Ap psychology neuroscience and behavior notes

CHAPTER 3 – NEUROSCIENCE AND BEHAVIOR I. Neurons: The Origin of Behavior A. Discovering How Neurons Function 1. Neurons – cells in the nervous system that communicate with each other in order to perform information processing tasks 2. About 100 billion neurons in the brain 3. Neurons produce a fundamental invisible physical component of visible behavior. Neurons have come in many shapes and sizes, and communicate without touching B. Components of Neuron 1. Cell Body (Catfish) – coordinates information processing tasks and keeps cell alive 2. Dendrites – receive information from other neurons and transfer it to the cellular body 3. Axon – transmits information to other neurons, muscles or glands a. Myelin Sheath – an insulating layer of fatty material around the occon that accelerates conductivity b. Myeline sheath consists of glial cells a. Glial cells - support cells located in the nervous system (a) Clean dead tissue, provide nutrients to neurons and provide myelin for oxon 4. Synapse – a compound between the axons of one neuron and the dendrite of another neuron or some a. Adults have between 100 and 500 trillion synapses C. Major types of neurons 1. Sensory neurons – receive information from the outside world and transmit this information to the brain via the spinal cord 2. Motor neurons – transmit signals from the spinal cord to the muscles to produce movement 3. Interneurons – connect sensory neurons, motor neurons or other interneurons D. Neurons specialized in location 1. Turkey cells carry mostly motor information from the cerebelly to the rest of the brain and spinal cord 2. Pyramidal cells carry all kinds of information from the brain cortex 3. Bipolar cells transmit visual information to the brain from retina II. Electrochemical Actions of Neurons: Information Processing A. Electrical Signaling: Conducting Information Within Neurons 1. Communication within and between neurons takes place in two stages - conduction and transmission, together they are called electrochemical action a. First, the signal is received and can trigger an electrical conduction down octon b. Second, the signal travels chemically via synapse to the next neuron 2. Rest potential – the difference in electrical charge between the inner and outer sides of the neural cell membrane 3. Charged molecules, or ions, flow differentially across the cell membrane to set the potential for rest a. At rest there is a higher concentration of potassium (K+) on the inner inside of the cell and sodium (Na+) outside cell b. The flow of ions across the cell membrane is controlled by opening and closing channels that are specific to each ion 4. The resting potential of neurons is about -70 million 5. Action potential – an electrical signal carried out along the length of the axon of neurons to synapse 6. Input must exceed the threshold for activating action potential 7. All-or-nothing, that is, the power of action potential remains the same from start to finish and is not influenced by further changes in input strength 8. Refractory period - the time after the action potential during which the new action potential 9 cannot be launched. Naked segments of axion between parts of myelin are called ranvier nods, which causes action potential for jump (salty conduction) and speed of conduction B. Chemical signaling: Transmission between neurons 1. Neurotransmitters – chemicals that transmit information via synapse to receiving neural dendrites 2. Receptors – parts of the cell membrane that receive neurotransmitters and trigger or prevent a new electrical signal a. Act as a lock-and-key system, where only certain neurotransmitters can activate certain receptors 3. Sending, or presynaptic neuron, releases neurotransmitters in the synapse receiving postdynamic neuron 4. Neurotransmitters were wiped out of the synapse when they finished binding to receptors via three different processes a. Re-entry – neurotransmitters return to the presyaptic neuron via transporter b. Enzymatic degradation – enzymes can destroy a neurotransmitter while still in synapses c. Autoreceptors can also detect whether there are too many neurotransmitters being released and signal a presyaptic neuron to stop the release of C. Types and functions of neurotransmitters 1. Acetylcholine – a neurotransmitter involved in a number of functions, including voluntary motor control 2. Dopamine – a neurotransmitter that regulates motor behavior, motivation, pleasure and emotional arousal 3. Glutamate – the main excitatory neurotransmitter involved in the transmission of information through the brain 4. GABA (gamma-aminobutinic acid) – the primary inhibitory neurotransmitter in the brain 5. Norepinephrine – a neurotransmitter that affects mood and arousal 6. Serotonin – a neurotransmitter involved in the regulation of sleep and alertness, diet and aggressive behavior 7. Endorphins – chemicals that act within pain pathways and brain emotion centers D. How drugs mimic neurotransmitters 1. Agonists – drugs that increase the action of neurotransmitter 2. l-dopa increases dopamine and helps in the treatment of Parkinson's disease 3. Prozac increases serotonin by blocking re-intake, which helps treat symptoms of depression E. Antagonists - drugs that block neurotransmitter 1. MPTP destroyed dopamine production of neurons 2. Propanolol blocks beta receptors for norepinephrine in the heart, which helps with stage fright III. Organization of the nervous system A. Division of the nervous system 1. Central nervous system (CNS) – brain and spinal cord 2. Peripheral nervous system (PNS) – connects the central nervous system with the body's organs and muscles a. Somatic nervous system – a set of nerves that transmits information to and from the central nervous system b. Autonomic nervous system – a set of nerves that carries involuntary and automatic commands that control blood vessels, body organs and glands a. Sympathetic nervous system – a set of nerves that prepares the body for action in a meastic situation b. Parasympathetic nervous system – helps the body return to normal resting state B. Components of the central nervous system 1. The spinal cord coordinates breathing, pain, movement and other functions a. Spinal reflexes – simple pathways in the nervous system that quickly create muscle contractions b. The spinal cord is divided into four regions, each of which controls the other part of the body IV. Brain structure In general, simpler tasks are controlled by lower regions and complex functions to higher regions of A. Hindbrain – an area of the brain that coordinates information coming in and out of the spinal cord. Medulla – extension of the spinal cord to the skull that coordinates heart rate, circulation and breathing a. Reticular formation – cluster of neurons in medulla that regulates sleep, alertness and arousal levels b. Cerebellum (cerebellum) – a large rear brain structure that controls fine motor skills, coordination and balance c. Pons (bridge) – a structure that transmits information from the cerebelly to the rest of B. Midbrain's brain – above the rear brakes, coordinates orientation and movement in the environment and contributes to the excitement of 1. Tectum – orients the organism in the environment 2. Tegmentum - involved in movement and arousal, including motor behavior (substantia nigra and dopamine), motivation, and pleasure C. Forebrain – the highest level of the brain, controls complex cognitive, emotional, sensory and motor functions 1. Tectum – orients the organism in the environment 2. Cerebral cortex – the most fun layer of the brain, visible to the naked eye, and divided into two hemispheres 3. Subcortical structures – areas of the pretina located under the brain cortex near the very center of the brain a. Thalamus – transmits and filters information from the senses and transmits to the brain cortex b. Hypothalamus (under the thalamus) – regulates body temperature, hunger, thirst and sexual behavior i. Four F behaviors: fighting, escaping, feeding, and mating c. Hypothatural gland – a master gland of the system for the production of hormones in the body, which releases hormones that direct the functions of many other glands in the body d. Limbic system – a group of forebrain structures including the hypothalamus, amygdala, and hippocampus, which are involved in motivation, emotions, learning, and memory e. Hippocampus – a structure critical for creating new memories and integrating them into the knowledge network so that they can be kept indefinitely in other parts of the brain f. The amygdala - perched on top of each hippocampus horn, plays a central role in many emotional processes, notably the formation of Mr Basal Gangli's emotional memories - a set of subcortical structures (including striatum) that directs deliberate movements 4. The brain cortex a. Fitting a lot of cortex into small spaces and. Gyri – smooth, raised surfaces of the cortex ii. Sulci – fostering or cracks in the cortex b. Three-level cortex function and. The separation of the cortex into two hemispheres (a) Each side is approximately symmetrical and controls many functions on the opposite, or contralateral, side of the body (b) Commissure – the axon beams that make up possible communication between parallel areas of the cortex in each half, the largest being the corpus callosum ii. Functions of each hemisphere (a) Each hemisphere has four lobes (1) of the occipital lobe – a region in the back of the brain that processes visual information (2) Parietal Lobe – located in front of the occipital lobe and performs functions such as touch (3) Temporal Lobe – located laterally and under the parietal cortex, is responsible for hearing and language (4) The frontal lobe – behind the forehead – has specialised areas for , abstract thinking, planning, memory, and judgment (b) Homunculus (small man) – rendering of a body in which each part shown is proportionate to representation in the somatosensory (parietal) or motor (frontal) cortex (c) The role of specific cortical areas (1)areas of the association – areas of the cortex consisting of neurons that help provide meaning and meaning to information registered in parts of the primary cortex D. Brain plasticity 1. The brain is plastic: Functions assigned to certain parts of the brain can be able to be converted into other areas 2. Extensive use of your hands (e.g. concert pianist) may result in greater hand displays in the cortex than non-pianistS V. Development and evolution of nervous systems A. Prenatal development of the central nervous system 1. The nervous system is the first large body system to form in the embryo a. After the third week of fertilization, the nervous system goes from the sphere with a ridge, to the groove, to the neural tube b. Week five prebrain and Hindbrain differential c. For the seventh week and later, forebrain spreads to cerebral hemispheres 2. Ontogeny – how the brain develops within an individual 3. Phylogeny – how the brain evolved within a certain type B. Evolutionary development of the Central Nervous System 1. Even the simplest animals have sensory and motor neurons a. Single protozoa have systems for sensing and moving towards food B. Invertebrates (e.g. jellyfish and flats) have developed simple nervous systems with commissars and ganglia 2. Vertebrates evolved differently from invertebrates. Vertebrates have developed separate sensory and motor systems b. A hierarchy developed in vertebrates a. Higher parts of the brain have evolved to cope with more complex behaviors than the lower parts of the brain c. Different vertebrae have different levels of complexity in forebrain a. Birds rely on highly developed striatum b. Mammals have a developed striatum and a more developed brain cortex d. Primate brains, especially humans, evolved faster than other mammals, due in part to gene mutations (changes in gene DNA) that resulted in the adaptation of C. Gen and Environment 1. Nature and nurturing a. Either genetics or the environment played a big role in the production of certain behaviors, traits, etc. B. The interaction between nature and upbringing determines what people do 2. What are genes? A. Gene – a unit of hereditary transfer, built from DNA (deoxyribonucleic acid) b. Chromosomes – strands of DNA wounds around each other in the configuration of double helise c. Degree of kinship – the likelihood of sharing genes (e.g. you share 50% of your genes with each parent) and. Monozygotic twins (identical twins) – share 100% of the gene because they came from one fertilized egg ii. Dizygotic twins (fraternal twins) – share 50% of the gene because they came from 2 fertilized eggs, just like the other siblings iii. The two studies are often used to determine the amount of behavior, traits, or disorder attributable to d genes. Heritability – a measure of the variability of behavioural traits between individuals genetic factors and. Calculated as a share and reported as a number from 0 to 1.0 ii. Heritability of .50 for intelligence tells us that 50% of intelligence is made up of genes, but not which genes may control that 50% iii. This result of heritiveness stems from the population, not from one person IV. Heritability depends on the environment v. Heritability is not destiny; circumstances may change the likelihood of behaviour or pathology VI. Brain Research A. Learning about brain organization by studying brain damaged 1. A lot of research on brain function has come from behavioral deficit studies versus specific brain damage (eg, Broca area) 2. The emotional functions of A. Phineas Gage's frontal lobe accident, which essentially separated his frontal lobes from the rest of his brain, resulted in the understanding that the frontal lobes are essential to maintaining emotional stability on 3 October 2015. Different roles of the left and right hemispheres a. Split-brain surgery – surgical division of the corpus callosum b. It is permissible to understand how some behaviors are transferred to only one hemisphere (e.g. language is usually processed in the left hemisphere) B. Brain listening: Individual neurons and EEG 1. Electroencephalography (EEG) – a device used to record electrical activity in the brain, usually detected by electrodes on the scalp 2. Activity patterns from groups of neurons indicate sleep, arousal, and certain perceptions of 3. Imaging from individual neurons showed us how cells in some parts of the brain respond to stimuli (e.g. occipital neurons or feature detectors, responding to dots or lines on screen) C. Brain Imaging: From visualizing structure to seeing the brain in action 1. Neuroimaging techniques - methods used to produce images of living, healthy brain tissue and activity 2. Structural brain imaging – computerized axial tomography (CAT) a. X-rays taken from many angles to produce a composite of different brain densities b. It is often used to detect structural problems (e.g. tumors) 3. Magnetic resonance imaging (MRI) – images resulting from short but powerful magnetic impulses applied to the brain and interpretations of how cells in tissue respond to impulses 4. Functional brain imaging - allows scientists to watch the brain in action during some behavior, based on increased blood flow in active regions a. Positron Emission Tomography (PET) b. Functional Magnetic Resonance Imaging (fMRI) (fMRI)

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