

# LANGUAGE AND THE BRAIN

Chapter 13

The Study of Language by George Yule

# Example

## Book, P: 156

I once had a patient who suffered a **right hemisphere** stroke and fell to the ground, unable to walk because of a paralysed **left leg**. She lay on the floor for two days, not because no one came to her aid, but because she kept blithely reassuring her husband that she was fine, that there was nothing wrong with her leg. Only on the third day did he bring her in for treatment. When I asked her why she could not move her leg, and held it up for her to see, she said indifferently that it was someone else's leg.

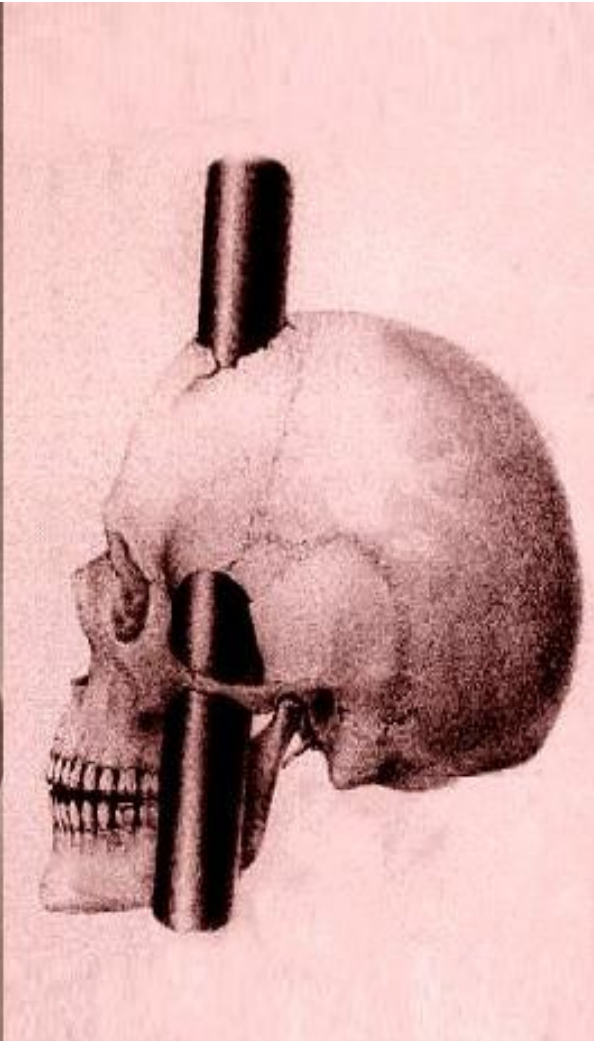
# Notes

- The damage was done to the **right** hemisphere of the patient's brain.
- The woman could no longer organise her own leg but she could **still talk** about it.
  - ▣ The ability to talk was unimpaired which means that language is located else where in the brain.

❖ **So where is language located?**

# What is Neurolinguistics?

- **Neurolinguistics:** The study of the relationship between language and the brain.
  - Although it is a fairly new term, this study dates back to the 19<sup>th</sup> century.
- **Phineas Gage in 1848:**
  - A rod went through his **upper left cheek** and out from the **top** of his **forehead** to injure the **front part of his brain**. He suffered a type of injury no one could recover from. However, a month later he was healed.



**The rod into Cage's head**

# Conclusion

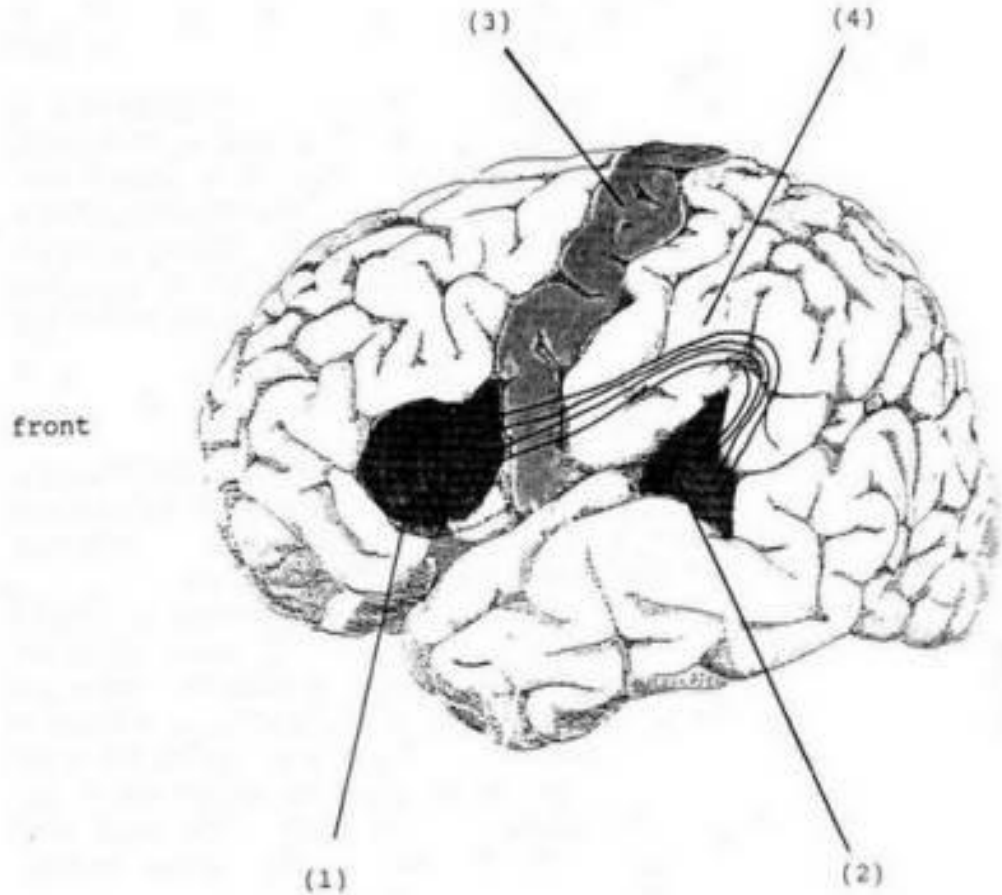
- The brain is made up of two parts:
  1. The **left** hemisphere
  2. The **right** hemisphere
- Cage's **language** abilities were **unaffected**. This proves that language is **NOT** located at the **front** of the brain.
- The most important parts of the **brain** are in the areas **above** the **left** ear.

# Parts of the Brain

The shaded areas indicate the general **locations** of the **language functions** involved in **speaking** and **listening**.

## How do we know this?

From **autopsies** of the brains of people who were known to have specific **language disabilities**.



# (1) Broca's Area

- The technical term for **Broca's area** is the “**anterior speech cortex**”.
- It was named after **Paul Broca**.
  - ▣ He was a French surgeon, who reported in the **1860s** that **damage** to this specific part of the brain was **related** to extreme **difficulty** in **producing speech**.



# (1) Broca's Area - Conclusion

- **Damage** to the **same part** in the **right** hemisphere did **NOT** have the same effect.
  - **Language ability** is located in the **LEFT** hemisphere.
- This finding was first used to **argue** that **language ability must be located in the left hemisphere** and since then has been treated as an indication that **Broca's area** is crucially involved in the **PRODUCTION of speech.**

## (2) Wernicke's Area

- The technical term for **Wernicke's area** is **'posterior speech cortex'**.
- It was named after **Carl Wernicke** .
  - ▣ He was a German doctor who reported in the **1870s** that **damage** to this part of the brain was **found** among patients who had **speech comprehension difficulties**.

## (2) Wernicke's Area - Conclusion

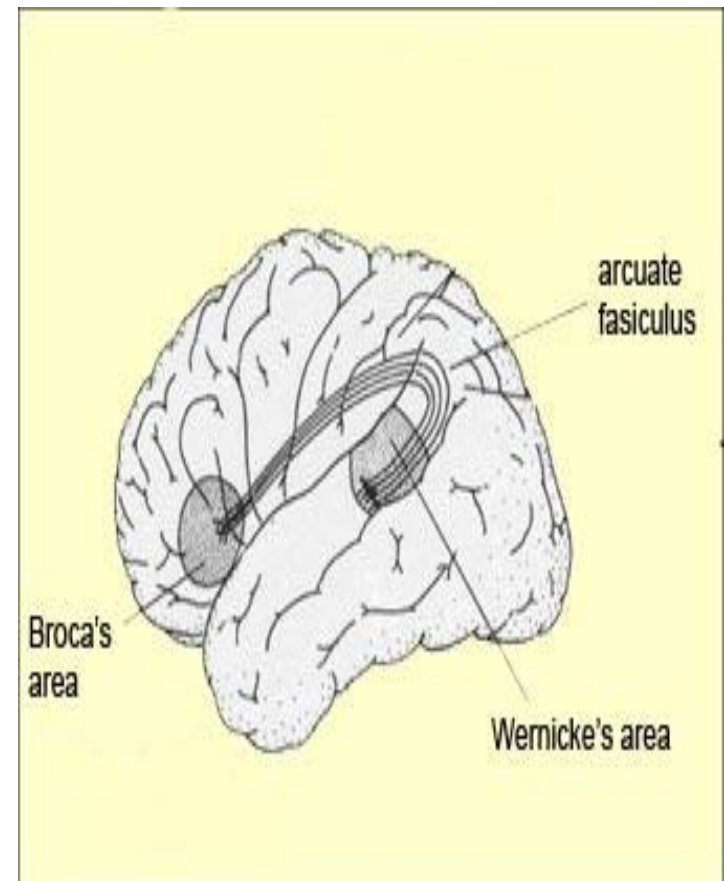
- This confirmed that **language** is **located** in the **left** hemisphere of the **brain**.
- It led to the view that **Wernicke's area** is the part of the brain crucially **involved** in the **understanding** of **speech**.

# (3) Motor Cortex

- The **motor cortex** is an area that generally **controls** the **movement** of the **muscles**.
  - ▣ i.e. controls moving the hands, feet, arms... etc.
- The **closest part** of it to the **Broca's area controls** the **articulatory muscles** of the **face, jaw, tongue** and **larynx**.
- Two neurosurgeons in the **1950s, Penfield** and **Roberts**, **found** that by **applying** small amounts of **electrical current** to **specific areas** of the brain, they could **identify** those **areas** where the **electrical stimulation** would **interfere** with normal **speech production**.

# (4) The Arcuate Fasciculus

- The **arcuate fasciculus** was also discovered by **Carl Wernicke**.
- It is known to **form** a crucial **connection** between **Wernicke's** and **Broca's** areas.



# Conclusion

- Specific aspects of language ability can be given to specific locations in the brain, which is called the Localisation View.
- The **localisation view** has been used to suggest that:
  - The **brain activity** involved in **hearing a word**, **understanding** it, then **saying** it, follows a **definite pattern**.

# The Pattern

- This definite **pattern** can be summarised as follows:
  1. The **word** is **heard** and **comprehended** via the **Wernicke's area**.
  2. This **signal** is **transferred** via the **arcuate fasciculus** to **Broca's area** where preparations are made to **produce** it.
  3. A signal is sent to the **motor cortex** to physically **articulate** the **word**.

# Tongue Tips and Slips

- A number of researchers have noted that we all **experience occasional difficulty** in getting brain and **speech production** to work together smoothly.
- Minor **production difficulties** provide possible **clues** to how **language** is **organised** within the **brain**.



# The Tip of the Tongue Phenomenon

- This phenomenon happens when we know the word, but it just won't come out.
- Studies on this have shown that speakers generally :
  1. Have accurate phonological outline of the word.
  2. Can get the initial sound correct.
  3. Know the number of syllables in the word.
- This also occurs with uncommon words and names.
- It suggests that our 'word-storage' system may be partially organized on the basis of phonological information and that some words are stored more easily than others.

# The Tip of the Tongue Phenomenon

Another **speech error** and a subtype of the **tip of the tongue** phenomenon is called **malapropisms**.

**Malapropisms:** The substitution of a word for a word with a similar sound, in which the resulting phrase makes no sense but often creates a comic effect.

- They are named after a the character in a play “**Mrs. Malapropism**” who consistently produced such mistakes.
- **Examples:**
  - Fire *distinguisher* → *extinguisher*
  - Rainy weather can be hard on the *sciences*. → (sinuses)
  - Having one wife is called *monotony*. → (monogamy)

# Slips of the Tongue

- Another kind of **speech errors** is commonly described as a **slip of the tongue** such as “make a long shory stort” and “use the door to open the key” .
  - Such slips are known as **spoonerisms** after **William Spooner** who was known for making this kind of mistakes.
- **Spoonerisms: The interchange of two sounds, usually initial, in words.**
  - **An example by Spooner:**
    - You have hissed all my mystery lectures.
- **Spoonerisms** are a result of a **sound** being **carried over** from one word to the **next**. **Examples:**
  - black bloxes → black boxes, Noman numerals → Roman numerals
  - Tup of tea → cup of tea, Shu flots → flu shots
  - Beel fetter → feel better, Stick neff → stiff neck
  - Loop before you leak → Look before you leap

# Slips of the Ear

- **Slips of the ear** may provide some clues to **how the brain tries to make sense of the auditory signal it receives.**
- **Example:**
  - ▣ To hear 'great ape' instead of 'gray tape'
  - ▣ A: "I just bought a new hearing aid. It cost me four thousand dollars, but it's state of the art. It's perfect."  
B: "Really, what kind is it?"  
A: "Twelve thirty."

# Aphasia

- Some people live with these ‘slips’ constantly. They **suffer** from different types of **language disorders**, generally described as ‘**aphasia**’.
- **Aphasia: An impairment of language function due to localised brain damage that leads to difficulty in understanding and/or producing linguistic forms.**
- **What causes Aphasia?**
  - ▣ A **stroke** is the most common cause (when a blood vessel in the brain bursts or is blocked).
  - ▣ **Traumatic head injuries** from **violence** or **accidents**.

# Broca's Aphasia

- **Broca's aphasia**, a serious **language disorder**, is also known as '**motor aphasia**'. In this type of aphasia, **comprehension** is much better than **production**.
- **Production is characterised by:**
  1. **Reduced** amount of **speech**
  2. **Distorted articulation**
  3. **Slow** and **effortful speech**.
  4. **Use** of **lexical morphemes** (nouns, verbs, adjectives, adverbs).
  5. **Omission** of **functional morphemes** (articles, prepositions) and **inflections** (Plural -s, past tense -ed).
    - That is why it is categorised as "**agrammatic**" speech.
- **Example of minor aphasia:**
  - I eggs and eat and drink coffee breakfast.

# Wernicke's Aphasia

- **Wernicke's aphasia** , a serious **language disorder**, is also known as '**sensory aphasia**'. It results in **difficulties** in **auditory comprehension**.
- People who has **Wernicke's aphasia** :
  1. Can actually **produce very fluent speech** which is **difficult** to make sense of.
    - **Example:** "I can't talk all of the things I do, and part of the part I can go alright, but I can't tell from the other people."
  2. Suffer from "**anomia**" i.e. **difficulty in finding the correct word**.
    - **To overcome this, speakers use different strategies like:**
      - Trying to describe the object.
        - **Example:** "*the thing to put cigarettes in*" for "ashtray".

# Conduction Aphasia

□ **Conduction aphasia** has been associated with **damage** to the **arcuate fasciculus**.

□ **People who suffer from conduction aphasia:**

1. **Mispronounce** words but they **don't** have **articulation problems**.
2. Are **fluent** but may have **disrupted rhythm** because of **pauses** and **hesitations**.
3. Have **good comprehension** of **spoken words**.
4. Find it **difficult** to repeat a **word or phrase** uttered by someone else.
  - Because what the **speaker hears** and **understands CANNOT** be **transferred** very successfully to the **speech production area**.
    - **Example:** Fosh for wash and vaysse for base.



# Notes on Aphasia

- ❖ Many of the symptoms mentioned such as the **word-finding difficulty** can **occur** in **all** types of **aphasia**.
- ❖ **Difficulties** in **speaking** can also be **accompanied** by **difficulties** in **writing (production)**.
- ❖ **Impairment** of **auditory comprehension** tends to be **accompanied** by **reading difficulties (understanding)**.
- ❖ These **types** of **aphasia** are almost always the **result** of **injury** to the **left hemisphere**.

# The critical period

- The **specialisation of the left hemisphere for language** is described in terms of **lateral dominance** or **lateralisation** (one-sidedness).
- **Lateralisation** begins in **early childhood**.
  - i.e. when language acquisition takes place.
- During **childhood**, there is a period **when the human brain is most ready to learn a language**. It is known as **the critical period**.

# The Critical Period - Genie

## Genie's case:

- ❑ She was a girl referred to as “Genie” in 1970, who was admitted to a hospital in LA.
- ❑ She was 13 years old and spent most of her life tied to a chair in a small closed room because of her father.
- ❑ Her only human contact was with her mother who was forbidden to spend more than a few minutes to feed her.
- ❑ She spent her whole life in a state of physical, sensory, social and emotional deprivation.

## As a result:

- ❑ She was unable to use language when she was first brought into care.
- ❑ Contact with others allowed her to imitate sounds and to communicate.
- ❑ Syntax remained very simple.

# Notes on Genie's Case

- Her **limited capacity** to **develop complex speech** supports the idea that part of the **left hemisphere** of the brain is open to **accept** a **language** program **during childhood**.
  - ▣ If **no program is** provided, as in **Genie's** case, then the **facility** is **closed down**.
- **Tests proved** that she had **NO left hemisphere language facility**.
- She was **using** her **right hemisphere** for **language** functions.
  - ▣ This raises the possibility that our capacity for language is **NOT limited** to only one or two **specific areas** but is based on **more complex connections** extending throughout the **whole brain**.
- When Genie was **beginning** to **use speech**, it was noted that she went through some of the **same** early **'stages'** found in **normal child language acquisition**.