Behavioral Neuroscience Notes

PSYC 360

Start

January 21, 2025

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End

May 14, 2025

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CHAPTER 1

ORIGINS OF BEHAVIORAL NEUROSCIENCE

1.1 Prehistoric

- A million years or more, people have been interested in the brain. Archaeological evidence shows that skulls are bashed in (jagged, not precise). As a result, the person dies, and therefore the brain is vital to life.

1.2 7000 Years Ago

- New holes in the brain, but these holes show signs of healing. Therefore, these new holes are intended to help the person who is suffering. The fancy name is trephination.
- The theory for these holes is that they were drilled to cure the person. In other words, to relieve a person of a wicked spirit.

1.3 5000 Years Ago

- *Egyptian* physicians show that they were aware of brain damage through their writings.
- Complications arise because they thought the heart contained the soul–you need it to live and emotions effect it.

1.4 Ancient Greece–4th Century, BC

1.4.1 *Hippocrates*

- Ponder the correlation between structure and function. Now, extend this thought to the brain/head.
- The brain is the place where sensation and intelligence reside. Not the heart.

1.4.2 *Aristotle*

- Clung to the idea of the heart being the one in charge.
- Figured the brain was a radiator. That is, we would send heated blood to the brain for it to be cooled off. This "heated blood" arose from our emotions. Thus, humans are more rational because we have a lot of cooling when compared to other animals.

1.5 Roman Empire–*Galen* 2nd Century, AD

- Galen is a physician to gladiators.
- Thought the cerebellum was for motor control (because the cerebellum is hard, like muscles) and the cerebrum is for memory because it is soft, and you can "write on it."
- Noticed there were large spaces (called "ventricles," or "spaces") that were filled with fluid.
- From here, we get the four humors (fluids).
- Galen thought that these fluids are what control the brain, NOT the brain structure itself. Think of the purpose of canned vegetables. The tin container does not actively contribute to the liquid / vegetables; rather, it is disposable.
- These ideas were jumpstarted by the invention of aqueducts. The movement of water was so important from aqueducts, so the idea this idea was extended to the brain.

1.6 Analysis by Analogy–17th Century

- *French* developed hydraulically controlled machines.
- Again, this is adding to the idea that liquids (which can flow through things and cause movements) are responsible for the brain's functionality.

1.7 *René Descartes*–1596-1650

- Believed that non-humans–what he called animals–are controlled by fluid.
- From this, he posited that the human body is a material entity functioning as a machine (like animals)–these are known as reflexes.
- But, the mind is nonmaterial and free from the laws of the universe and was uniquely human.
- Question: How does the nonmaterial part of the body (the mind) communicate with the material part of the body? Through the pineal gland! This gland would move around like a joystick and would manipulate the fluid that came from the third ventricle.

1.8 The Mind/Body Problem

- What is the basic relationship between mental events and physical events?
- *Dualism*–The mind exists independently of the brain and exerts some control over it.

- Strengths: Commonsense view.
- Weaknesses: The universe is composed of matter or energy.
- Modern neuroscientific explanation: Everything the body does rests on the events taking place in specific, definable parts of the nervous system–the "mind" is the product of the nervous system activity.

1.9 The Scientific Method–17th and 18th Century

- A new world view at the end of the Renaissance.
  - Replace *Rationalism* with *Scientific Method*.
- Closer look at the substance of the brain:
  - Gray and white matter change the way we look at the brain. That is, why would these parts of the brain that are clearly different, be different if the brain is used just to move fluids around.
  - Also, everyone has the same brain structure, so these bumps and groves must mean something.

1.10 Electricity

- *Isaac Newton* showed it is possible to electrically stimulate nerves.
- Then, *Luigi Galvani* and *Emil du Bois-Reymond* showed that electricity can make muscles contract.
- Later on, *Hermann von Helmholtz* showed that the speed of nerve conduction is not instantaneous.
- This important distinction shows that these nerves are not like wires–such as *Luigi Galvani* and *Emil du Bois-Reymond* thought.
- *Bell* and *Magendie* showed that the dorsal nerve root and the ventral nerve root are different.
- The dorsal nerve root is for sensory information, and the ventral nerve root is for motor information.
- *Dorsal* = *Sensory*: Think of the dorsal fin of a shark sensing vibrations in the water.
- *Ventral* = *Motor*: Think of a vent (like a car exhaust) pushing out movement.
- *Johannes Müller* came up with the doctrine of *Specific Nerve Energies*.

    - This doctrine states that the nature of a sensation depends on which nerve is stimulated, not on how the nerve is stimulated.
    - For example, if you stimulate the optic nerve, you will see something. If you stimulate the auditory nerve, you will hear something.
- Spawned the *Great Debate*: Is the brain a homogenous mass or is it made up of different parts?

1.11 The Great Debate

- *Franz Joseph Gall* and *Johann Spurzheim* thought the bumps and groves on the head were due to the size of the brain parts.
- They concluded that the size of the brain parts was correlated to the use of that part.
- This is known as *phrenology*.
- *Localization of Functions*–brain function can be localized to regions, pathways, or neurons.
    - Basically, if you cut out a piece of brain, and the animal (a pigeon) is no longer able to do a specific task, then that part of the brain is responsible for that task.
    - However, it turns out that these pigeons were able to relearn the task, so the brain is not as localized as we thought (this research is from Flourens).
- *Aggregate Field Theory*–the brain is a homogenous mass.
    - Complex brain functions emerge from the collective interactions of numerous simple neuronal activities.
    - Unlike localizationist models, this theory emphasizes the distributed nature of cognitive processes across neural networks.
- *Pierre Flourens* (1794–1867)
    - Studied the effect of brain damage with pigeons and supported the Aggregate Field Theory.
- *Paul Broca* (1824–1880)
    - Found a patient who could understand language but could *not speak*.
    - After the patient died, Broca found a lesion in the *left frontal lobe*.
    - This area is now known as *Broca's area*.
    - This area is responsible for *speech production*.
    - These results put us back into the realm of Localization of Function.
- In comes *Carl Wernicke* (1874)

- Found a patient who could speak but could *not understand* language.
- After the patient died, Wernicke found a lesion in the *left temporal lobe*.
- This area is now known as *Wernicke's area*.
- This area is responsible for *language comprehension*.

- Then, we have *Gustav Fritsch* and *Eduard Hitzig* (1870)
  - Similarly to *Luigi Galvani* and *Emil du Bois-Reymond*, they electrically stimulated the brain.
  - They found that the *motor cortex* is responsible for *movement*.
- *Shepherd Ivory Franz* (in D.C. from 1907–1924)
  - Found that people are able to relearn tasks after brain damage.

1.12 Same Resolution?

- *Modified Aggregate Field Theory*
  - *Karl S. Lashley* (1890-1958)
    - *The Principles of Mass Action*
      - Complex behavior–such as learning–is dependent on the total mass of the brain.
    - *Equipotentiality*
      - Specialization of function is not tied to specific brain regions.
      - All parts of the cortex contribute equally to complex behavior.
    - *Vicarious functioning*
      - If one part of the brain is damaged, another part can take over.

1.13 Analysis

1. **Prehistoric**: Recognition of the brain's vital role in life through skull injuries. No scientific theories yet.
2. **7000 Years Ago**: Trephination (skull drilling) practiced to release "evil spirits," indicating early medical intervention.
3. **5000 Years Ago**: Egyptians documented brain damage but prioritized the heart as the seat of the soul.
4. **Ancient Greece—Hippocrates (4th Century BCE)**: Proposed the brain as the center of sensation/intelligence, countering heart-centric views.

5. **Ancient Greece—Aristotle**: Defended the heart as the command center, viewing the brain as a blood-cooling "radiator."

6. **Roman Empire—Galen (2nd Century CE)**: Linked cerebellum to motor control and cerebrum to memory; emphasized ventricular fluids (humors) over brain structure.

7. **17th Century (Analysis by Analogy)**: Hydraulic systems inspired fluid-based brain theories.

8. **René Descartes (1596–1650)**: Dualism (mind vs. body); proposed pineal gland as the mind-body interface.

9. **17th–18th Century (Scientific Method)**: Shift to empirical study; recognition of gray/white matter differences.

10. **Electricity Discoveries**: Newton (nerve stimulation), Galvani/du Bois-Reymond (muscle contraction via electricity), Helmholtz (nerve conduction speed), Bell/Magendie (sensory/motor nerve roots), Müller (specific nerve energies).

11. **The Great Debate**:

    Table 1.1: Key Figures in the Great Debate: Localization vs. Aggregate Theory

Localization	**Aggregate Theory**
Johannes Müller	Pierre Flourens
Franz Joseph Gall	Shepherd Ivory Franz
Johann Spurzheim	
Paul Broca	
Carl Wernicke	
Gustav Fritsch	
Eduard Hitzig	

12. **Modified Aggregate Theory**: Karl Lashley emphasized mass action and equipotentiality.

Table 1.2: Key Scientists and Contributions

Scientist	**Contributions**	**Active Dates**
Hippocrates	Brains as seat of sensation/intelligence	
Aristotle	Heart as command center; brain as radiator	
Galen	Cerebellum (motor), cerebrum (memory); humors	
René Descartes	Mind-body dualism; pineal gland	
Isaac Newton	Early nerve stimulation via electricity	
Luigi Galvani	Electricity-induced muscle contraction	
Emil du Bois-Reymond	Same as Galvani	
Hermann von Helmholtz	Measured nerve conduction speed	
Charles Bell	Ventral nerve = motor	
François Magendie	Dorsal nerve = sensory	
Johannes Müller	Doctrine of specific nerve energies	
Franz Joseph Gall	Phrenology (brain localization)	
Johann Spurzheim	Promoted phrenology	
Pierre Flourens	Aggregate theory	
Paul Broca	Localized speech production (Broca's area)	
Carl Wernicke	Localized language comprehension (Wernicke's area)	
Gustav Fritsch	Mapped motor cortex	
Eduard Hitzig	Same as Fritsch	
Shepherd Ivory Franz	Relearning post-brain damage	
Karl S. Lashley	Mass action, equipotentiality	

CHAPTER 2

STRUCTURE AND FUNCTIONS OF CELLS OF THE NERVOUS SYSTEM

CHAPTER 3

STRUCTURE OF THE NERVOUS SYSTEM

3.1 Neuroanatomy

Neuroscience is the study of the nervous system. Behavioral neuroscience is understanding the nervous system's underlying behavior.

3.1.1 Nervous System Structure

Structural Nervous System

How are neurons organized into systems?

- **Central Nervous System (CNS)**
  - Brain
  - Spinal Cord
- **Peripheral Nervous System (PNS)**

Functional Nervous System

What are the 'jobs' of the nervous system?

- Somatic Nervous System
  - Skeletal Muscles (Striated)
  - Sensory information in
  - Voluntary motion out
- Autonomic Nervous System
  - Uses smooth muscles
  - Glands
  - Sympathetic Nervous System
    - Fight or Flight
    - Heart rate, blood pressure, respiration, and alertness.
  - Parasympathetic Nervous System
    - Rest and Digest
  - Enteric Nervous System

- A mesh-like system of neurons that governs the function of the gastrointestinal system.
- AKA: 'Second Brain'
- GI problems are correlated with psychological disorders.
- The GI track houses a lot of our microbiota.
- Fecal Microbiota Transplant
  - Rat studies showed that when a skinny rat has a fecal transplant from a fat rat, the skinny rat becomes fat. This works in reverse too.
  - Therefore, the microbiota change the *behavior* of the rat.
- Elevated Plus Maze
  - A test to measure anxiety in rats.
  - The rats with the fecal transplant from the anxious rats were more anxious.
  - **This is huge!** This shows that the microbiota can change if a rat is anxious or not!

Starting a new list because I don't know where to put this. But we are starting with Meninges.

3.2 Meninges

- Cover the outside of the nervous system.
  - Three for the CNS and two for the PNS.
  - The PNS does not use the arachnoid mater.
- **Dura Mater**
  - "Hard Mother"
  - The outermost layer.
  - Tough and fibrous.
  - Contains blood vessels.
  - Early anatomists called it "pachymeninges" because similar to elephant skin.
- **Arachnoid Mater**
  - "Spider Mother"
  - Middle layer.
  - Web-like structure.
  - Contains blood vessels.
  - Subarachnoid Space

        - Between the arachnoid and Pia mater.
        - Contains cerebrospinal fluid (CSF).
    - Arachnoid trabeculae
        - Web-like structures that connect the arachnoid mater to the Pia mater.
        - Allows for the subarachnoid space to be filled with CSF.
- **Pia Mater**
    - "Soft Mother"
    - Innermost layer.
    - Thin and delicate.
    - Flows over every sulcus (grooves), fissure (deep indentations), and gyri (bumps).
    - Follows the contours of the brain and spinal cord.
- **Meningitis**
    - Inflammation of the meninges.
    - Can cause symptoms such as headache, fever, a stiff neck, or hallucinations.

3.3 Cerebrospinal Fluid (CSF)

- Similar to blood plasma.
- Functions of CSF
    - Protection
        - Failures:
            - Brain is injured.
            - AND even Contrecoup–when the brain is injured on the opposite side of the impact–injuries.
            - Chronic Traumatic Encephalopathy (CTE)
                - Old name: Dementia Pugilistica (boxer's dementia).
                - Symptoms (not exhaustive): Memory loss, confusion, impaired judgment, impulse control problems, aggression, depression, Parkinson's-like symptoms, insomnia, and progressive dementia.
                - Causes ventricular enlargement. In other words, the larger your ventricles, the less brain matter you have.
                - Also causes atrophy of the fornix. The fornix is a C-shaped bundle of nerve fibers in the brain that acts as the major output tract of the hippocampus.
                - Tau are abnormally phosphorylated aggregate into tangles. They accumulate both inside neurons and even released into extracellular space.

- The CSF also moves neurotransmitters, waste, hormones, nutrients, and other substances from one place to another.
  - For example, the CSF moves β-amyloid (in-between cells) from the brain to the blood.

- **Choroid Plexus**
  - **Ependymal cells**
    - Lines the ventricles.
    - These are the cells that produce the CSF.
  - If the choroid plexus is not working properly, it can cause hydrocephalus.
  - **Hydrocephalus**
    - "Water on the brain"
    - Swelling of the brain due to the accumulation of CSF.
  - Derives from the Pia mater.

3.3.1 Flow of CSF

- **Lateral ventricles**
  -
- **Third Ventricle**
  - Looks like a duck's head.
  - Is connected to the pituitary gland through the infundibulum.
- The CSF routed through the medial longitudinal fissure and into the Superior Sagittal Sinus.
- **Interperducular Fossa**
  - The space between the two cerebral peduncles.
- **Interventricular Foramen**
  - Connects the lateral ventricles to the third ventricle.
- **Cerebral Aqueduct**
  - Connects the third and fourth ventricles.
- **Central Canal**
  - Connects the fourth ventricle to the spinal cord.
  - For remembering purposes, the *cerebral* aqueduct is in the *brain* and the central canal is in the spinal cord.

- **Subarachnoid Space**
  - Foramen of Magendie (Medial) and Luschka (Lateral)
    - Two tiny little holes in the fourth ventricle.

3.3.2 Dumping of CSF

- Arachnoid Villi/Granulations
  - Absorbed into blood stream from the superior sagittal sinus.

3.3.3 Getting Some CSF Out -or- Putting Something Into It

- Where would you have them stick that needle?
  - **Dural Sac**
    - Enlarged space in the lumbar region.
    - Testing and introduction of anesthetic agents.
    - Epi = Something in
  - **Lumbar Puncture**
    - AKA: Spinal Tap.
    - Tap = Taking something out

3.4 Cranial Nerves

#	Name	Type	Information Carried
I	Olfactory	S	Smell
II	Optic	S	Vision
III	Oculomotor	M	Eye movement, pupil constriction
IV	Trochlear	M	Eye movement
V	Trigeminal	B	Touch to face, motor control of mandibles
VI	Abducens	M	Eye movement
VII	Facial	B	Taste and facial expression
VIII	Auditory (Vestibulocochlear)	S	Hearing
IX	Glossopharyngeal	B	Taste and swallowing
X	Vagus	B	Taste and sensation from neck, thorax, abdomen, swallowing, control of larynx, parasympathetic nerves to heart and viscera
XI	Spinal Accessory	M	Movement of shoulders
XII	Hypoglossal	M	Movement of tongue

3.4.1 Mnemonic for Cranial Nerves

Old **Op**ie **oc**casionally **t**ries **tri**gonometry **a**nd **f**eels **ve**ry **glo**omy, **vagu**e, **a**nd **hypo**active.

3.5 Terms

- Santiago Ramon y Cajal (1911)
  - Used the Golgi stain to show that neurons are separate cells.
- *Soma* – Cell Body
- *Nucleus* – Contains DNA
- *Dendrites* – "Branches"
  - Purpose is to increase the surface area of the neuron, so it can receive the most amount of information.
- *Axon terminal botton* – The ends of the neuron that send information.
- *Glial cells* – Support cells by insulating the axon for better communication.
- *Myelin sheath* – Insulates the axon.
- *Unmylinated axons* are called grey matter.
- *Ganglion* – A collection of cell bodies in the PNS.
- *Nerve* – A collection of axons in the PNS.
- *Nucleus* – A collection of cell bodies in the CNS.
- *Tract* – A collection of axons in the CNS.

Grey Matter	White Matter
Cell bodies Dendrites Unmyelinated axons	Myelinated axons

Table 3.1: Gray vs White Matter

CNS	PNS
Nucleus	Ganglion

Table 3.2: Gray Matter Division

BNS	PNS
Tract	Nerve

Table 3.3: White Matter

3.6 Brainstem

3.6.1 Hindbrain

- *Myenlencephalon*
  - *Medulla Oblongata*
    - Enlargement of the cord.
    - Lots of gray matter.
    - *Reticular Formation*
      - A network of nuclei.
      - Regulates sleep, wakefulness, and arousal.
      - Also regulates heart rate, blood pressure, respiration, and skeletal muscle tone.
    - *Pyramids*
      - Two ridges on the ventral surface.
        - Voluntary motor system.
    - *Olives*
      - Audition and motor learning.
      - Located on the lateral surface.
- *Metencephalon*
  - *Pons* – "Bridge"
    - White matter on the outside and gray on the inside.
    - *Locus Coeruleus*
      - Produces norepinephrine.
      - The norepinephrine is sent to the forebrain.
  - *Cerebellum*
    - Caudal portion of the brain.
    - Balance, hand/eye coordination, soothes movements.

- Shifting attention between vision and hearing, sensory timing (judging rhythms), language, emotional control, and reward valuation.
- Cerebellar agenesis – the cerebellum is not developed.

3.6.2 Midbrain

- *Techtum* = "Roof"
  - *Superior Colliculus* – Visual Reflexes
    - Pupils opening and closing in response to light.
  - *Inferior Colliculus* – Auditory Reflexes
  - Colliculus = "Little Hill"
  - *Pineal Gland* – Melatonin
- *Tegmentum* = "Floor"
  - *Substantia Nigra* = "Black substance."
    - Get its black coloring from the creation of dopamine.
    - Clearly, this brain structure makes a majority of dopamine (1 of 3).
  - *Red Nucleus* – Motor coordination.
    - Get its red color from iron oxidation.
    - Connects to the cerebellum for that motor coordination.
  - *Periaqueductal Gray Area* – Opioids.
    - Peri = around, so peri-aqueductual = around-the cerebral aqueduct.
    - Handles endogenous pain relief.

3.7 Forebrain

3.7.1 Diencephalon

- *Thalamus*
  - Massa Intermedia = intermediate mass. This connects the two halves together.
  - Made up of many specific relay nuclei.
    - *Lateral Geniculate Nucleus* – Vision
    - *Dorsal Medial Nucleus* – Pain
      - Routes the pain from the thalamus to the prefrontal cortex.
  - . . . and of non-specific relay nuclei.
    - *Nucleus Reticularis* – Promotes wakefulness.
      - Goes to different parts of the brain, not just one specific part like the specific relay nuclei.

- *Hypothalamus*
  - Irregular shape, size of a thumbnail.
  - Encases the ventral part of the third ventricle.
  - **Survival of the individual**
    - Eating
    - Drinking (water)
      - Salt regulation
    - *Suprachiasmatic Nucleus*
      - Circadian rhythms
      - Daily fluctuations of temperature
  - **Survival of the species**
    - Territoriality
    - Sexual activity
    - Reproduction
  - **Integration of information**
    - Endocrine system
    - Autonomic nervous system

3.7.2 Telecephalon

- *Corpus callosum*
  - Connects the two hemispheres.
  - Remember that the neurons in this structure go from lateral to lateral, and not from dorsal to ventral.
  - Creates the roof of the lateral ventricles.
  - Agenesis of the cc
    - AKA: Callosal Agenesis
    - Vision impairments,
    - hypotonia,
    - poor motor coordination,
    - delays in motor milestones,
      - (Such as sitting and walking.)
    - cognitive disability,
      - (Disability in complex problem solving.)
    - and social difficulties.
      - (Missing subtle social cues maybe cause of impaired fair processing.)
  - *Corpus Callosotomy* – Split brain surgeries.

- Used to treat epilepsy.
- Gives information about lateralization of hemispheres.
- **Left Hemisphere**
  - language
  - serial events
- **Right Hemisphere**
  - creativity
  - synthesis

- *Basal Ganglia*
- *Limbic System*
- *Cerebral Cortex*

3.8 External Surface Structures

- **Ansate Sulcus / Cruciate Fissure** - Located on the dorsal surface, separating frontal and parietal lobes.
- **Medial Longitudinal Fissure** - Runs along the midline, separating the two cerebral hemispheres.
- **Cerebellum** - Located at the posterior base of the brain.
- **Coronal Sulcus / Superior Frontal Sulcus** - Found on the dorsal aspect, part of the frontal lobe.
- **Transverse Fissure** - Separates the cerebellum from the cerebrum.
- **Anterior / Rostral** - Toward the front of the brain.
- **Posterior / Caudal** - Toward the back of the brain.
- **Medial** - Toward the midline of the brain.
- **Lateral** - Away from the midline.

3.9 Ventral Structures

- **Olfactory Bulb** - Located at the most anterior portion of the ventral side.
- **Cerebral Peduncle** - Found on the ventral midbrain, connects the cerebrum to the brainstem.
- **Pons** - Bulging structure on the brainstem, anterior to the medulla.
- **Pyramids on the Medulla** - Located on the ventral surface of the medulla oblongata.
- **Spinal Cord** - Extends from the medulla caudally.
- **Optic Chiasm** - X-shaped structure where optic nerves partially cross.
- **Median Eminence / Tuber Cinereum** - Located at the base of the hypothalamus.
- **Mammillary Body** - Small round structures part of the limbic system, posterior to the hypothalamus.

- **Periamygdaloid Cortex / Uncus** - Located in the medial temporal lobe, part of the piriform cortex.
- **Entorhinal Cortex** - Medial portion of the temporal lobe, key in memory processing.
- **Lateral Olfactory Tract** - Extends from the olfactory bulb along the ventral surface.
- **Rhinal Fissure** - Separates the neocortex from the piriform cortex.
- **Insula / Island of Reil** - Located deep within the lateral sulcus.
- **Sylvian Fissure** - Separates the temporal lobe from the frontal and parietal lobes.

3.10 Midbrain and Hindbrain Structures

- **Superior Colliculus** - Dorsal midbrain, involved in visual processing.
- **Inferior Colliculus** - Below the superior colliculus, involved in auditory processing.
- **Pineal Body** - Small endocrine gland, located dorsally near the thalamus.
- **Hypothalamus** - Located below the thalamus, controls endocrine functions.
- **Corpus Callosum** - Large fiber bundle connecting the two cerebral hemispheres.
- **Cingulate Gyrus** - Located superior to the corpus callosum, involved in emotion regulation.
- **Cerebral Aqueduct** - Connects the third and fourth ventricles, running through the midbrain.
- **Tegmentum** - Ventral part of the midbrain, involved in motor control.
- **Massa Intermedia of the Thalamus** - Connects the two halves of the thalamus.
- **Fornix** - White matter tract connecting the hippocampus to the hypothalamus.

3.11 Limbic System and Deep Brain Structures

- **Hippocampus** - Located in the medial temporal lobe, essential for memory formation.
- **Amygdala** - Anterior to the hippocampus, involved in emotion processing.
- **Fimbria** - White matter tract leading from the hippocampus.
- **Caudate Nucleus** - Part of the basal ganglia, involved in motor control.
- **Lateral Ventricle** - Space within the corpus callosum, part of the ventricular system.
- **Third Ventricle** - Space located between the two halves of the diencephalon.

3.12 Cranial Nerves

- **Hypoglossal Nerve** - Located at the ventral medulla, controls tongue movement.
- **Glossopharyngeal / Vagus Nerve** - Found laterally on the medulla, involved in autonomic and sensory functions.
- **Auditory (Vestibulocochlear) / Facial Nerve** - Located near the pons, involved in hearing and facial expressions.
- **Abducens Nerve** - Controls lateral eye movement, located near the pons-medulla junction.
- **Trochlear Nerve** - Involved in eye movement, emerges dorsally from the brainstem.
- **Trigeminal Nerve** - Large nerve at the pons, responsible for facial sensation and chewing.
- **Oculomotor Nerve** - Controls most eye movements, located at the midbrain.
- **Optic Nerve** - Transmits visual information, connects to the optic chiasm.