones.

The results of mixing colors depend on whether the light waves being sensed are emitted or reflected:

- When the light is emitted (ex: from a TV screen), the wavelengths of each contributing hue are *added*.
- When the light is reflected (ex: from a photo in a book), the wavelengths of each contributing hue are *subtracted*.

A Color Tug-Of-War?
Hering – noticed that whereas some pairs of colors can be mixed to make one color having a tinge of the other (ex: yellow with a tinge of red), the same is not true of other pairs of colors (ex: red mixed with green gives you brown)

- <u>Opponent process theory of color vision</u> – for some pairs of colors, if one of the colors is present, it causes cells to inhibit sensing the complementary color (such as red versus green) in that location
    a. Red inhibits green; yellow inhibits blue; black inhibits white; vice versa
    b. Explains <u>afterimages</u> – image left behind by a previous perception
        i. Cones feed into *opponent cells* in the retina and in part of the thalamus
            1. <u>Opponent cells</u> – cells that respond to one color from a pair (blue/yellow, red/green, or black/white), and inhibit sensing the other color from the pair
        ii. If you stare at a color, (ex: red), after a while the cones that register it become adapted to that stimulus, and they stop firing. If you then look at a white background, the green cones will respond more strongly than the red ones, and these green cones thereby stimulate the red/green opponent cells more strongly than do the red ones, and thus, you see green.

The trichromatic and opponent process theories are both correct, but describe separate systems that work together!

<u>Color Blindness</u> – acquired (by brain damage) or inherited inability to distinguish two or more hues from each other or to sense hues at all
Most common: red/green

- For most people with red/green color blindness, the problem arises because their red and green cones have the same colored substance that filters the incoming light. Thus, the 2 types of cones do not respond to different wavelengths as they should, leading 2 hues to appear the same.
- Color blindness from brain damage usually results from damaging the bottom portion of the temporal lobe. These people cannot distinguish hue – see the world as if in a black-and-white photo.

Phase 1 of Visual Perception: Organizing the Visual World
Separate the figure from the ground:

- <u>Figure</u> – set of perceptual characteristics (ex: shape, color, texture) that typically corresponds to an object
- <u>Ground</u> – background

<u>Perceptual constancy</u> – the perception that characteristics of objects (ex: shapes, colors) remain the same even when the sensory information striking the eyes changes

- <u>Size constancy</u> – the perception that the actual size of an object remains the same even when it is viewed at different distances

- Shape constancy – the perception that the actual shape of an object remains the same, even when it is seen from different points of view and so the image on the retina changes shape
- Color constancy – the perception that the color of an object remains the same even when it is seen in different lighting conditions
    - Monkeys raised in light of only a single hue have an impaired ability to see colors as constant.
    - Studies of brain mechanisms of color constancy suggest that it may occur because we see the lightest thing in a scene as white (no matter what the lighting conditions) and the color of everything else is relative to that white.

Knowing the Distance

Examining how far away objects are from you and how far they are from each other helps you:

- *Separate figure from ground*
- *Preserve size constancy*
- *Preserve shape constancy*
- *Guide navigation and reaching*

We need to know the relative positions of objects in 3D space, but images are projected onto the 2D surface of our retinas.

Cues we can use to derive 3D from 2D:

Static Cues

- Binocular cues – cues to the distance of an object that arise from both eyes working together
    - Convergence – degree to which the eyes swivel toward the center (are crossed) when a person focuses attention on an object
        - The more you have to cross your eyes, the closer the object
- Retinal disparity – difference between the images striking the retinas of the 2 eyes
    - Used by the brain to determine which objects are in front and which are behind others
    - Only works to about 10 feet
- Monocular cues – the difference between the images striking the retinas of the 2 eyes, aka binocular disparity
    - Often used by artists to create the illusion of distance
    - Texture gradient – an increase in the density of the texture of an object with increasing distance
    - Other cues: linear perspective, foreshortening, atmospheric perspective, occlusion cues
    - Cross-cultural studies have shown that people are not born with the ability to interpret some monocular cues in drawings – they must learn to do so

Motion Cues – specify the distance of an object on the basis of its movement; work well with one or two eyes

- Motion parallax – a motion cue in which the way that objects seem to shift with movement provides information about how far away they are

Phase 2 of Visual Perception: Identifying Objects and Positions

2 Goals accomplished by 2 separate pathways:

1. Identify objects → "what" pathway: occipital lobe to bottom of temporal lobe
2. Identify spatial relations → "where" pathway: occipital lobe to back of parietal lobe

Evidence:

1. Lesion studies
2. Neuroimaging

Identifying Objects: Knowing More Than You Can See

9.00 EXAM 1 NOTES

KOSSLYN CHAPTER 3 – *Sensation and Perception: How the World Enters the Mind*

The final phases of perceptual processing allow the perceptual units organized during Phase 1 to access information you've stored in memory from your prior experience.

The Phase 1 processes that separate figure from ground sometimes organize a shape into a set of distinct parts, and in Phase 2 processing, these parts can serve as the basis for identifying the object.

We can see parts of an object individually, but it is also clear that we do not always identify objects in terms of their individual parts. (Ex: picture of Britney Spears – you don't notice that some of the parts in the face are upside down)

- We usually focus on the overall views of shapes and look for details only if we need them.

Informed Perception: The Active Viewer

Bottom-up processing – processing that is triggered by physical energy striking receptor cells

- Imagine: dominoes → When the neural equivalent of the first domino is tripped by the light waves reaching our eye, other neural signals are successively tripped, like falling dominoes, until you've understood what you're seeing.

Top-down processing – processing that is guided by knowledge, expectation, or belief

- Allows you to impose what you want to see on what is actually out there
- Does not change how you see an object, but instead just makes it easier to organize or interpret

Bottom-up processing and top-down processing are often in play at the same time!!

Top-down processing can affect the way you interpret the results from bottom-up processing.

- *Delk & Fillenbaum* – people were asked to use a dial to adjust a sample color until they thought it matched the color of the background cut-out.
  - When asked to match the color of the normally red objects, the participants consistently selected a redder color than the one they chose to match the color of objects that are not normally red.
    - The knowledge of the usual color of the objects affected, via top-down processing, how participants saw the actual color.

Top-down processing can be guided by your perceptual set – the sum of assumptions and beliefs that lead a person to expect to perceive certain objects or characteristics in particular contexts.

Coding Space in the Brain: More Than One Way to Identify "Where"

The main goal of processing in the "where" pathway is to use the sum total of the distance cues to identify the distance and direction of objects, either relative to yourself or relative to other objects.

Kosslyn – proposed that the brain uses 2 different ways to specify spatial relations

- *Categorical spatial relations* – specify relative positions with categories such as "above," "beside," etc.; don't give you a particular, specific spot but instead, gives you a group of possible locations
  - Don't help with 2 main tasks of vision:
    - Providing information to guide navigation and reaching
- *Coordinate spatial relations* – specify continuous distances from your body or another object that serves as an "origin" of a coordinate space

Evidence of this comes from studies of *cerebral lateralization* – how functions are accomplished in the left hemisphere versus the right hemisphere of the brain

- Left cerebral hemisphere – better at identifying categorical spatial relations
- Right hemisphere – better at identifying coordinate spatial relations, which are essential for navigation
  - Patients with damage to the left hemisphere have more difficulty using categorical spatial relations than coordinate spatial relations, vice versa.

9.00 EXAM 1 NOTES

<u>KOSSLYN CHAPTER 3 – *Sensation and Perception: How the World Enters the Mind*</u>

Attention: The Gateway to Awareness

<u>Attention</u> – the act of focusing on particular information, which allows it to be processed more fully than what is not attended to

- We are only aware of what we attend to

Reasons why we pay attention:

1. The stimulus grabs our attention (bottom-up)
2. We are actively searching for it (top-down)

Paying attention increases sensitivity to the attended events

<u>Selective attention</u> – the process of picking out and maintaining focus on a particular quality, object, or event, and ignoring other stimuli or characteristics of the stimuli

Pop-Out: What Grabs Attention?

<u>Pop-out</u> –occurs when perceptual characteristics of a stimulus are sufficiently different from the ones around it that it immediately or automatically (via bottom-up processing) comes to our attention

Active Searching: Not Just What Grabs Attention

In some situations, what we see / hear influences what we expect, which in turn directs our attention.

Another use of top-down processing occurs when you anticipate a particular event and thus maintain attention as you wait for it

We cannot always use top-down processing to focus on 1 characteristic and shut out others. Bottom-up processing keeps us perceptually honest – we see what's there, not just what we want to see.

Seeing Without Awareness

<u>Blindsight</u> – visual perceptual processes cannot be at work (often because of damage to V1), but we can still "see" (ex: avoid obstacles when walking, etc.)

- The optic nerve branches into separate pathways, which lead to different place sin the brain, and one of these pathways bypasses the primary visual cortex, which is a brain area crucial for visual consciousness –the awareness of seeing. Instead, this pathway leads directly to the parietal lobe, which allows people to know the locations of visual stimuli – even when the brain areas crucial for visual consciousness (or connections from these areas) are damaged.

<u>Repetition blindness</u> – ex: A bird in the hand is worth two in the the bush; the inability to see the second instance of a stimulus when it appears soon after the first instance

- Results because repeated stimuli are registered not as individual events but simply as a single "type" of event.

<u>Change blindness</u> – not seeing large alterations of features as scenes change over time if those features are not of central interest

<u>Attentional blink</u> – a rebound period in which a person cannot pay attention to a second stimulus after having just paid attention to another one (which need not be the same as the second stimulus); occurs for pairs of stimuli, but unlike repetition blindness, can occur for paris of different stimuli

HEARING

Auditory Sensation: If a Tree Falls But Nobody Hear It, Is There a Sound?

Auditory sensations begin when physical energy strikes the ear, at which point that energy (in the form of waves of pressure) is transduced into neural signals.

9.00 EXAM 1 NOTES

KOSSLYN CHAPTER 3 – *Sensation and Perception: How the World Enters the Mind*

Sound Waves: Being Pressured

Sound arises when any type of molecules move and create pressure waves that enter our ears.
Pressure waves that give rise to sound are periodic, have frequency (units = Hz) and amplitude

Pitch – how high or low a sound seems; higher frequencies of pressure waves produce the experience of higher pitches

Loudness – strength of a sound; pressure waves with greater amplitude produce the experience of louder sound (units = dB)

Answer: If a tree falls in the forest but nobody hears it, there is no sound. Sound is *caused* by pressure waves, but the waves themselves are not sound. Sound is a psychological event, and hence depends on a nervous system to transduce the physical energy of the waves to nerve signals.

The Brain's Ear: More Than A Microphone

➔ ***See p. 105 for Anatomy of the Ear***

3 Parts: outer ear, middle ear, inner ear

The eardrum (*tympanic membrane*) stretches across the inside end of the auditory canal, and everything between the eardrum and the auditory nerve is designed to convert movements of the eardrum to the nerve signals that are sent to the brain.

Pressure waves move the eardrum → moves 3 bones (hammer, anvil, stirrup) in the middle ear → transfer / amplify vibration → *basilar membrane* vibration (different frequencies of sound are transduced into the nerve signals that underlie auditory sensation) → hair cells on the receptor cells lining the basilar membrane are moved by the vibrations and trigger nerve signals → sent to the brain

2 theories about how the basilar membrane converts pressure waves to sound sensations:

1. Frequency theory – higher frequencies produce higher rates of neural firing
2. Place theory – different frequencies activate different places along the basilar membrane

Deafness: Hear Today, Gone Tomorrow

>28 million Americans have some sort of difficulty in hearing

Conduction deafness – caused by physical impairment of the outer or middle ear

- Ex: broken ear-drum; ossification of middle ear bones

Nerve deafness – occurs when the hair cells are destroyed by loud sounds

- Once a hair cell is destroyed, it is gone forever
- Nerve deafness may impair our ability to hear only certain frequencies; in these cases, a hearing aid can amplify the remaining frequencies, improving hearing

Phase 1 of Auditory Perception: Organizing the Auditory World

Sorting Out Sounds: From One, Many

Auditory scene analysis – distinguishing individual sounds to separate auditory figure from ground

Gestalt laws of organization apply here as well: similarity (grouping sounds with the same pitch); continuation (grouping the same pitch continued over time)

Speech-segmentation problem – the problem of organizing a continuous stream of speech into separate parts that correspond to individual words

- Words do not have pauses between them when we speak, but we can nonetheless identify individual words.

Categorical perception – automatically grouping sounds as members of distinct categories that correspond to the basic units of speech

- Infants, monkeys, chinchillas, etc. engage in categorical perception; suggesting that the perceptual system itself does the work, not the language systems of our various cultures.

Locating Sounds: Why Two Ears Are Better Than One

Hearing makes use of differences in the stimuli reaching the 2 ears to assess the distance of a sound source.

Difference in loudness at the two ears is used as a cue for both the distance and position of the object making the sound.

Our heads block sound, and amplitude of a pressure wave is smaller when it reaches the ear on the side of the head away from the sound source → effective for high-frequency sounds

Some cues still depend on one ear, though! (Ex: moving closer or farther from a sound source)

Phase 2 of Auditory Perception: Identifying Objects and Positions

More than Meets the Ear

You can adjust your criterion for "detecting a signal," and this adjustment will be based on what you expect to hear.

Warren & Warren – people listened to a tape-recorded sentence after part of a word had been replaced with the sound of a cough.

- <u>Phonemic restoration effect</u> – although part of the word was actually missing, all the participants claimed that they actually heard the entire word and denied that the cough covered part of it. Some weren't even sure that the cough occurred.
    - Does not just apply to speech sounds; also in music (seeing a cello being plucked is enough to alter the sound we hear)

The sound of music is affected by top-down processing but also that visual information can cross over and affect auditory processing. Neuroimaging studies also show that vision can modify how sound is processed in the brain.

Hearing Without Awareness

<u>Cocktail party phenomenon</u> – the effect of not being aware of other people's conversations until your name is mentioned and then suddenly hearing it

- To be aware of the sound, you had to be aware of the conversation (bottom-up processing), but you weren't aware of it until your name was spoken.

<u>Dichotic listening</u> – a procedure in which participants hear different stimuli presented separately to each of the two ears (through headphones) and are instructed to listen only to sounds presented to one ear

- People still register some information from the ignored ear (ex: whether the voice is male or female)
- Spurred myth that people can learn in their sleep
- Unless people are paying attention, very little information is perceived; even when that information is perceived, it is retained very briefly, and when tested hours later, people remember virtually none of it

Specifying Positions

The auditory and visual perceptual mechanisms that specify position have much in common.

Both sorts of processing can specify the position of an object relative to the body or relative to other objects and apparently do so in similar ways → rely on the same portions of the parietal lobes

The 2 processes often work together when we note the positions of objects.

- People can locate a stimulus in the dark solely on the basis of the sound it emits more accurately if they move their eyes toward the source of the sound than if they do not.

9.00 EXAM 1 NOTES

KOSSLYN CHAPTER 3 – *Sensation and Perception: How the World Enters the Mind*

SENSING AND PERCEIVING IN OTHER WAYS

Smell: A Nose for News?

Smell and taste are often grouped together as the chemical senses because both rely on registering the presence of specific chemicals.

In general, people are bad at identifying odors, but people differ widely in their sense of smell.

- Women are generally better than men at detecting many types of odors.
- Younger adults are better at detecting odors than either children (<14 years) or middle-aged adults (40-50 years)

Distinguishing Odors: Lock and Key

Molecules have different shapes, and the olfactory receptors are built so that only molecules with particular shapes will fit in particular places on the receptors. When the specific molecule fits into a particular receptor, the receptor sends a signal to the brain, and we sense the odor.

There is not a single receptor for each odor we smell – the overall pattern of receptor activity signals a particular odor.

Buck & Axel – identified the genes that produce the individual odor receptors

The sense of smell is tightly bound to emotions and to memories.

1. 2 major neural pathways send signals about odor into the brain:
    a. connected to the limbic system – involved I emotions
    b. passes through the thalamus – involved in memory
2. Neuroimaging studies have shown that the left cerebral hemisphere plays a special role in emotional responses to odors and that the right cerebral hemisphere plays a special role in memory for odors.
    a. The axonal connections between the two hemispheres explain how the odors and memories tap into each other.

Olfaction Gone Awry: Is It Safe to Cook Without Smell?

Smell serves to signal the presence of noxious substances. Our brains are wired so that odors can quickly activate the *stress response* – the bodily changes that occur to help a person cope with a stressor.

We use smell as a warning that something is amiss. (Ex: smell is often the only signal that food / meat is spoiled.)

Pheromones: Another Kind of Scents?

Pheromones – chemicals that function like hormones but are released outside the body (in urine and sweat); serve as a means of communication; modulate the functions of various organs

Perfume manufacturers exploit pheromones.

Taste: The Mouth Has It

Taste buds – receptor cells for taste, which are microscopic structures on the bumps on the tongue surface, at the back of the throat, and inside the cheeks

- Die and are replaced, on average, every 10 days.

Sweet, Sour, Salty, Bitter, and More

The flavors of food arose from combinations of 4 tastes: sweet, sour, salty, and bitter

Fifth taste: umami – arises from the amino acid glutamate (think MSG in Chinese food!)

In addition to the 5 types of taste receptors, dendrites of neurons in the mouth appear to be irritated by spicy foods.

Taste and Smell

People have a much harder time detecting flavors when smell is blocked.

SOMASTHETIC SENSES: NOT JUST SKIN DEEP

Somasthetic senses – senses that produce the perception of the body and its position in space – specifically, kinesthetic sense (awareness of where the limbs are and how they move), vestibular sense (sense of balance), touch, temperature sensitivity, pain, and possibly magnetic sense

- Arguable: extrasensory perception (ESP)

Kinesthetic Sense: A Moving Sense?

Kinesthetic sense – registers the movement and position of the limbs

2 types of specialized cells sense this information:

1. Tendons – materials that connect muscles to bones; triggered by tension
2. Muscles – contraction / stretching

Vestibular Sense: Being Oriented

Vestibular sense – provides information about the body's orientation relative to gravity; relies on semicircular canals of inner ear

Touch: Feeling Well

Skin – body's largest organ

- Protects body from the environment; makes crucial vitamins, triggers release of hormones

Because of the many ways that signals from receptors in the skin can be combined, we can feel may more types of sensations than we have types of receptors.

Receptor cells in the skin over different parts of the body send neural signals to different parts of the somatosensory cortex; somatosensory cortex preserves a map of the body, with neurons in different locations of cortex indicating that different locations of the body have been stimulated.

- The larger the portion of somatosensory cortex devoted to a particular area of the skin, the more sensitive we are to stimulation of that area.

Temperature

There are distinct spots on your skin that register only hot or only cold.

- If a cold spot is stimulated, you will feel a sensation of cold even if the stimulus is something hot.

Pain

Pain can warn us of impending danger and is crucial to survival.

The sensation of pain arises primarily when either of 2 different neural pathways are stimulated, each of which underlies a different type of pain. Because the 2 pathways differ in the speed with which they transmit signals, we can feel double pain – the sensation that occurs when an injury first causes a sharp pain and later a dull pain

Endorphins – painkilling chemicals produced naturally in he brain

Pain involves bottom-up and top-down processing.

- Gate control – the mechanism that allows top-down processing to inhibit interneurons that send pain signals to the brain
  - Can explain how hypnosis influences pain → selectively make pain feel less unpleasant but make person still aware of the intensity of the pain; alters processing in only some of the areas that register pain
  - Acupuncture – the needles are a counter-irritant, reducing the pain by introducing painful stimuli elsewhere in the body

Other Senses?

Magnetic Senses: Only for Birds?

Bird migration is guided by the earth's magnetic field – the birds have tiny bits of iron in neurons.

KOSSLYN CHAPTER 3 – *Sensation and Perception: How the World Enters the Mind*

Mole rats / mice – magnetic fields disrupt spatial learning for brief periods of time

Extrasensory Perception (ESP) – ability to perceive and know things without using the ordinary senses AKA *anomalous cognition, psi*

- Telepathy – the ability to transmit thoughts directly from mind to mind
- Clairvoyance – ability to perceive events without using the ordinary senses or reading someone else's mind
- Precognition – ability to foretell future events
- Psychokinesis – ability to move objects simply by willing them to move, and not by manipulating them physically

4 reasons to be skeptical:

1. Failure to replicate
2. Lack of brain mechanism
3. Lack of signals
4. Alternative explanations