# Grandmama's Teeth

How human articulatory channel is adapted for Speech


TEAM : HIGHBROW HERONS

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# Survival of the fittest

- Characteristics and adaptations for survival



- These adaptations explain some things which humans/animals do



- Still it does not explain every action of that species

<u>Explainable</u>
Wings are present in birds which enable them to fly!

<u>Not explainable</u>
Nowhere from a bird's body can we guess that a bird makes nests and lay eggs

# Adaptations for speech

**Parts of articulation :**

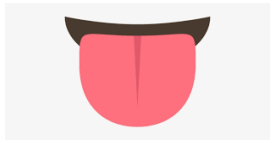
Active :
- Lower lip
- Tongue
- Glottis (Voice box)

Passive :
- Upper lip
- Teeth
- Uvula
- Palate
- Epiglottis

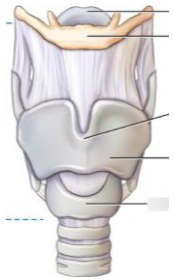
Rate of breathing is affected by speech and vice versa …
- Breathing – in is accelerated
- Breathing – out is slowed down

Dental sounds

Labial sounds



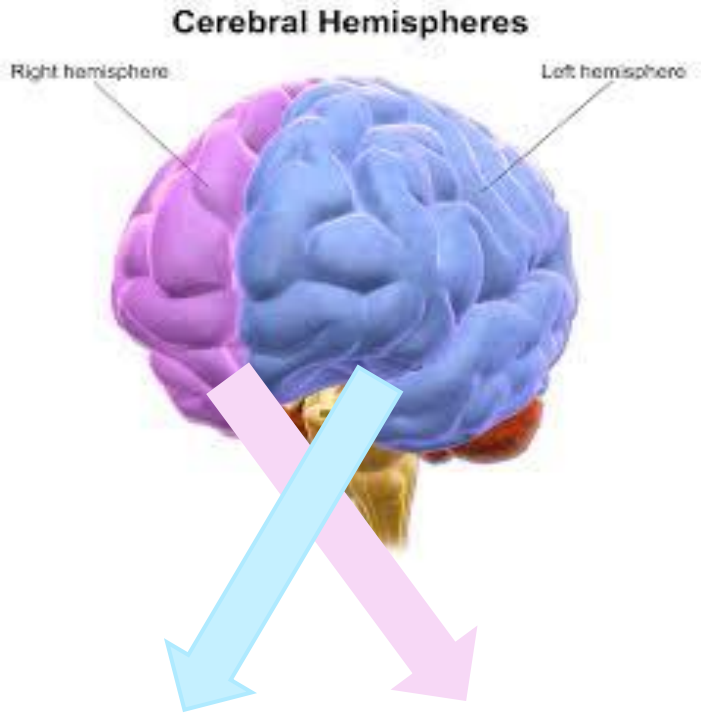
Pharyngeal sounds



Contains Laryngeal box / vocal cords which helps in speech modulation …

**Did you know ???**
- Monkeys eat and breath simultaneously whereas humans cannot do so !!!
- So many organs are responsible for speech articulation , but which is the mastermind ?

# Mastermind ⟷ The Brain

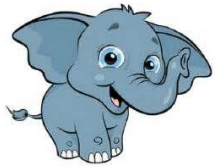



Controls right side of the body and linguistic sounds

Controls left side of the body and non-linguistic noise

In the majority of population who are right handers which is the dominant hemisphere for speech ?

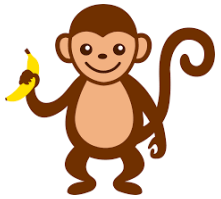
Brain-Body ratio :



VS

Quantity matters …

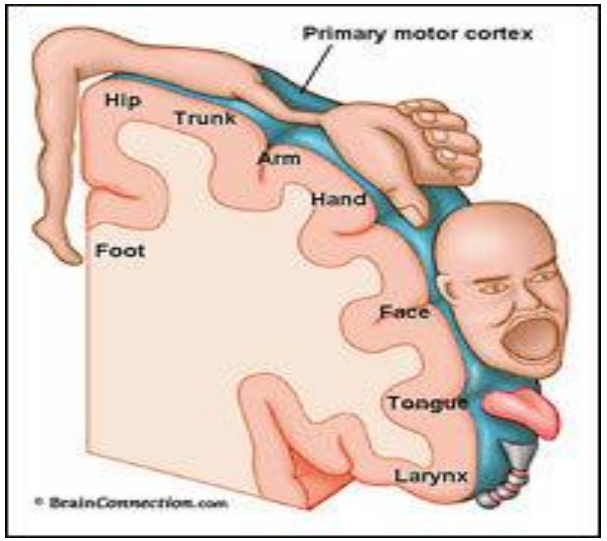
Development of Brain



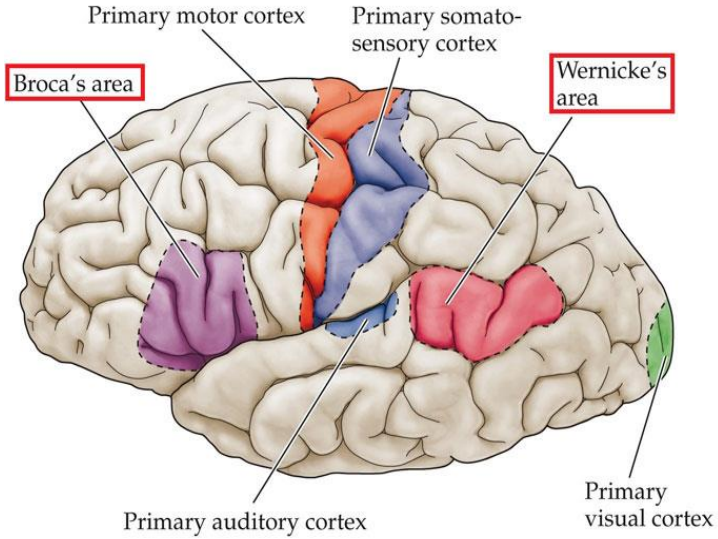
VS

Quality matters …

# Intricacies behind phonation




Homunculus is an imaginary figure made of body structures on the brain based on the weightage of their motor representation. This diagram shows us clearly that parts of hands and speech articulation are majorly represented in brain.




- Wernicke's area(22)is responsible for the thought process to understand and initiate the speech.
- Broca's area (44) is responsible for articulation
- Arcuate fasciculus is the connection between the two areas.

**TO ANSWER A QUESTION-**

Question

If heard (Auditory cortex)/ If read (Visual cortex)

Processing an answer after comprehending the question(Wernicke's area)

SENSORY APHASIA

The thought process travels (Arcuate fasciculus)

CONDUCTIVE APHASIA

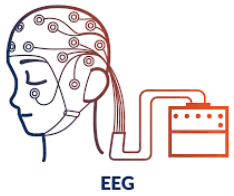
The stimulus to spell out the words of the answer coherently(Broca's)

MOTOR APHASIA

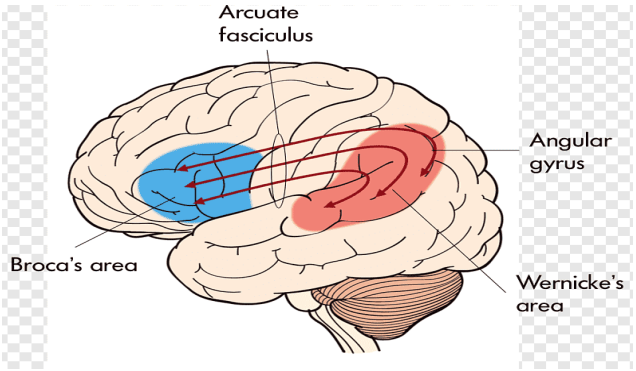
GLOBAL APHASIA -- when a large part of the brain gets damaged

# Coordination matters …

Previously used techniques like blood flow monitoring, oxygen consumption by brain areas selective to speech was not helpful in identifying the particular areas responsible for the articulation of speech …




Recent non-invasive techniques like **ERPs**, **MRI** are found to be clearer and more precise at picturing the brain




**Process involved behind :**
Comprehension of question and production of an answer is a complex task involving Broca's, Wernicke's and several other areas

**Coordination :**
Now it is found that not just the location of speech but the intricate connection between those areas matter more than the location itself

# Complexity of speech …

**Producing a word** is not as simple as it seems :

There is a series of overlapping actions in which the succeeding sound influences the preceding sound significantly before the utterance of the complete word

Ex : GEESE

geese
goose
geezer

**Planned articulation**
Sentences with 'IF THEN' and 'EITHER OR' should be planned well in advance before articulating it..

To paint a picture one should picturize the whole art even before the starting to paint …

**Rhythmic Principle**
Underlying biological 'beat' which enables us to organise language.
One-sixth of a second is the basic time unit in speech production.

# Intelligence - independent of language

Although intelligence is a confluence of mastering various skills, but it is independent of language.

A person who is eloquent in speech might not be intelligent overall and vice versa

We don't need to comment on how big a **genius** he is …
( That's Stephen Hawking BTW )

**William's syndrome** - Patients lack spatial awareness but have language fluency preserved.


# Gender - hormones & Genetics - Dyslexia


Women have greater verbal fluency

Men are better at mathematical reasoning

These variations are probably due to hormonal influences on developing brain

Language depends on multivariate factors such as :

1. Hormones
2. Hereditary
3. Environmental factors
4. Psycho-social factors

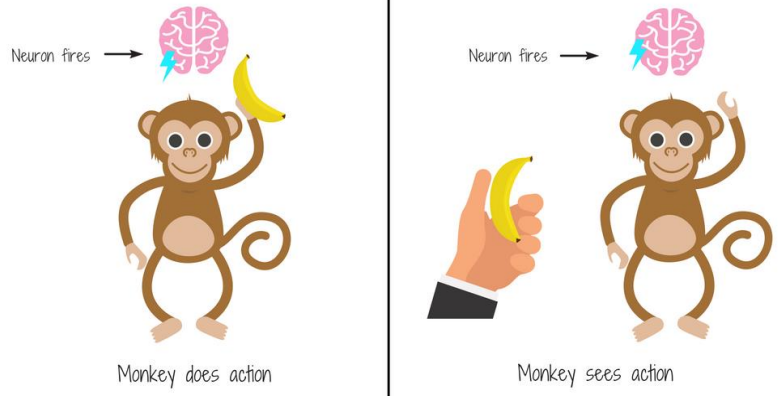

Environmental factors

Dyslexia run in generations and is dependent on genetics

# Mirror Neurons

Studies show that three-year-old kids lack empathy whereas a four-year-old kid has developed that attitude. But the exact time of development of empathy is not known

Autism is a spectrum of disability where the person has attitude of mind blinded ness / lack of empathy. This is somehow related to the delayed milestones in the individual.




Empathy is governed by mirror neurons. It has been found that humans and chimps have good amount of mirror neurons due to which they are capable of imitating and thereby learning actions on seeing / hearing them. This is an important foundation stone in learning of languages

# CONCLUSION

- Speech is a very intricate process which is initiated at the complex cerebral level, and produced through laryngeal structures after desired modulation.
- Problem at any one level of processing will lead to aphasia or deranged voice quality.
- Being a very complicate process, the brain has to activate and coordinate between various levels to formulate and plan a sequence of words.
- Processes like planned articulation, rhythm principle shows how tedious it is for the brain to run the show for speech production.
- Multivarious factors like gender, social, psychological, environmental impact is felt on the development of language skills.
- Various modalities of research tell us that the complexity of speech processing is yet to be fully unraveled. Parting with the hope to learn more interesting facts on human linguistics in the years to come….