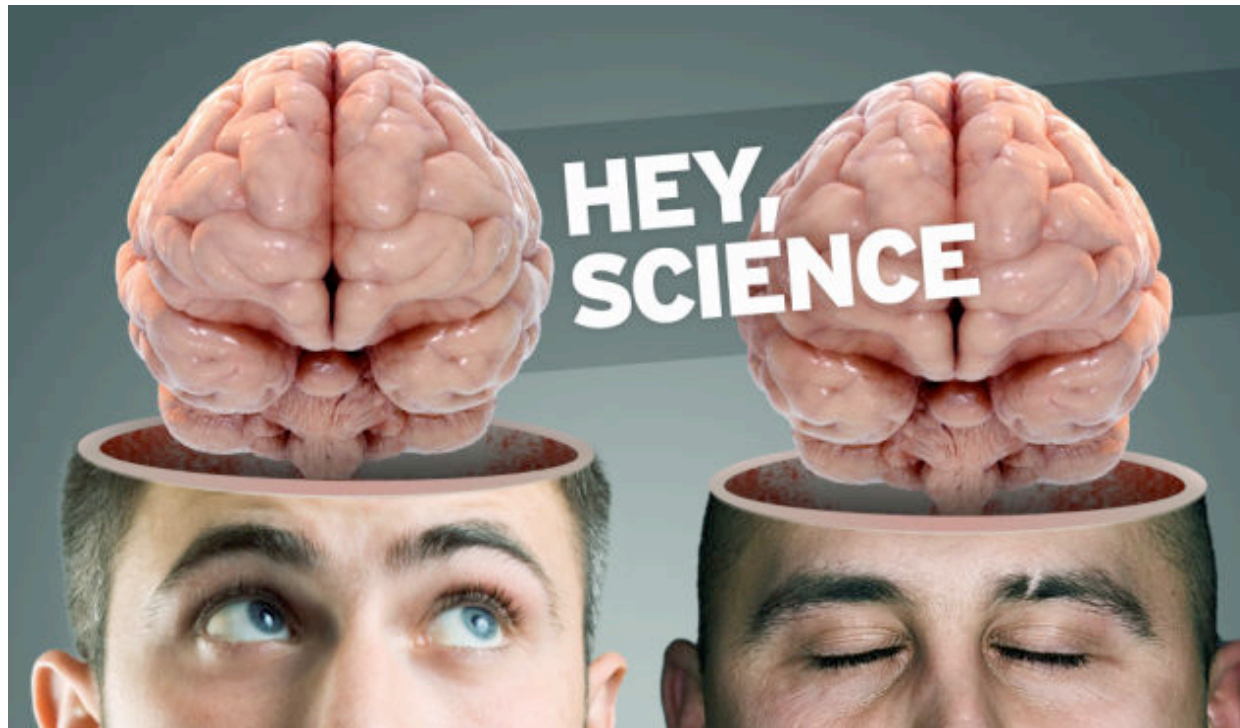




Is Language in the Brain?

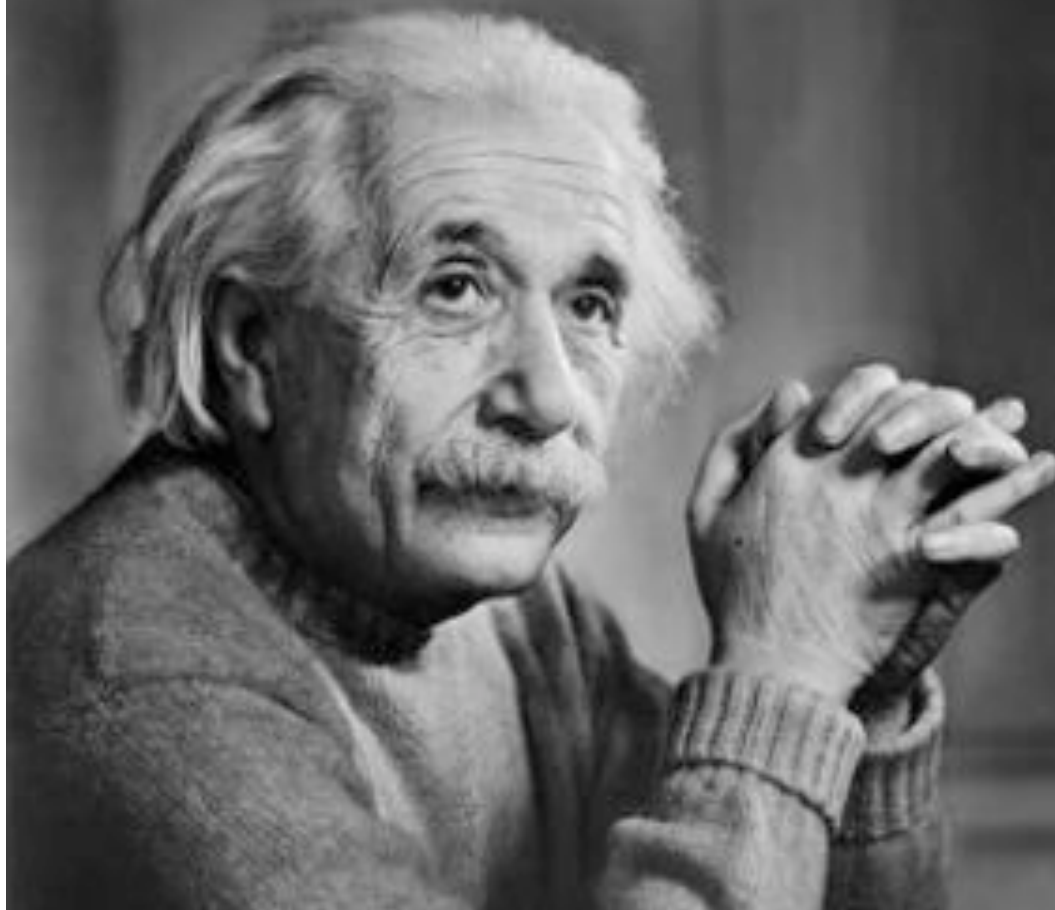


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If you can't explain it **simply**, you don't understand it well enough.

– Albert Einstein



What is language?

- Language is a **symbol system**.
- It includes **rules** regarding the **combination of sounds** into **meaning units**, meaning units into **words**, words into **sentences**, along with the rules for using that language.



cavbertyw

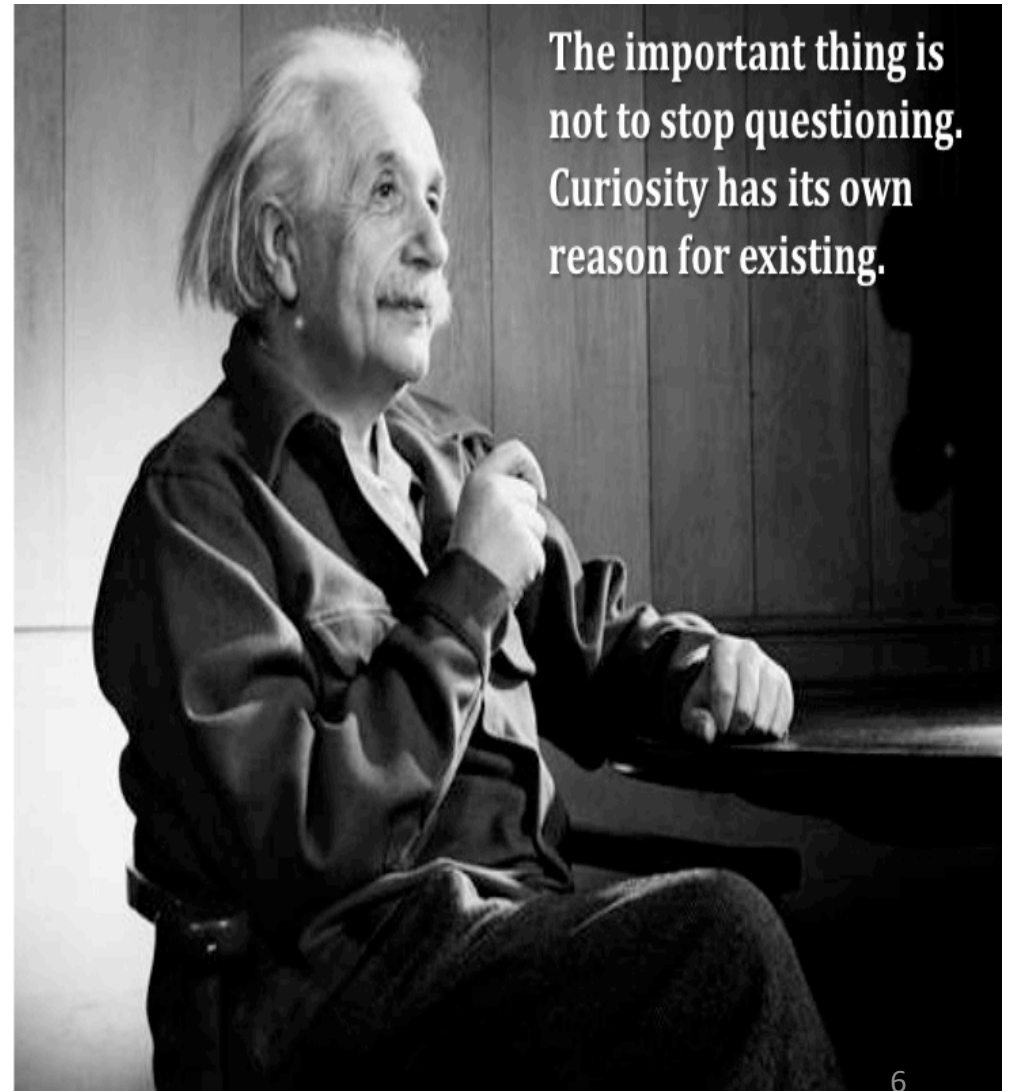
Combination of sounds into words

John here not

Words into sentences along with the
rules for using that language

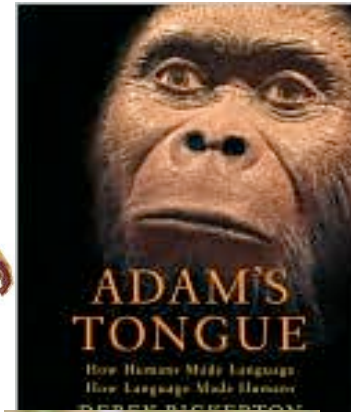
Five interesting questions

1. Is language a capacity that only humans possess?
2. Are both hemispheres implicated in language?
3. Why did the 19th century physicians Paul Broca and Carl Wernicke give their names to two distinct brain areas?
4. How is language affected after damage to each of these areas?
5. What can we learn about language from disorders of the brain?



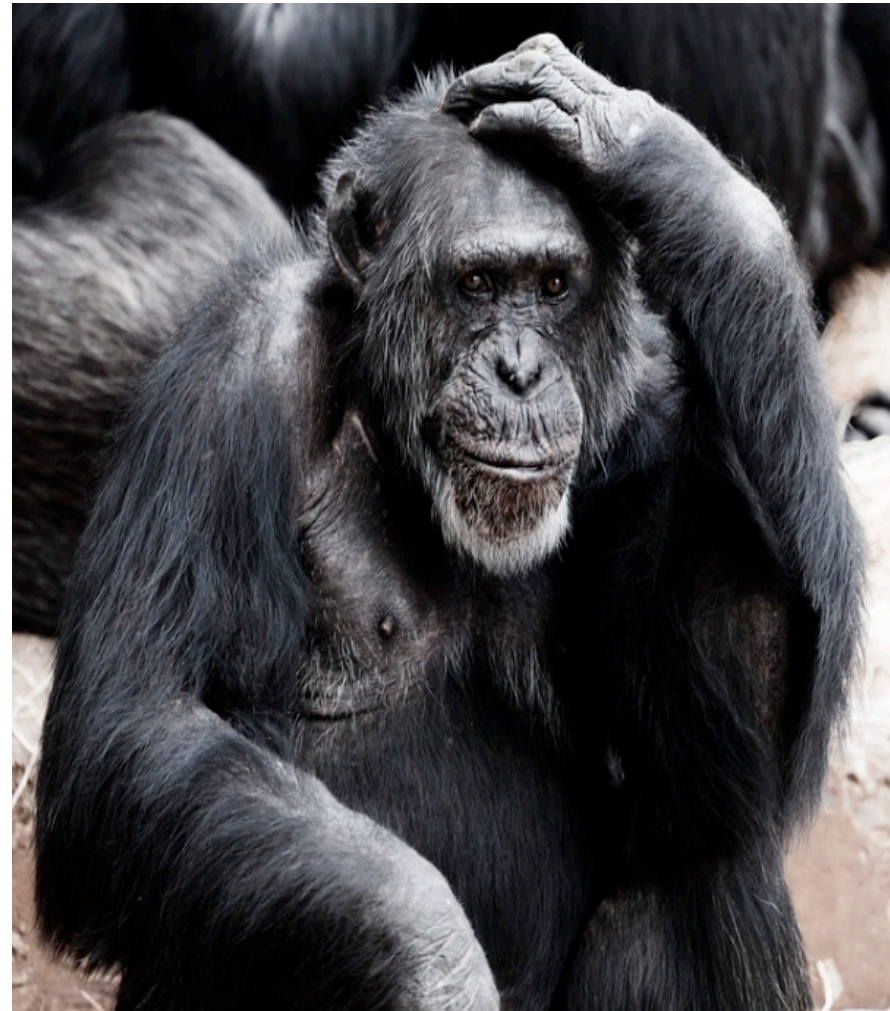
1. Is language only human?

**ONLY
HUMAN**



Higher apes

- Higher apes can be taught *symbols* (signs) for concepts/objects.
- Washou at the age of 6 had learned 100 individual signs.
- Among apes communication takes place within a social group who have spent most or all their lives together.
- The meaning of gestures differs from species to species.



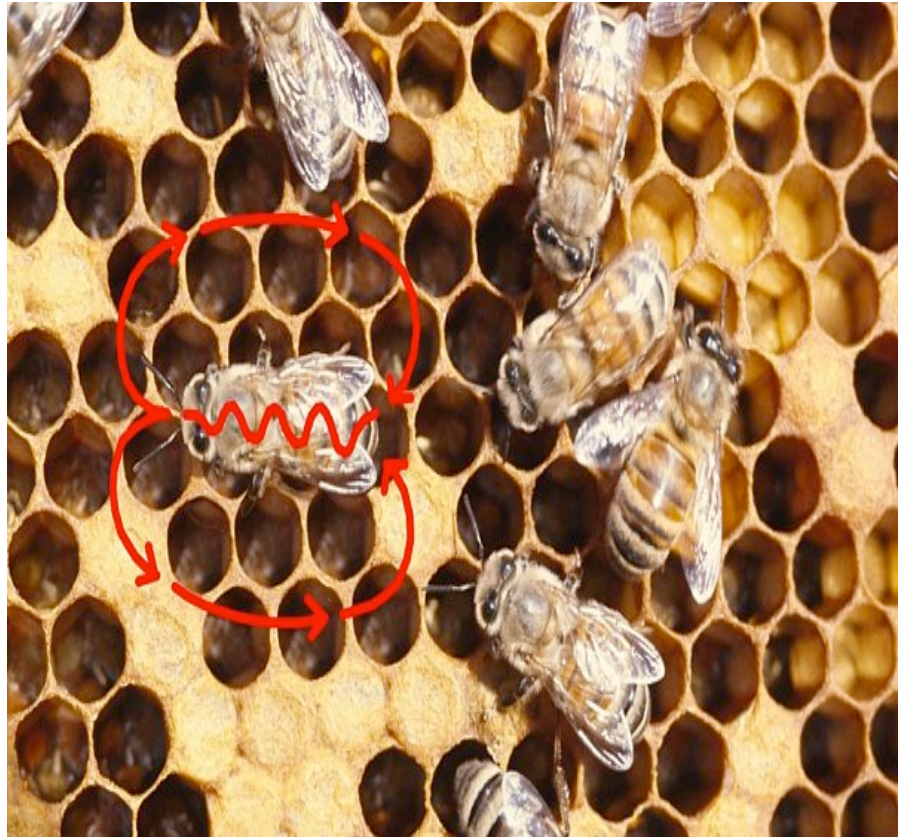
Bird calls and songs

- **Bird calls** consist of one or more short notes: *responses to danger, nesting, flocking*.
- These calls seem intended to create group activity in specific situations.
- **Bird songs** are used primarily by males to attract females or establish territory.
- Bird songs are limited to these and only these functions.
- Internal elements aren't separable into meaningful units and cannot be rearranged to produce new songs.

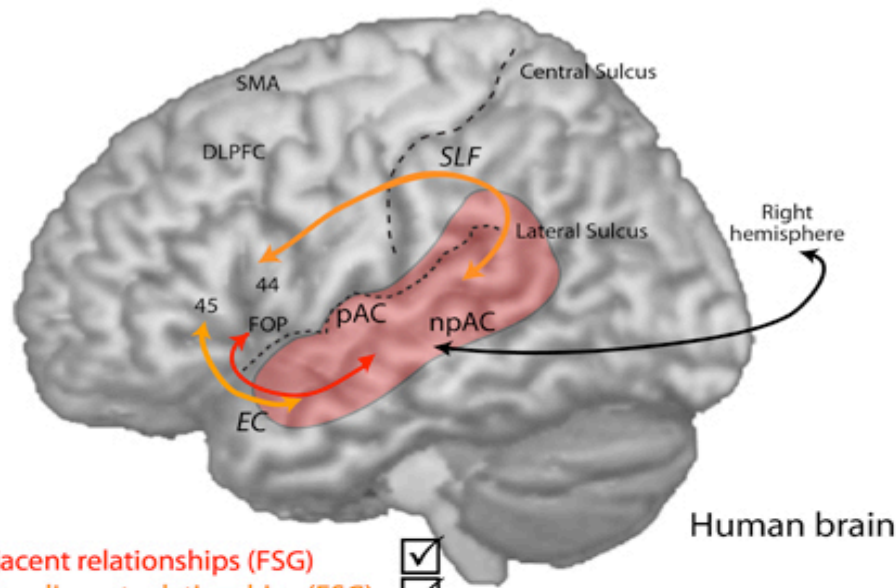


Bee dances

- 3 types of dances on the wall of the hive to communicate to other bees the source of the nectar: *round dance*, *sickle dance*, *tail wagging dance*
- Bee communication confined to a single subject: **the location of nectar with respect to the hive**

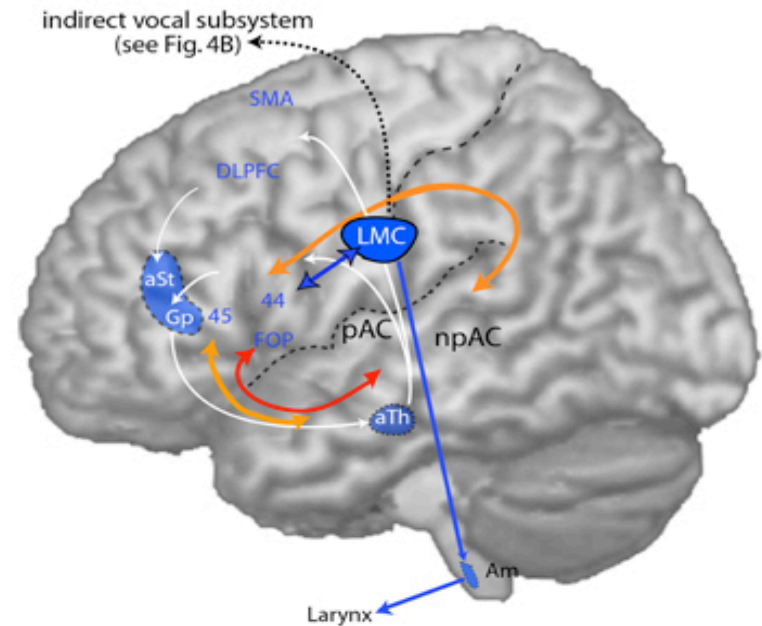


A Human syntax perceptual learning system

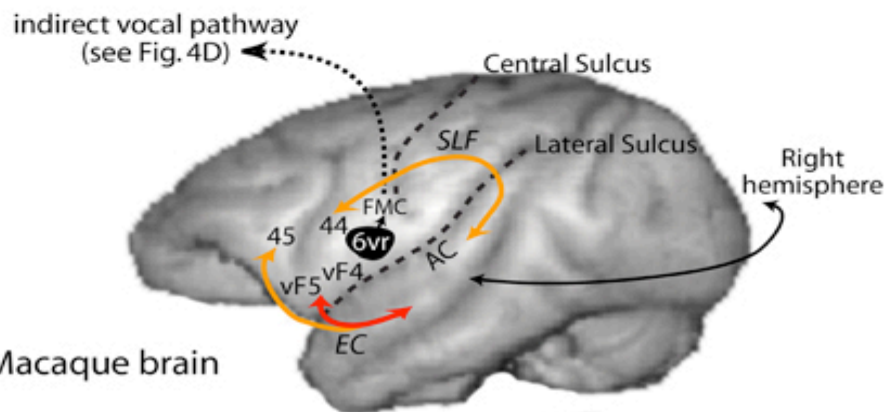


Adjacent relationships (FSG)
 Non-adjacent relationships (FSG)

B Human learned vocal-production system

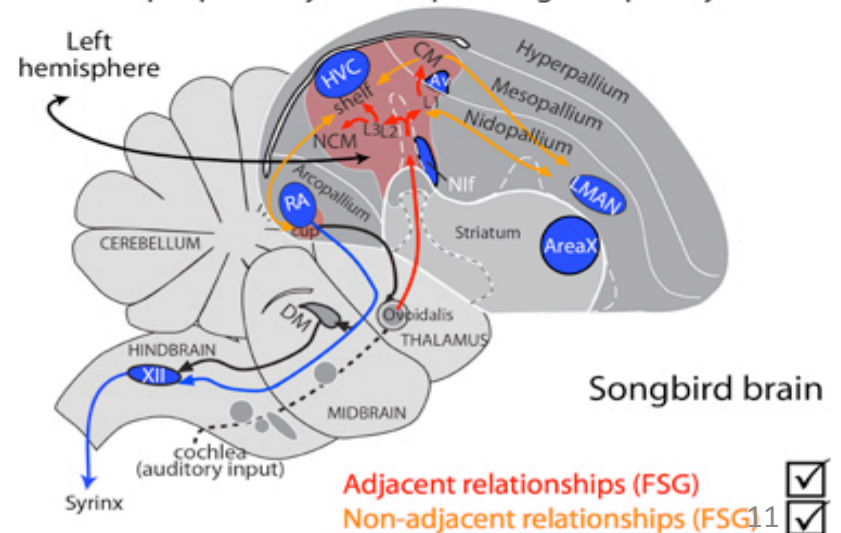


**C Monkey 'proto-syntactic' sequencing hypothesis:
Multiple pathways for sequence learning complexity**



Adjacent relationships (FSG)
 Non-adjacent relationships (FSG)

**D Songbird 'syntactic-like' sequencing hypothesis:
Multiple pathways for sequencing complexity**



Adjacent relationships (FSG)
 Non-adjacent relationships (FSG)

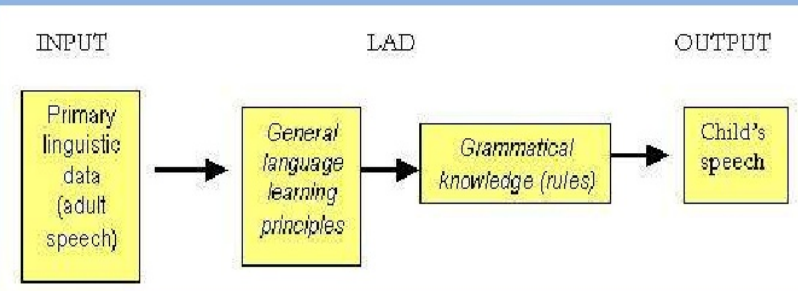
Human Language

Noam Chomsky



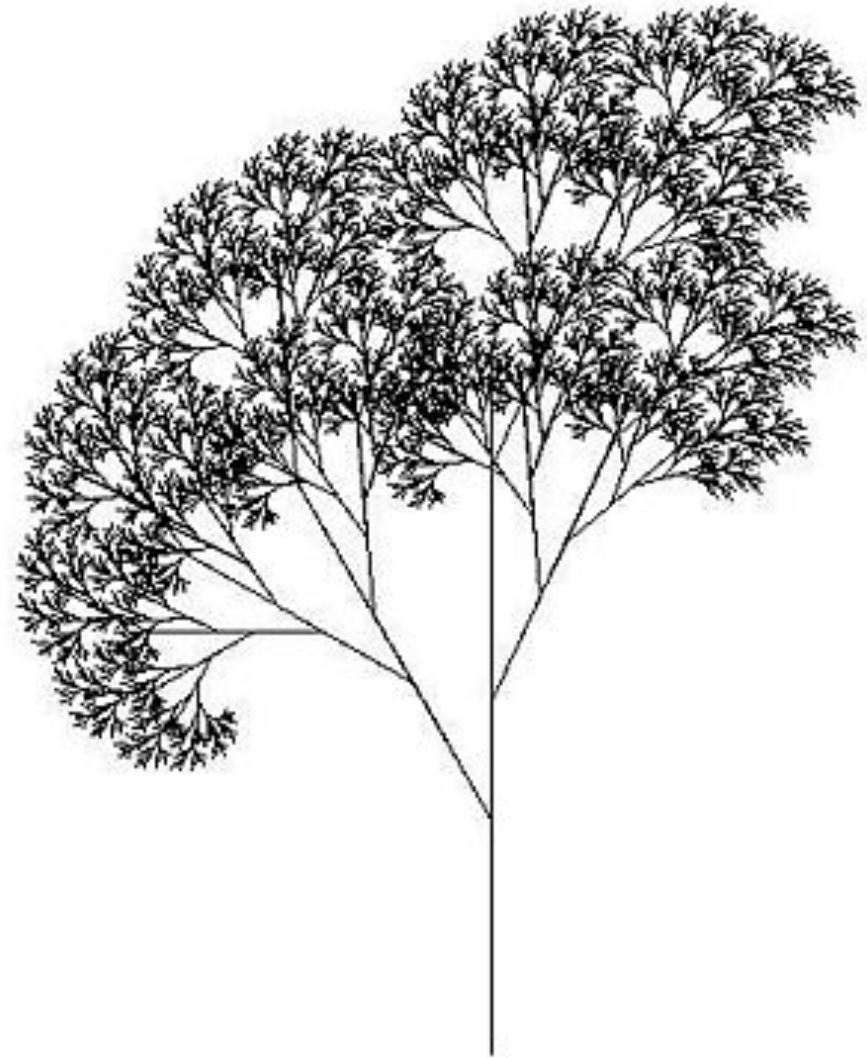
Mechanism of Innate Theory

- According to Noam Chomsky, the mechanism of language acquisition formulates from innate processes.



Yes, language is specific to the human species!

- Language Acquisition Device: **LAD**
- **Infininitely creative**: the process of **recursion** and **merge**
- **Unlimited in its expressive capacity**
- Human language is very **changeable**



John said

that Mary thinks

that Bill will visit the Mediterranean Science Festival

after he asks George

if Sophie will also come

whose mother said that she must do her
homework

before she can drive the car

to pick up Bill

who will be waiting with Nikos

as Sophie will be tonight's driver

because after the visit the

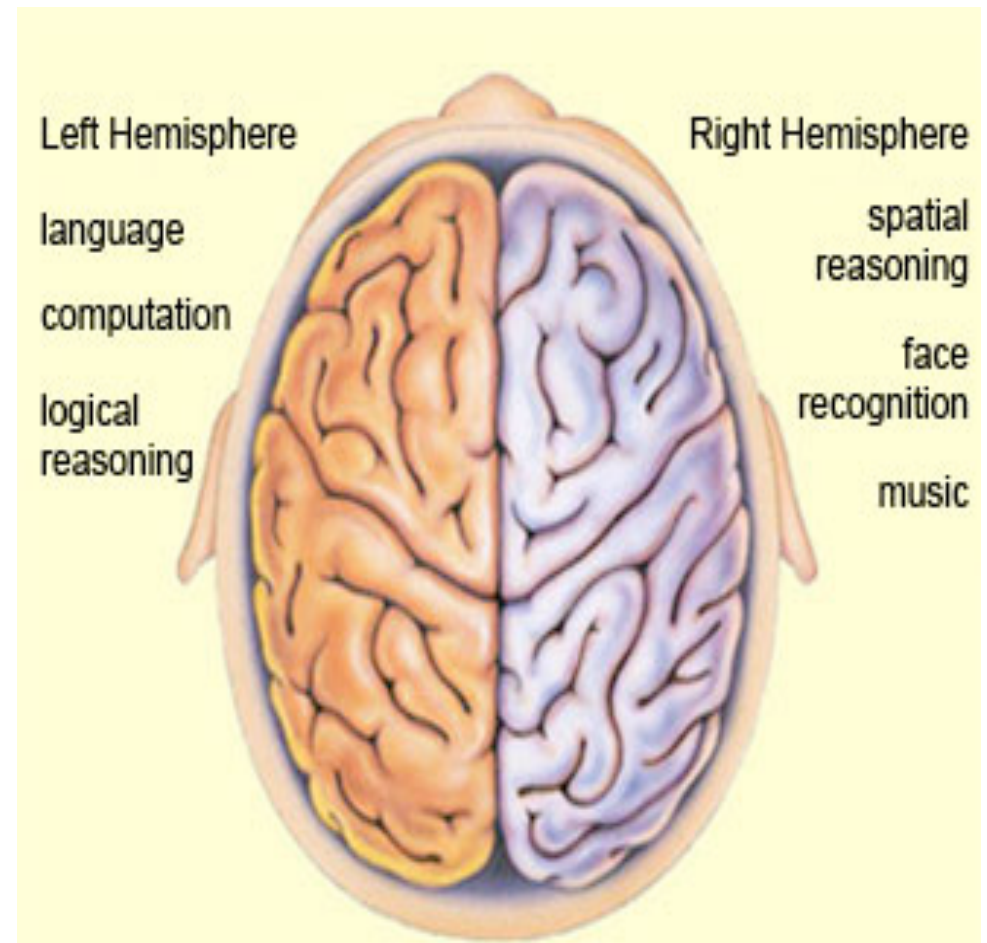
boys want to go clubbing at

the bar behind the castle

which belongs to...

2. Are both hemispheres involved in language?

- **Language** is the most lateralized of all abilities: the **left hemisphere** is better than the right at **most language-related tasks**.
- However the **right hemisphere** proved to be able to understand single written and spoken words; also right hemisphere detects **prosody** and **discourse**.
- The **right hemisphere** proved better than the left at a variety of tasks involving **spatial ability, emotional stimuli** and **musical tasks**.



Right And Left Brain Personality Theory Debunked

Anatomically, the left hemisphere is considered as the “logical brain” and is responsible forwording, logical thinking, analysis, linearity and sequence.

Is it a myth?

The myth originated in the 1800s and gained ground in the 1960s
It arose from Roger Sperry's Nobel-Prize winning research

A study of epilepsy patients following a brain surgery revealed that damaging the corpus callosum, the connection between the two brain hemispheres, could result in a loss of communication between the two sides of the brain.

Neuroscientists debunked the theory

Neuroscientists at the University of Utah claim the theory is inaccurate.
They examined the functional Magnetic Resonance Imaging (MRI) scans of 1,011 people.

In contrast, the right hemisphere controls the left side of the body and is known as the “creative brain”. The right hemisphere is the part of brain that deals with imagination and colors, spatial awareness, as well as rhythm.

What are the results of the study?

It is absolutely true that some brain functions occur in one or the other side of the brain.

Language tends to be on the left, while attention is more on the right. But people do not tend to have a stronger left or right-sided brain network.

Personality type has nothing to do with one hemisphere being more active, stronger, or more connected.

It is not accurate to say that creative people are more “right –brained” .

Differences in gender didn't significantly affect brain lateralization, but the results of that research truly contradict the results obtained in prior experiments.



3. Why did the 19th century physicians Paul Broca and Carl Wernicke give their names to two distinct brain areas?

Pierre Paul Broca (1824-1880)

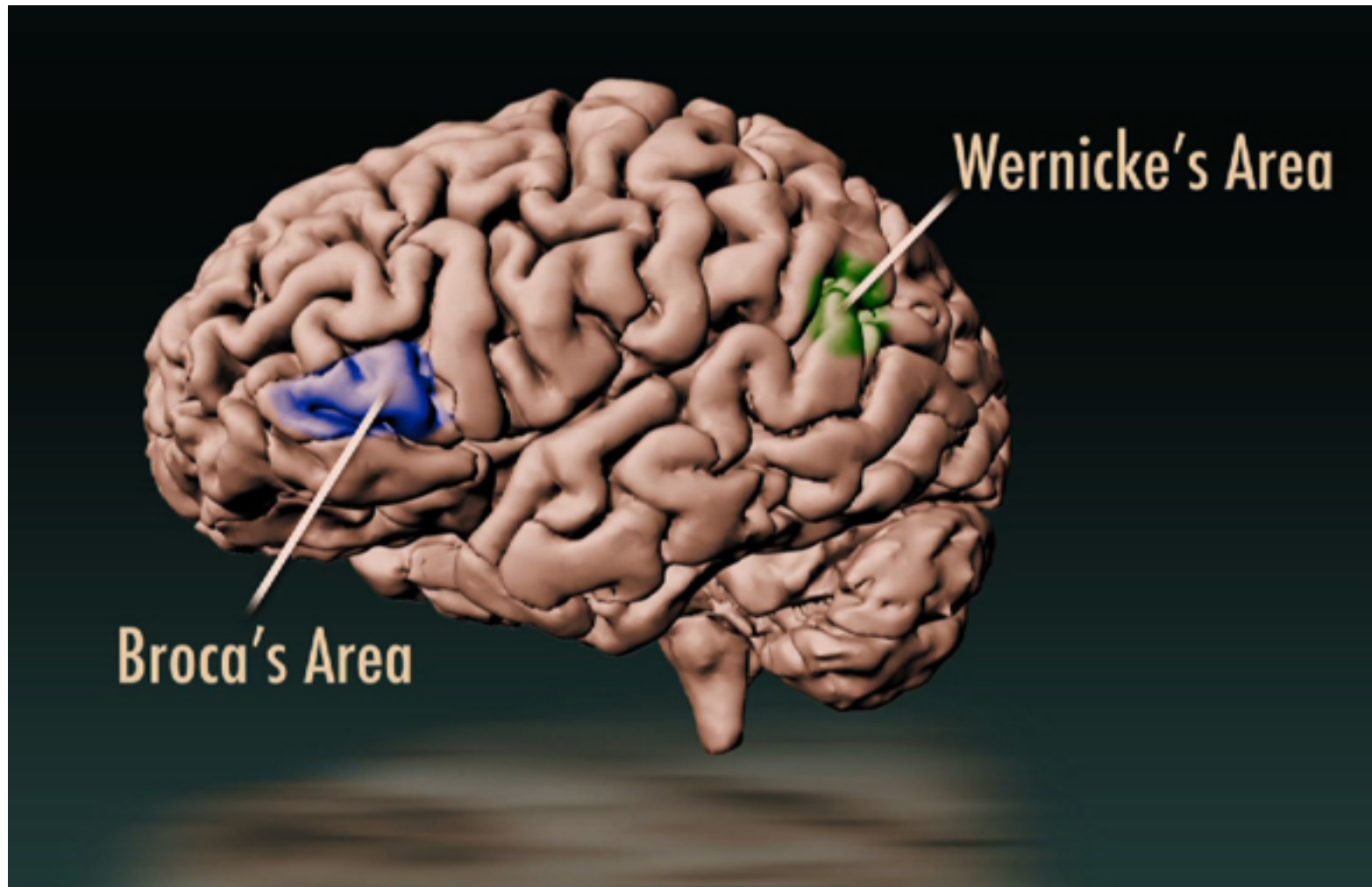


French physician, surgeon, anatomist, anthropologist

Carl Wernicke (1848-1905)



Polish physician, anatomist, psychiatrist, neuropathologist



Much of the language function is processed in several association areas, and there are two well-identified areas that are considered vital for human communication:

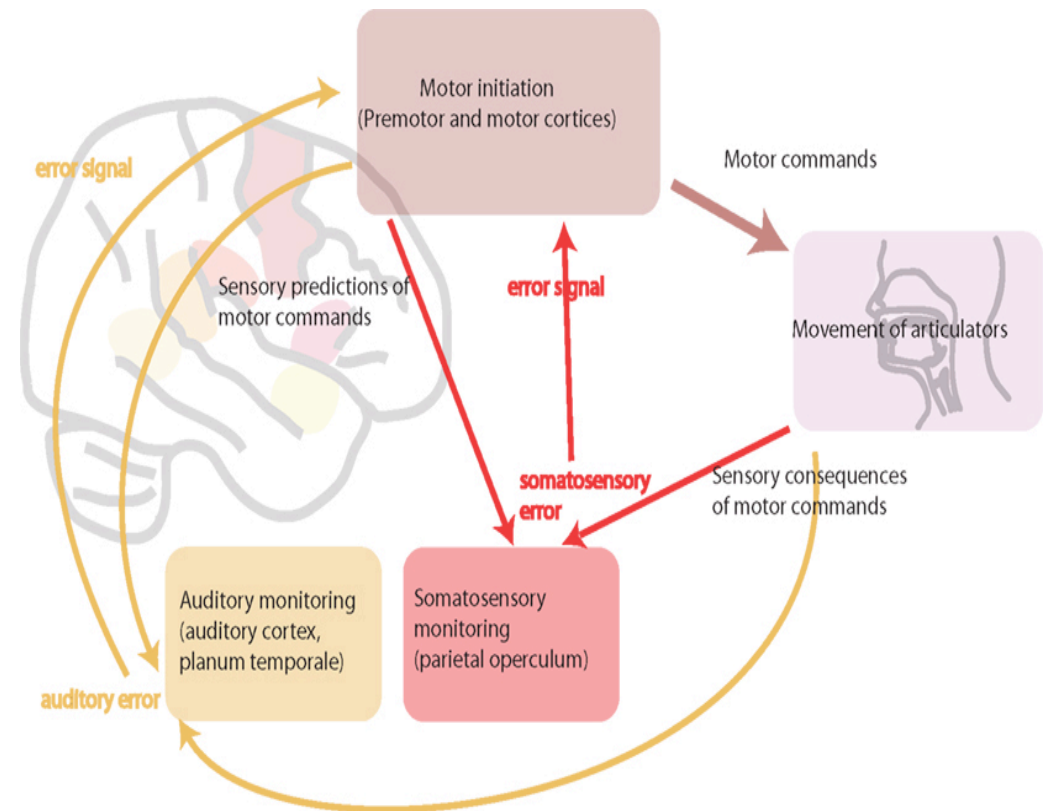
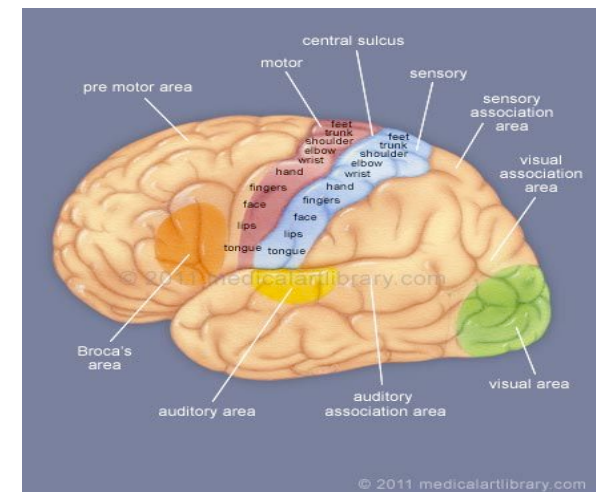
Broca's area and **Wernicke's area**.

These areas are usually located in the **dominant hemisphere** (left hemisphere in 97% of people) and are considered the **most important areas for language processing**.

This is why **language** is considered a **localized** and **lateralized** function.

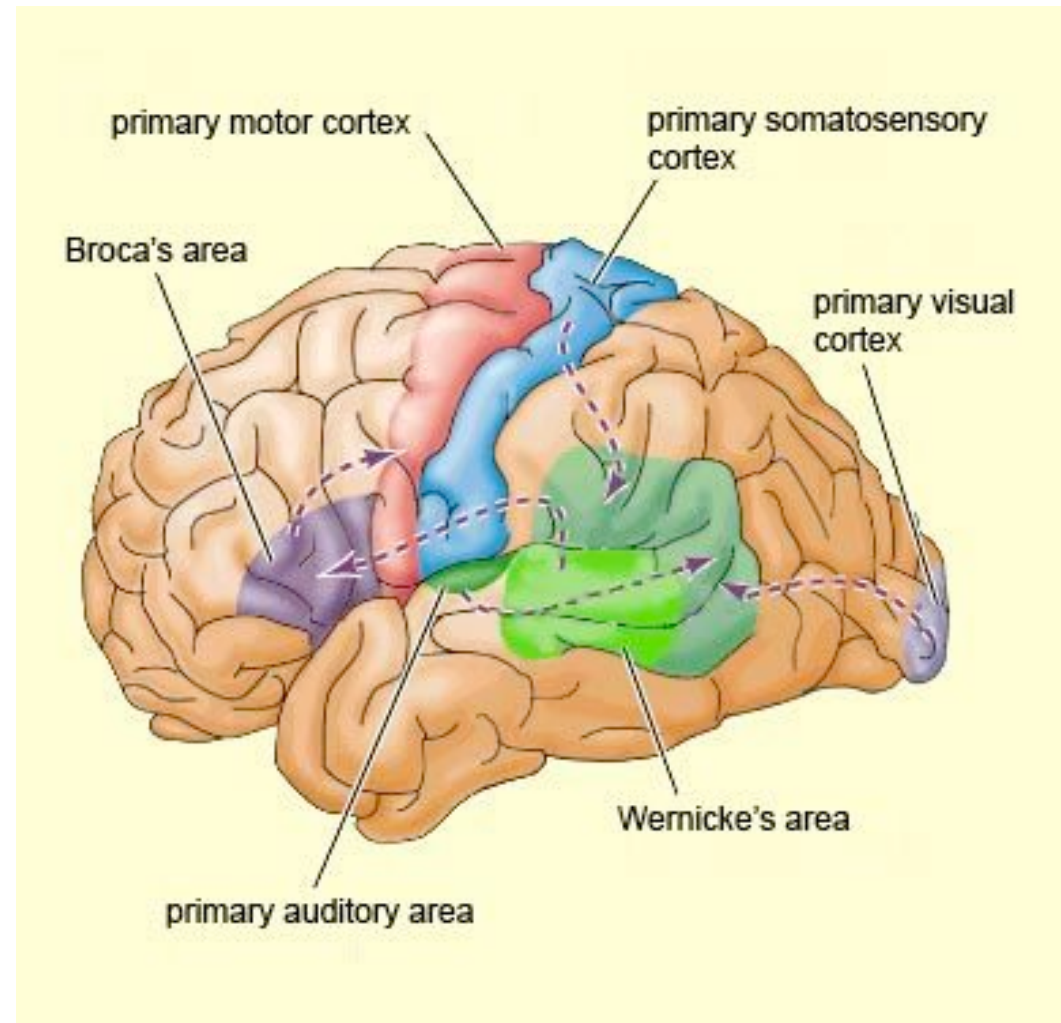
Broca's area

- **Broca's area** is involved mostly in the **production of speech**. Given its proximity to the **motor cortex**, neurons from Broca's area send **signals** to the **larynx, tongue and mouth motor areas**, which in turn send the signals to the **corresponding muscles**, thus allowing the creation of **sounds**.



Wernicke's area

- Considering its position, **Wernicke's area** is located relatively between the **auditory cortex** and the **visual cortex**.
- **Receptive language** has traditionally been associated with Wernicke's area of the posterior superior temporal gyrus (STG) and surrounding areas.
- Current models of speech perception include greater Wernicke's area.
- Its main function is the **comprehension of language and the ability to communicate coherent ideas, whether the language is vocal, written, signed.**



Damage to the Brain

Aphasia is a language disorder that can affect an individual's ability to speak, read, write, and understand.

What causes Aphasia?

Aphasia can be caused by **brain damage** from either a **stroke** or **head injury**, and can be a result from a **tumor** or growth in the brain.

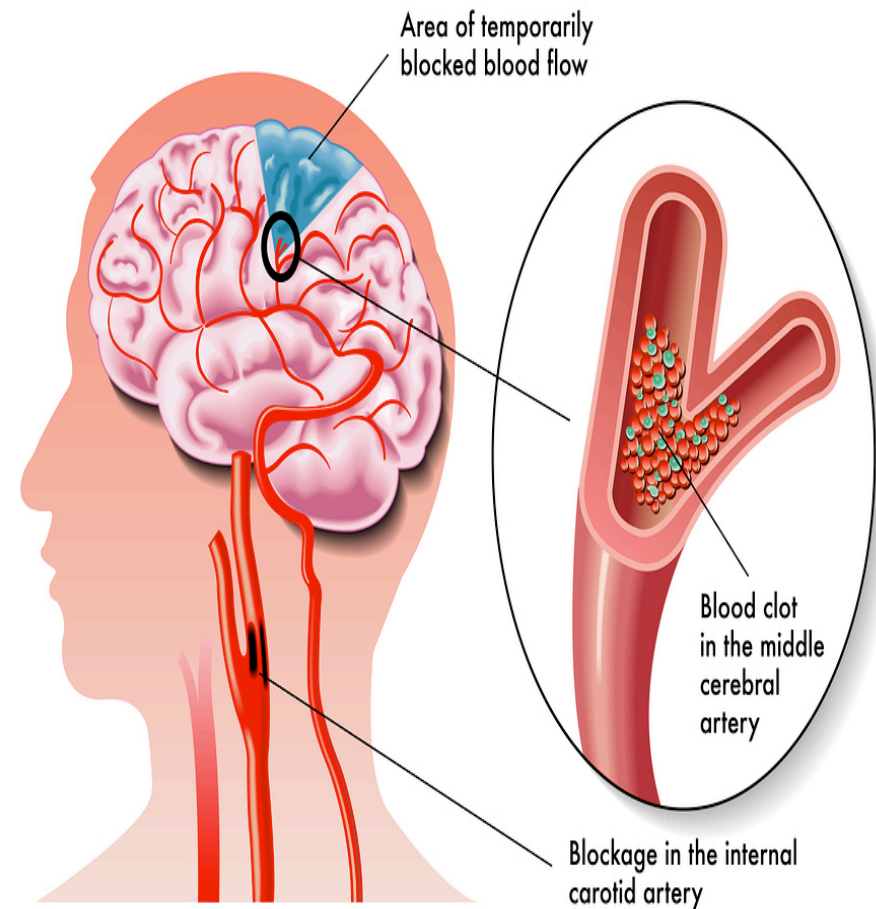
The brain damage is usually located in the left hemisphere of the brain.

For most people, the left side of the brain houses the main language centers, such as **Broca's Area** and **Wernicke's Area**.

Types of Aphasia:

There are three general types of Aphasia, all of which present different problems depending on the severity of the injury.

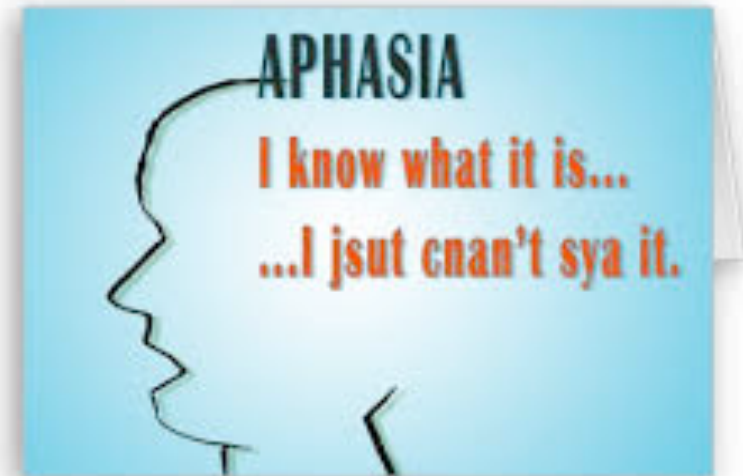
1. **Global** - affects an individual's ability to speak, read, write, and understand
2. **Receptive** - where individuals have trouble understanding and reading
3. **Expressive** – where individuals have trouble with speaking and writing



Damage to Broca's area

Expressive Aphasia:

- Usually characterized as a **nonfluent aphasia**, this language disorder is present when injury or damage occurs to or near **Broca's area**.
- Individuals with this disorder have a **hard time producing speech and language**, although most of their **cognitive functions remain intact**, and are **still able to understand language**.
- They are aware of their language disorder and may get frustrated.



Expressive Aphasia is also referred to as **Non-fluent Aphasia, Motor Aphasia** and **Broca's Aphasia**.

Individual's with Expressive Aphasia have trouble with **speaking** and **writing**.

Individuals with this disorder may:

- have a difficult time thinking of the words they want to say
- have problems spelling words
- only be able to say one or two words at a time
- have trouble putting together sentences that make sense
- leave words out of sentences
- make up words

Broca's patient

Mr Leborgne

"Tan Tan"





Mr. Leborgne's brain
which is preserved in
the Depuytren
museum in Paris

Damage to Wernicke's area

Receptive Aphasia:

- Individuals with receptive aphasia are **able to produce speech** without a problem.
- However, most of the words they produce **lack coherence**.
- At the same time, they have a **hard time understanding what others try to communicate**.
- They are often **unaware of their mistakes**.



Is language in the brain?



- **Language processing** refers to the way humans use words to communicate ideas and feelings, and how such communications are processed and understood.
- Thus it is how the brain creates and understands **language**. Most recent theories consider that **this process is carried out entirely by and inside the brain**.
- The essential function of the cortical language areas is **symbolic representation**. Even though language exists in different forms, all of them are based on symbolic representation.
- This is considered one of the **most characteristic abilities of the human species** - perhaps the most characteristic.
- **However very little is known about it and there is huge scope for research on it.**
- Most of the knowledge acquired to date on the subject has come from **patients** who have suffered some **type of significant head injury**, whether external (wounds, bullets) or internal (strokes, tumours, degenerative disease).

The question remains a subject of intense scientific scrutiny and debate

Thank you

