PSYC 200 Lecture 4
Jan 18th

THE HUMAN BRAIN (CONT'D)

what happens when neurotransmitter attaches itself to a receptor?
causes receptor to open up, so things can move from the outside to the inside
when ions move across membrane, electrical current is made
so we have sodium ions moving through receptor and this is gonna cause a change in potential in the post-synaptic region
neurotransmitter: **inhibitors ---> hyper polarize** and **excitatory ---> depolarize**
neurotransmitters only respond to electrical potential signals and nothing else
action potential ---> neurotransmitter

intercellular signal (neurotransmitter) ---> neurotransmitter receptors ---> intracellular signal (change in membrane potential)

in order for neurotransmitter to work, it needs a resting membrane potential, some sort of resting activity
same thing for receptors, they have to be reset back to resting potential

diffusion: not all neurotransmitters released will be attached to receptors
reuptake: neurotransmitter taken from receptor and taken back into presynaptic region it might be destroyed or it might be recycled
enzymatic destruction: proteins come and destroy neurotransmitter at receptor

drugs affect synaptic transmission, each step in transmission can be affected by a specific drug because it is a chemical process
class of drugs called SSRI's : selective serotonin reuptake inhibitor, prescribed to treat depression, the neurotransmitter serotonin is low in depressed individuals, you need to boost the levels
serotonin is terminated by it being brought back to the post synaptic region
how to prolong their effects? prevent them from being reuptaked, block the transporter proteins from taking neurotransmitters back to cell (PROZAC blocks the reuptake effects of serotonin)

ecstasy (X) builds up the concentration of serotonin in the synapse, keeps levels high therefore prolonging their effects, makes people feel buzzed and happy

when you take ecstasy you feel good when you take it and throughout the week you will eventually crash because you will have all these empty axon terminals because serotonin levels will increase and then rapidly decrease, you will feel good eventually as the brain is working overtime to replenish the serotonin levels
serotonin levels never go back to normal after popping X, neurons that aren't functioning anymore are destroyed, apoptosis (cell suicide)
you only lose a few serotonin cells as they weren't working properly either, you lose serotonin cells after the end of the ecstasy cycle
when you pop pills again, you don't get the same high as before because you have fewer serotonin cells and in the next day you will crash and it is greater than the last crash from the first time, you lose more serotonin cells and your normal mood isn't normal anymore
monkey took ecstasy for 7 days straight and lost 80% of serotonin cells

the nervous system is like the mafia, when cells don't behave normally the mob gets suspicious and put a hit on the cell and gets it killed

VIDEO: https://www.youtube.com/watch?v=W4N-7AlzK7s

most important function of brain is that it is capable of changing and this is called 'plasticity'
learning and memory were results of synaptic plasticity, everytime that you learn something new, changes take place at synaptic level in your brain (at the level of connections between the neurons, being formed and strengthened)
synaptic plasticity: impoverished environment leads to an impoverished rat brain cell
however an enriched environment led to an enriched rat brain cell

observations of this experiment:
1) rats who spent time in enriched environment had bigger brains than rats from impoverished environment, was due to two things: a) greater number of extension for neurons (neural extension at axon and dendrite level) and b) the synapses were larger (had more receptors on it, contributed to larger number of brain cells)
2) they found an increase in the levels of an enzyme called acetylcholinesterase, it deactivates the neurotransmitter acetylcholine, helped for learning and memory (http://www.thinkib.net/psychology/page/9279/rosenzweig-bennet-diamond-1972)
3) increase in protein synthesis, they could be neurotransmitters

how does this experiment apply to us? stimulate your brain or lose it!
chance of developing Alzheimer's after age of 80: 50%

part of your brain called hippocampus and it is involved in learning and memory (spatial memory: where you are)
in london cab drivers, this area of the brain was 20% larger than a normal individual: more denser and more connections

spinal cord
it is the width of your pinky, length in men: 45 cm
ends in lower back and starts at neck, it is white because it is covered in myelin, encased in bony structure to protect it, contains tracts (a collection of axons found inside of nervous system): ascending tracts and descending tracts
ascending tracts carry sensory information (leading from organs to brain)
descending tracts carry motor information (leading from brain to organs)

3 principle functions:
distribute motor fibres to the effector organs of the body
reflexive control circuits
collect somatosensory info and pass it on to the brain

spinal nerves: serve as a link between CNS and the rest of the body
what is being carried in spinal nerves? they contain axons that are carrying sensory info and motor info (TEST QUESTION)
not both, axon can carry one or the other
because spinal nerves are located outside of CNS, they are part of the peripheral nervous system
if you cut yourself by accident, the skin cells have ability to repair and regenerate themselves,

muscles can do this too
neurons however can't repair themselves, you can fabricate neurons but the problem is telling it where to connect its dendrites, we can't do that yet, we can make neurons but can't program them

reflexes
reflexes are automatic neuromuscular actions generated in response to specific stimulus
reflexes are automatic because they are not under conscious control
basic function is to keep you alive because they cause you to react when you don't have any time for conscious decision making
the sensory neutron detects some danger, signal is sent to spinal cord (affront), sent to motor neurone which sends an efferent signal back to the source of danger: reflex

the human brain
triarchic brain: brainstem, limbic system and neocortex (3 regions of the brain)
brainstem: oldest part of the brain, responsible for survival type functions, breathing, heartbeat, genital arousal
limbic system: made up of many structures, controls social and emotional behaviour, how we feel, also influences our thought processes, plays important role in memory
neocortex: on evolutionary scale it is the newest part of the brain, the most important part of the neocortex is the frontal lobe, within frontal lobes there is an area called the prefrontal cortex, some consider this the most important part of neocortex, necessary for executive functions, it is like the boss of your brain, choosing right and wrong, also helps experience emotions

the brain stem and subcortical structures
brain stem is connected to spinal cord through an opening at base of skull known as the **foramen magnum**
most significant trauma is caused by the swelling of the brain, brain is found in an enclosed space called the skull, swelling is caused by burst arteries or broken blood vessels, this increases liquid fluid in the brain, fluid looks for a way to escape and the only way out is through the foramen magnum, therefore crushing the brainstem
medulla controls breathing rate and heart rate, also controls gag reflex
pons regulates arousal, also controls sleep dreaming processes as well

the midbrain: visual and auditory reflexes

sitting above the brain stem is the **thalamus**, its basic functions are a) it filters all incoming visual or auditory or sensory information and send it to specific areas of the brain (relay station), it is the bouncer of the brain: identifies info and lets it in or out and b) it serves as an integration centre for sensory info as well and c) it also helps regulate consciousness and sleep and dreaming and states of arousal
the cerebellum is located behind the brainstem, muscle coordination and procedural memories (remembering how to do something in a sequence of events, how to ride a bike, tying your shoe, basically habits that we have learned)

the brain stem and subcortical structures
the thalamus and the basal ganglia are part of the subcortical structural
brainstem is made up of midbrain medulla and pons

cerebellum is found behind brainstem

the basal ganglia is involved in voluntary motor movements (primary function), help with motor control, it is involved in cognition and different forms of learning (motor learning), emotional processing, just like cerebellum, it is involved in formation of procedural memories
made up of **caudate, putamen and globes pallidus** (they are interconnected)
caudate and putamen are known as a striatum, damage to the striatum results in huntingtons (loss of inhibitory control)

the limbic system
amygdala is found in middle portion of temporal lobe, controls emotional response, if it evaluates incoming info as threatening, it will activate the flight or fight response (do i stay here and deal with the threat or do i turn around and run away?), this is a physiological response that prepares the body for action
the hippocampus is found behind amygdala, responsible for learning and memory
the cingulate cortex is found in middle portions of brain, we believe it is involved in processing of painful stimulus, might play a role in helping to choose a response, might play a role in formation of memory, we are not sure, it is located above the corpus colossal
corpus colossal is a white structure made up of millions and millions of axons that are connecting the left half of your brain to the right one, connecting the two hemispheres, helps share info between the two
hypothalamus is found below thalamus and its basic function is to link the nervous system to the endonervous system, made up of tiny structures whose basic function is to control survival-type behaviour
endocrine system is involved in the release of hormones which regulate metabolism and growth and development and moods
pituitary gland secretes human growth hormone, secretes hormones that affect all other glands in the body, male testes secrete testosterone after getting message from pituitary gland

the cerebral cortex is the outer part of the brain, developed most recently, outer portion is not very thick (ranges between 1.5 mm to 3.5 mm in thickness and in some areas it can go up to 5 mm), cerebral cortex is called grey matter because it has a greyish hue to it because it is made of neural cell bodies and glial cells
beneath the cortex, there is **myelin** (white matter) because there are axons and axons are covered by myelin
grooves in the brain are called **fissures** or **sulcus** (fissures are very deep grooves and sulcus are very shallow grooves), in-between these grooves we have **gyri** (elevated portions)
difference between our brains and monkeys brains is that they dont have the grooves because as our brains evolved, we developed more areas of our brains and we tried to fit more stuff into the same space, compressing the brain causes the grooves to form, if we didn't have gyri and grooves, we would have enormous heads

we have 4 lobes: the smallest is the **occipital lobes** (visual processing), **temporal lobes** (emotions, memory, language comprehension, auditory processing, auditory cortex), **parietal lobes** (boldly sensations like touch, pain, body temperature, contains somatosensory cortex) and **frontal lobes** (role in intelligence, memory, language production, reasoning skills, personality,

emotions, goal-oriented behaviour, response selection, what makes us who we are is the frontal lobe)