

PHYSIOLOGY OF SPEECH

Objectives:

- ❖ Describe brain speech areas as Broca's, Wernicke's and insula
- ❖ Explain sequence of events in speech production
- ❖ Explain speech disorders as aphasia with its types, dysarthria, and acalculia
- ❖ Explain difference between aphasia and dysarthria.

Girls Slides Version

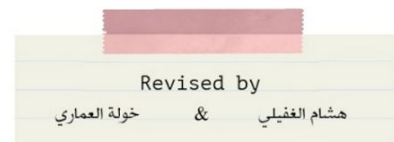
Done by:

- **Team leader:** Malak AlHamdi
- **Team members:** Bedour Jelaidan - Rahaf Bin Abbad - Rawan Aldhuwayhi

Edited & Revised by:

★ References:

- 435 girls slides and notes.



Color index: Important - Further explanation - Doctors Notes - Numbers.

*Please check out [this link](#) before viewing the file to know if there are any additions or changes.

Speech and Language “Intro”

- It is the highest function of the nervous system. **Unique for human**
- Involves understanding of spoken & printed words.
- It is the ability to express ideas in speech & writing.
- **Types of speech:**

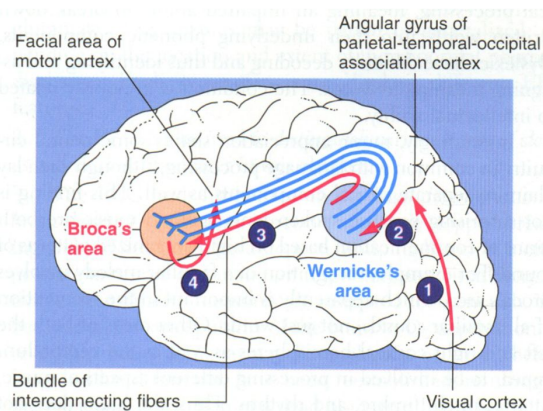
1.Spoken speech: understanding spoken words and expressing ideas in **speech**.

2.Written speech: understanding written words and expressing ideas in **writing**.

What is speech & language?

The ability to understand what we hear & what we see & the ability to express our ideas by speaking or writing

Areas involved in the Speech and Language



Area	location	function	comments
1.Angular Gyrus	Lies behind Wernicke's area fused posteriorly into the visual cortex.	Function: interpretation of information obtained from reading from visual cortex . Responsible for the visual experiences in the language and speech	-
2.Wernicke's area: 'General interpretive function'	-At the posterior end of the superior temporal gyrus . -Closely associated with 1 & 2 auditory areas.	-Responsible about comprehension of auditory & visual information, then project it to Broca's area via arcuate fasciculus -Interpretations of sensory experience. -Formation of thought in response to sensory experience.	مركز الفهم

		-Choice of words to express thoughts. choice of proper response : speaking or writing	
3.Arcuate fasciculus	-	connects Broca's area and Wernicke's area	-Like a highway -Direct connection of Wernicke's and Broca's areas for fast response
4.Broca's area	At the lower end of premotor area	<p>1) Process information received from Wernicke's area into detailed & co-ordinated pattern for vocalization نطق</p> <p>2) Then project it to the motor cortex to initiate the appropriate movement of the lips and larynx to produce speech</p> <p>-Movement of muscles that responsible to produce speech -Initiation of motor part of the speech and writing</p>	<p>-In adult who learn second language during adulthood. The MRI shows portion of Broca's area which is concerned with the second language adjacent to but separate from area concerned with the native language</p> <p>-But in children who learn second language early in life there is only single area involved for both languages</p> <p>الشخص الذي تعلم لغة أخرى في صغره منطقة البروكا تكون واحدة لكلا اللغتين، أما من تعلم لغة ثانية عند الكبر، فمنطقة بروكا تكون منفصلة عن منطقة لغة الأم و أصغر.</p>

-Wernicke's area and angular gyrus are parts of the parieto-occipito-temporal area (which is an association area), Wernicke's area is the area of language comprehension and the angular gyrus is responsible for initial processing of visual language (reading)

- Broca's area is a part of prefrontal association area. Broca's area is involved in the motor aspect of speech and receives inputs from wernicke's area. Broca's area provides output to the nearby motor cortex that controls the muscles required for speech.

Insula:

-A portion of the cerebral cortex **folded** deep within the **lateral sulcus**. **Considered as the fifth lobe**

-It is involved in the **motor** function of hand and eyes

What happens when we want to speak?

-**Wernicke's area** receive information from both **auditory & visual** areas then projects these information to **Broca's area** via **arcuate fasciculus** →

-**Broca's area** will process information received from **Wernicke's area** into co-ordinated pattern of vocalization and then project that pattern to the **motor area** which will initiate movement of muscle of speech in tongue, larynx and lips.

What happens when we want to write?

Broca's area receives information from **Wernicke's area** and processes it in the area of hand skills → coordinated pattern of muscle movement projected to the arms & hand region of the **motor cortex** → initiation of necessary muscle movement in the hand & arms required for **writing** a particular word

Dysarthria	<ul style="list-style-type: none"> -Abnormality in articulation (motor dysfunction) -Due to neurological conditions involving motor function (upper or lower motor neuron lesion) -Difficulty in the articulation, all speech centers are intact but the problems in the tracts
Dyscalculia	<ul style="list-style-type: none"> -Difficulty in learning or comprehending arithmetic and mathematics -Seen in developmental disorder.

Aphasia

What is Aphasia?

- Abnormality of language function due to injury of language centres in cerebral cortex.

What are the consequences of Aphasia?

- Comprehension or expression of words will be affected.

What can cause Aphasia?

- thrombus or embolism of cerebral vessels, trauma.

❖ Types of Aphasia

1. Motor or Broca's aphasia (nonfluent):

- Lesion of Broca's area.
- Patient will **understand spoken & written words** (normal intellectual function)

but find it **difficult to speech** or to **write**.

يفهمون اللي (يُقال/يُكتب) لهم, بس ما يقدرين يردون أو يكتبون

- Poorly articulated speech, slow with great effort & abnormal rhythm.
- In some cases speech may be limited to 2-3 words.
- Other example that will lead to nonfluent aphasia → **Insula damage:**

Progressive non-fluent aphasia (similar to that of Broca's):

- Deterioration of normal language function.
- Non fluent aphasia with normal comprehension.
- **Intact other non-linguistic cognition.**

- Seen mostly in degenerative disorders. **In elders i.e. Alzheimer's**
- Atrophy of the **left anterior insular cortex**.

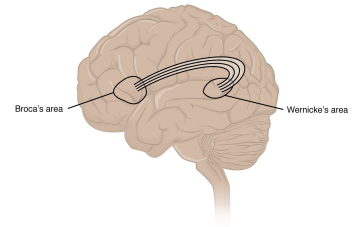
تمامًا مثل الـ motor aphasia اللي نشوفها عندما يكون فيه مشكلة في الـ Broca's الفرق أن هنا المشكلة في الـ Insula و أنها أكثر شيوع في الكبار في السن الذين يعانون من ألزهايمر يعني كبير في السن و لديه Motor aphasia, الأغلب أن المشكلة في الـ Insula لاحظ أن في كل الحالتين, إذا كان لدينا Motor aphasia فالمشكلة الأساسية أنه لا يستطيع أن يتكلم أو يكتب لكن الوظائف الحركية الأخرى مثل: تحريك اليد, المشي, الأكل ← تكون طبيعية!

2. Sensory or Wernicke's or receptive aphasia (fluent):

- Lesion of wernicke's area +/- arcuate fasciculus.
- **Impaired comprehension.**
- **Loss of intellectual function.**
- Failure to interpret meaning of written or spoken words even though the individual has no hearing deficits and may be able to read the words on a page.
- Meaningless & excessive talk (in sever cases). (**verbal diarrhea**)

3. Conductive aphasia (fluent):

- Lesion of nerve fibres of arcuate fasciculus. **Connection between comprehension & speech**
- Patient understand speech of others but can not repeat it.
- Meaningless speech.



كيف نفرق بين Wernicke's aphasia و conductive aphasia؟

في الـ conductive aphasia عندما يعطون أوامر غير الكلام أو الكتابة يستطيعون تأديتها بعكس Wernicke's aphasia.

4. Anomic aphasia:

- Lesion of **angular gyrus**, thus **Broca's & Wernicke's are intact**.
- Speech & auditory comprehension is normal but **visual comprehension is abnormal**, due to visual information being not processed & not transmitted to Wernicke's area.
- **Dyslexia (word blindness)** interruption in the flow of visual experience into Wernicke's area from visual area. **Sometimes it is for specific letters & specific numbers. They have NORMAL IQ.**

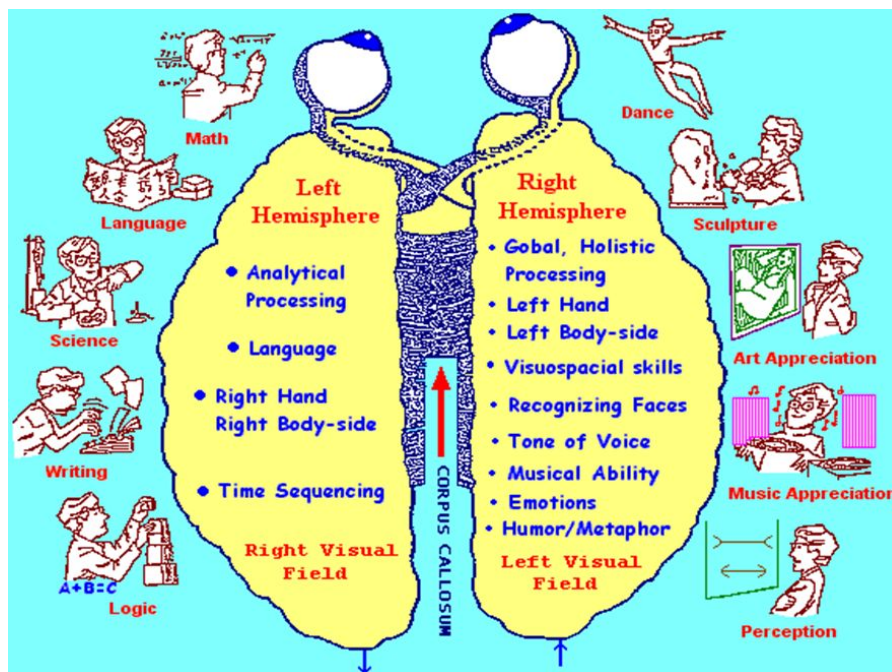
The problem is in the way the mind interprets what the eyes see -- like optical illusion, except this is with words. The problem is not with what the eyes see and reality happens with ordinary people on a page.

Visual experience of a word → occipital lobe → **angular gyrus** → Wernicke's area → Broca's area

في هذا المسار لما يكون الانتقاليور قايرس فيه مشكلة, الشخص ما يقدر يستوعب بعض الحروف اللي قاعد يشوفها أنت الآن قرأت هذه الجملة لكن شخص لديه Dyslexia قد لا يستطيع أن يقرأها لأن بعض الحروف بالنسبة له بلا معنى, أو متداخلة أو عليها غيوم مثلاً.

Right Hemisphere (the representational hemisphere)	Left Hemisphere (the categorical hemisphere)
<ul style="list-style-type: none"> - The right hemisphere controls the left side of the body. - Temporal and spatial relationships.¹ - Analyzing nonverbal (body language) information. - Communicating emotion. - recognition of emotion. - Recognition of tunes, rhythms. - Holistic problem solving.² 	<ul style="list-style-type: none"> - The left hemisphere controls the right side of the body. - Produce and understand language. - understanding and manipulating language: recognition, use, and understanding of words and symbols. - Speech. (angular gyrus, Broca's and Wernicke's areas are more highly developed in the dominant "categorical" hemisphere) - Identification of objects by name. - Mathematics, logic, analysis.

The idea of having a dominant hemisphere is a *myth*. We use both our hemispheres based on the situations.



¹ Relations between objects (shape, distance) & time (minutes, weeks)

² An approach for solving problems by looking at the bigger picture.