PSYC 200 LECTURE 5
THE HUMAN BRAIN (CONT'D)
JAN 20TH

brain has a topographical representation/organization, very orderly manner
somatosensory cortex and motor cortex
the body is mapped out in an orderly fashion in the brain
functional areas of the brain
groove between the motor and somatosensory cortexes is called the central sulcus
behind sulcus you have somatosensory cortex and neurons here process info that represents badly sensations like pain, touch, temperature
in front of sulcus you have motor cortex and functions of neurons here is to control voluntary motor actions
another important groove is called the sylvian fissure
wernicke's area: responsible for language comprehension and it is located on the left side in about 90% of humans, if this part of brain is damaged, person can no longer understand what you're saying to them
also on the left side there is the broca's area: responsible for language production, both language comprehension/production organs can be damaged
both language areas are found on left side of brain in 90% of humans
association cortex: located in frontal, parietal and temporal lobes
posterior association vs anterior association
posterior association: combine sensory info together (auditory sensory and vision)
anterior association: combine sensory info with motor info to be able to come up with proper responses

the divided brain
bodily functions are controlled by the brain in a contralateral function (the left half of brain controls right half of the body and vice versa), however there are exceptions to this, for example, the left half of the cerebellum controls left half of body and vice versa
two halves are highly integrated, connected physically and functionally through band of white fibres called the corpus colossum
physically, they are not exactly the same and in terms of functions, both left and right halves have similar functions
however there are exceptions: language is taken care of in the left half of the brain for 90%, other 10% is located on right side or shared between both hemispheres
lefties have language functions in the right hemispheres, righties have language functions in the left hemisphere
for girls, language function is split over two hemispheres
right hemisphere is good for establishing spatial relationships (reading maps, putting together crossword puzzle, patterns, mathematics) and recognizing faces
what happens if you disconnect left and right sides of brain? commissurotomy is when you disconnect the left and right hemispheres by cutting the corpus callosum
procedure was introduced to treat intractable epilepsy/seizures (that they tried everything possible to treat epilepsy so this procedure was last resort, rationale was that by doing this procedure you could reduce the severity of the seizures)
when having a seizure neurons go crazy and you have convulsions in right side on body (left side of hemisphere is affected), by disconnecting the two halves, you could isolate the random discharge of neural activity on just one side of the body

all who went through this procedure have seen improvements
roger perry and michael gazzaniga wanted to explore the extent to which the hemispheres of the brain are able to function independently, whether these hemispheres had separate and unique functions
idea was to name objects that were presented on a screen
object on left side of screen will be processed by right side of brain (visual cortex), you will see the ball but you will need to communicate this to researchers, for you to say the object's name, you need your language functions and you can't do this if your two hemispheres are disconnected, "i see nothing" because that visual info is isolated in the right side of brain
this phenomenon is known as "left field anomia": unable to name an object presented in the left visual field
if presented with a word "dog", when asked to say the word, response is that they don't see anything: "left field alexia"

amazing thing is that if you show if the word dog and he says i don't see anything and then you ask him "using your left hand can you pick out the corresponding picture to the word you were just shown?"
right side of brain controls let side of brain, info is located on the right so he will be able to pick out the animal with his left hand
even touching objects, if you put an object in a bag and you ask them to reach in and feel an object with their left hand, they will not be able to tell you what it is: "left tactile anomia" **THIS IS A QUESTION ON THE TEST**
if you put all objects in front of him and ask him to point out what he was feeling, he will be able to point it out to you
tying shoes blindfolded: need info to be communicated between two hemispheres of the brain, subject can't do it

left and right hemispheres process emotion, when brain is separated, patient can't process emotions well
effects of separating brain are mended if done at a younger age (ages 10-12) because brain is able to reorganize itself

SENSATION AND PERCEPTION

sensory systems: they allow you to interact with the outside world
sensory systems are need-specific: adaptive behaviour, for example there are bats that are nocturnal and they rely on hearing not using their eyes but using echolocation
sensation: the process through which we detect physical energy from the environment and code that energy as neural (electrochemical) signals, takes place in sensory organs like eyes and tongue
perception: refers to the way we select, organize and interpret sensory information, interpret the neural signals

psychophysics
we are unable to detect much of the physical energy that surrounds us (we have different thresholds, dogs sense more than us)

can we measure the energy from physical stimuli in our world? yes, we can detect light
there are several benefits of quantifying a sensory stimulus: one benefit is that it allows us to compare across animals/species, another benefit is that it provides us with an estimate of perceptual quality of a stimulus in a numerical term (example: how loud is a sound in terms of decibels?)
the study of the quantitative relationship between physical and perpetual qualities is called psychophysics

sensory thresholds
absolute threshold
minimum intensity level of a stimulus before it is registered by the brain in the form of a perceptual event, it produces 50% yes responses, half the time you will sense it and half the time you won't, you will detect something half of the time

signal detection theory
states that the detection of a stimulus depends on both the intensity of the stimulus and the physical and psychological state of the individual
you are in the shower and you are expecting a phone call, you will hear the phone ring
if you are not expecting a phone call, you will not hear it ring: expectation
your ability to detect something is affected by the intensity of the stimulus (how loud it is) and your physical state (how alert you are)

difference threshold (just noticeable difference (JND))
the amount of extra physical intensity that you would need to detect the difference 50% of the time
related to the 'standard stimulus' (whatever it is you are comparing it to)
weber's law: the difference threshold increases in a linear fashion with stimulus intensity
you are in a dark room with 10 candles, you add one candle and you will probably notice a difference in the lighting of the room
you are in a dark room with 100 candles and you add one more, you will not notice a difference in lighting

sensory processes
transduction
the process by which an environmental stimulus causes an electrical response in a sensory receptor (all sensory organs have these)
receptor cells are excited by physical energy (sound waves, light waves)
each receptor cell is specific to just one type of energy: receptor cells in your eyes only get excited by light waves, cells in your ears only get excited by sound waves
when the energy level of the stimulus exceeds the absolute threshold, it activates a sensory neuron, firing an action potential. physical energy ---> neural signal **TEST QUESTION**
the intensity of the stimulus decides how many neurons are excited and fires action potential
sensory adaptation
it is the adjusting of the sensitivity of the sensory system to the current environment and to important changes in the environment
if you are in the presence of a stimulus for a long period of time, you start reacting less and less

to it: adaptation
for example: you go to the library and you hear the tick tock of a clock and eventually you won't hear it anymore

3 factors that affect adaptation
1) the number of receptor cells in the sensory organs
2) the firing rate of your sensory neurons
3) corresponding input of neurons in brain, feedback

one reason vision is important is that it enables us to perceive information at a distance, you can avoid a danger better because you have more time to react
remote sensing: hearing, audition and olfaction (you need to be in direct contact with stimulus)
retina detects differences in intensity of light
photoreceptors: convert light energy into neural activity, it is here where transduction takes place
visual info ascends to cortex --> interpreted and remembered
when saying metaphors, references are often made to visual senses

visual system: the eye
the eye is the organ specialized for the detection, localization and analysis of light
as light strikes the curved surface of the cornea, that light is bent and converged on the back of the eye (retina) for transduction
the cornea performs most of the eye's refraction (bending of light), the lens also contributes to refraction of light
the lens plays a more important role especially if an object is located really close (9 meters), the closer an object is to us, the greater the refractive power needed to bring them into focus on the retina
how is this additional power provided by the lens? because the lens changes its shape to bring objects into focus
this process is called **accommodation (might be test question!!)**, this changes with age, an infant can focus on an object just beyond their nose, an adult cannot clearly see an object that is closer than their arm's length

visual system: the retina
the conversion of light waves into neural signals occurs in the photoreceptors at the back of the retina
two types of photoreceptors: rods and cones (IMPORTANT TO REMEMBER)
-**rods** are much more sensitive to light, used for night vision, rods are not sensitive to different wavelengths of light meaning rods don't contribute to colour vision
-**cones** are active during the day and they are sensitive to different wavelengths of light (colour vision)
retinal structures varies from fovea to the retinal periphery
the fovea (central retina) is a thinning of the retina at the centre of the macula, have more cones than rods here
fovea is responsible for high resolution vision
visual acuity means sharpness of vision

visual pathways
photoreceptors (transduction takes place here) ---> activate ganglion cells (axons of these cells

come together to form the optic nerve) ---> optic chiasm (when optic nerves from both eyes connect, optic tracts are inside nervous system, when optic nerves cross over in brain, they become the optic tract) ---> thalamus (where visual info goes) ---> visual cortex (where visual info is processed)
if a collection of neurons is found outside of the brain and spinal cord, they are called ganglion cells
left eye ---> right hemisphere of brain and vice versa

feature detection neurons
david huber and torsten wiesel first to show that primary visual cortex is made up of **feature detector neurons** which are visual cells that respond to particular element in the visual field
when visual info reaches cortex, it is broken down into billions of pieces before being re-pieced and sent back
simple cells: respond to a single feature of a stimulus, only responds to a vertical or horizontal line for example (found in occipital cortex)
complex cells: respond to two features of a visual stimulus, for example a line moving in a particular direction (found in occipital cortex)
hypercomplex cells: respond to three or more features of a stimulus, for example a line of a certain orientation of a certain length moving in a certain direction, found in temporal cortex, they can also be found in the parietal lobe

parallel processing
visual info reaches occipital lobe (simple and complex cells, initial info is processed here), two streams exit: a ventral stream and a dorsal stream
ventral stream: shape and colour of the object, "what is it?"
dorsal stream: location and movement of the object, "where is it?"
they have to meet to combine info and we don't know where it happens, we call this "the binding problem"

consequences of damage to primary visual cortex
patient needed to have a portion of his right primary visual cortex because of health issue, he suffered from "left hemianopia", he was blind in the left visual field, however he reported no conscious awareness of seeing objects in the left visual field however he could report movement and location of objects he could not recognize, this is called "blindsight" also known as cortical blindness
he was asked to looked straight ahead at a fixation point, he would hear a beep and there would be a light projected somewhere in his blind side and he has to use his eye to where he thought the light was, up until about 25 degrees he was really good at identifying where the light was yet he was blind in this eye