

# Neural Communication

**Biological Psychology** = aspect 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 Process

- Begin at resting potential(-70mV inside neuron)
- Stimulus opens Na<sup>+</sup> channels and tons of sodium ions flow in
  - **Polarization**
- After a threshold is reached, K<sup>+</sup> gates open, letting K<sup>+</sup> 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 targeted 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 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 *stratium* 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

### Summary

- Stages
  - Relieved Dolby Rescued Harry = mnemonic for remembering stages of action potential
  - **Relieved** = **R**esting
  - **Dolby** = **D**epolarization
  - **Rescued** = **R**epolarization
  - **Harry** = **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 **afferent** neurons
  - \* Brain -> Sense Organs
    - + Uses **efferent** neurons
  - \* Mnemonic = SAME
    - + **S**ensory **A**fferent **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 -> afferent neurons -> interneurons -> spinal chord

## 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

## 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 waves
  - \* Can generate very high-detail images