**Cerebral Cortex – Temporal Lobe Anatomy and Function**

****

**Outline**

* Temporay Lobe Anatomy
* Primary Auditory Cortex
* Auditory Association Cortex
* Weirnecke’s Area
* Primary Olfactory Cortex and Association Olfactory Cortex
* Insular Cortex
* References



**TEMPORAL LOBE ANATOMY**

**Boundaries of Temporal Lobe**

* **Lateral sulcus** (Sylvian fissure)
	+ Separates temporal lobe from frontal and parietal lobes
* **Preoccipital notch**: an imaginary line that can be drawn between the notch and the Lateral sulcus
	+ Separates the temporal lobe from the occipital lobe

**Divisions and Functions of Temporal Lobe**

* **Primary Auditory Cortex**
	+ Conscious awareness of sound
* **Auditory Association Cortex**
	+ Gives meaning or understanding of sound
* **Wernicke’s Area**
	+ Comphrehensive understanding of written or spoken language
* **Primary Olfactory Cortex and Association Olfactory Cortex**
	+ Conscious awareness of smell
* **Insular Cortex**
	+ Conscious awareness of gustation
	+ Visceral sensations & vestibular sensations

**Primary Auditory Cortex** Orange in drawing

* The Primary Auditory cortex is Involved in conscious awareness of sound stimuli
* It identifies the 3 characteristics of sound:
	+ Frequency
	+ Pitch
	+ Location

**How sound is perceived**

* Auditory pathway: → Inner hair cells in cochlea→ carried by **vestibulocochlear nerve** (CN VIII)→ cochlear nuclei in pontomedullary junction→ decussation at level of trapezoid body→ ascends as lateral lemniscus→ goes to thalamus (medial geniculate body)→ **primary auditory cortex**
* There is communication between the 2 sides
	+ The neurons decussate at the level of the trapezoid body, so the information is received controlaterally (opposite side)
	+ Example: a sound stimulus received by the left ear will be heard in the right Primary Auditory cortex

**Lesion of Primary Auditory Cortex**

* It will cause contralateral loss of sound stimuli
	+ Includes difficulty determining the location, pitch and frequency of a sound.

**Auditory Association Cortex** Blue in drawing above

* ****Once the stimulus has arrived in the Primary Auditory Cortex, it’s sent to Auditory Association cortex
	+ Analyzes pitch, localization and amplitude of sound
	+ Compares sound characteristics with previous sounds and helps to recognize the meaning and significance of the sound stimulus
		- Example: a wife tells her husband “she's fine” in a loud manner.
* The auditory association cortex will compare that sound characteristics with previous memories and help one recognize she isn't “fine”, instead “she ticked off”.

**Wernicke’s Area** Green in drawing

* Responsible for comprehension and understanding of written and spoken language
* Receives visual cues from visual association cortex in occipital lobe and auditory information from auditory association cortex in temporal lobe
	+ These information are used to help comprehend the language (written or spoken) being presented.
	+ Then Wernicke’s area sends impulses to **Broca's area (**via arcuate fasciculus) which is involved in stimulating muscles of speech production
		- Example:
		▪ Wife is talking about various things that happened at work today and you decide to tune her out, because you are listening to a Dr. M podcast. All of a sudden she says frustratingly with her very upset facial expressions “what did I just say, were you even listening?”
* ****Your Wernicke’s area will allow you to analyze the angry voice and frustrated face of the wife and then comprehend she is “ticked off”.
* Wernicke's area then sends that information to Broca’s area and then you respond “yeah of course I was listening”.

**Wernicke’s Aphasia (Receptive aphasia)**

* Caused by damage to Wernicke’s area, usually because of middle cerebral artery stroke.
	+ Symptoms:
		- Fluent speech: the patient is able to form words and sentences since Broca’s area isn’t damaged, however the speech will make no sense
* Inability to comprehend the meaning of a word or sentence

**Primary Olfactory Cortex and Olfactory Association Area**

* Located deep to temporal lobe, at the level of uncus, on medial portion of the brain
* ****Involved in the awareness of smell and analysis, recognize and identify smell patterns and store these smells in memory pathways
* Olfactory pathway:
	+ The smell will activate the receptors located in the nasal activity → activates **olfactory nerves** (CN I), which cross cribriform plate to reach **olfactory bulb** → gives rise to olfactory tract→
		- **Medial olfactory stria**: directed towards primary orbitofrontal cortex in frontal lobe
		- **Lateral olfactory stria:** directed to primary olfactory cortex
	+ From there, the stimulus is sent to Olfactory Association cortex, where it will be stored in our memory
	+ The stimulus can also reach the **amygdala** (limbic system), where that particular smell will be tied to certain emotions

**Insular Cortex** Pink in drawing below

* Not actually part of the temporal lobe, makes up its own lobe
* Located deep in Lateral fissure
* Functions:
	+ Receives visceral sensation: pain and temperature information from lungs, heart and GI tract
		- Information is sent to **insula** → analyzes, recognizes, and stores memory of visceral sensations
		- Example:
			* Gastroenteritis→ activates visceral sensory neurons of GIT→ sends signals to insula→ Insula remembers visceral pain from gastroenteritis
	+ Receives vestibular sensations from inner ear→ **Insula**
		- This helps us to be more aware of our dynamic and static equilibrium
		- ****Receives gustation (taste) from **taste buds** in fungiform papillae and vallate papillae→ Cranial nerves (VII and IX)→ **nucleus of tractus solitarius**→ insula
		- Insula helps us differentiate between different tastes
			* Sweet
			* Sour
			* Salty
			* Bitter
			* Umami

**References**

* Purves, Dale. Neuroscience. Available from: VitalSource Bookshelf, (6th Edition). Oxford University Press Academic US, 2017. University Press
* Siegel, Allan, and Hreday N. Sapru. Essential Neuroscience. Available from: VitalSource Bookshelf, (4th Edition). Wolters Kluwer Health, 2018.
* Waxman, Stephen G. Clinical Neuroanatomy. Available from: VitalSource Bookshelf, (29th Edition). McGraw-Hill Professional, 2020.
* Marieb EN, Hoehn K. *Anatomy & Physiology*. Hoboken, NJ: Pearson; 2020.
* Jameson JL, Fauci AS, Kasper DL, Hauser SL, Longo DL, Loscalzo J. *Harrison's Principles of Internal Medicine*. New York etc.: McGraw-Hill Education; 2018.
* Felten DL, O'Banion MK, Maida ME. Netter's Atlas of Neuroscience. Amsterdam, The Netherlands: Elsevier Health Sciences; 2015