

2016-09-21

Neural Communication

Biological Psychology

- Discipline of psychology concerned with physical ways neurons cooperate to compose mental processes
- Names:
 - Behavioral Neuroscientists
 - Neuropsychologists
 - Behavior Geneticists
 - Physiological Psychologists
 - Biopsychologists

Phrenology

- The study of the shape of skull and the making of inferences based off of that shape
 - Bumps on head indicate abilities or traits
- Developed by Franz Gall

The Neuron

- Anatomy
 - Soma = body of the cell
 - * Receives action potentials from dendrites
 - Dendrites = branching bodies that connect to other dendrites or axon terminals
 - * Receive action potentials via **neurotransmitters**
 - Axon = long, thin barrel with myelin sheath that uses electrotonic potential to relay signals from soma to axon terminals
 - * Covered with myelin sheath to split transmission into brief, fast electrotonic potentials and connecting action potentials to keep voltage high
 - Myelin sheath = waxy layer composed of **Schwann Cells**
 - * Serves to insulate stretches of the axon so that electrotonic potential can happen, speeding up transmission

- *Nodes of Ranvier* = gaps inbetween the myelin sheathing that allows an action potential to happen, keeping the voltage within the cell high enough to ensure the signal isn't lost
- Synapse
 - * The area where two neurons come near to each other
 - * Site of neurotransmitter release and intake

Action Potential

- Begin at resting potential(-70mV inside neuron)
- Stimulus opens Na⁺ channels and tons of sodium ions flow in
 - **Polarization**
- After a threshold is reached, K⁺ gates open, letting K⁺ out. Voltage drops as a result
 - **Depolarization**
- After a while, Sodium-Potassium pumps begin to create the gradient
 - **Repolarization**

Drugs that Target Neurotransmitters

- Action potential at dendrite is stimulated by neurotransmitter, typically
- Drugs can fit in those receptors
- **Antagonist**
 - The drug fits, but poorly; as a result, the *real* neurotransmitter can't fit
 - **Inhibits** the targetted neurotransmitter
- **Agonist**
 - The drug fits *really* well and simulates the neurotransmitter
 - **Excites** the neurotransmitter or increases activity

2016-09-22

Neurotransmitters

- Dopamine
 - Used in movement, attention, and learning

- Schizophrenia thought to be related to dopamine imbalance
 - * Thought to be a surplus of dopamine
- Parkinson’s disease thought to be related to loss of dopamine-releasing neurons
 - * Symptoms:
 - Movements are difficult to control
 - Shaking while at rest
 - Stooping posture or rigidity
 - Unbalance
 - * Treatments
 - L-dopa = agonist that immitates dopamine
 - Fetal tissue transplants
 - Adrenal gland transplants
 - Electrical stimulation of thalamus = stops shaking
- Part of “reward system” or limbic system
- Serotonin
 - Regulates sleeping patterns
 - Thought to be related to depression
 - * Especially low-serotonin
 - * High-serotonin is thought to cause mania
 - * *Prozac* excites serotonin
 - **SSRI** = Selective Serotonin Reuptake Inhibitor
 - Examples: Welbutrin, Zoloft, Celexa
- Acetylcholine
 - First neurotransmitter we discovered
 - Abbreviated “ACh”
 - Used in motor neurons–stimulates muscles to contract
 - Used in learning, memory, and muscle contraction
 - Nicotine is an agonist for Norepinephrine and ACh
 - Thought to be related to Alzheimer’s Disease
 - * Decay of memory, reasoning, and lanugage
- Endorphins
 - Regulates pain/pleasure
 - Pain is a stimulus for release
 - Agonists
 - * Morphine
 - * Codeine
 - Explains “runners high”
- Norepinephrine

- Excitatory neurotransmitter that causes “fight or flight” response
- Also related to depression
- Used in physical arousal, learning, and memory
- GABA
 - Inhibitory
 - Thought to be related to Huntington’s disease = death of neurons in *striatum* that make use of GABA
 - * Jerky movements
 - * Cognitive deterioration
- Glutamate
 - Very prevalent
 - Excitatory neurotransmitter
 - Excess glutamate and lack of GABA is associated with epilepsy

Neurons can be Excitatory or Inhibitory

- Excitatory = stimulates post-synaptic neuron to carry an action potential
- Inhibitory = Causes post-synaptic neuron to be less likely to start an action potential
 - GABA

2016-09-27

Summary

- Stages
 - Relieved Dolby Rescued Harry = mnemonic for remembering stages of action potential
 - * **R**elieved = **R**esting
 - * **D**olby = **D**epolarization
 - * **R**escued = **R**epolarization
 - * **H**arry = **H**
- Ions
 - SIPO = mnemonic for remembering ions
 - * **S**odium **I**n, **P**otassium **O**ut
- Agonists vs Antagonists

- Agonists = mimic effect of neurotransmitter
 - * Nicotine, Morphine
- Antagonists = block or inhibit effect of neurotransmitter

The Nervous System

- Nerves = small strands of neurons that act as highways for action potentials
 - Serve to connect brain to peripheral sensory organs
- Nervous System = the organ system the body employs to communicate between organs
 - Composition
 - * Nerve Cells
 - * **Peripheral Nervous System(PNS)** = nerve framework that connects brain to peripheral sense organs
 - * **Central Nervous System(CNS)** = the brain and spinal chord

Model of Nervous System

- Peripheral Nervous System
 - Autonomic Nervous System
 - * Controls unconscious actions of organs
 - * Sympathetic Nervous System = arousal
 - * Parasympathetic Nervous System = calming effect
 - *Think of a parachute—slows you down*
 - Skeletal/Somatic Nervous System
 - * Controls voluntary movement of skeletal muscle
- Central Nervous System
 - Brain
 - Spinal Chord

Types of Neurons

- Sensory Neurons
 - Serve as medium through which sensory information travels to brain
 - Sense Organs -> Brain
 - * Uses **affarent neurons**
 - Brain -> Sense Organs
 - * Uses **efferent neurons**

- Mnemonic = SAME
 - * **S**ensory **A**ffarent **M**otor **E**fferent
- Interneurons = linking neurons that connect other systems together
 - Only found in brain and spinal cord

Reflexes

- **Reflex** = a simple action undertaken via the **reflex arc**
- **Reflex Arc** = a pathway of nerves through which a reflex happens
 - Generally goes from sensory organ -> afferent neurons -> interneurons -> spinal cord -> interneurons -> efferent neurons -> motor neurons

Neural Networks

- Neural Networks = a web of inter-connected neurons that cooperate to process information
- Through experience and feedback, neural networks are modified

2016-09-29

Lesions

- Lesions = destruction of tissue cause either naturally or by purpose
- Walter Freeman = got Nobel Prize for procedure wherein he quickly caused damage to a part of the brain to cure depression or anxiety

Brain Scan

- Electroencephalogram(EEG)
 - Places 8 electrodes around the brain and records electric brain activity
- Computed Tomography Scan(CAT Scan)
 - X-ray photographs taken from different angles
 - A computer generates a composite image
- Positron Emission Tomography Scan(PET Scan)
 - A radioactive form of glucose is ingested and sensors detect where glucose goes

- Magnetic Resonance Imaging Scan(MRI Scan)
 - Large electromagnets and radio waves make water in the brain orient itself in line with the magnetic field
 - Can generate very high-detail images
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