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 transmisison

- *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
    - Cite of neurotransmitter release and intake

Action Potential Process

- 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

    - **Depolorization**

- 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

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 Alzheiumer'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 *stratium* that make use of GABA
- Jerky movements
- Cognitive deterioration

- Glutamate

  - Very prevelant
  - 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

Summary

- Stages

  - Relieved Dolby Rescued Harry = mneumonic for remembering stages of action potential
  - **R**elieved = **R**esting
  - **D**olby = **D**epolorization
  - **R**escued = **R**epolorization
  - **H**arry = **H**

- Ions

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

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 -> affarent neurons -> interneurons -> spinal chord -> 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

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 photoraphs 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