

# BIOLOGICAL APPROACH TO BEHAVIOUR

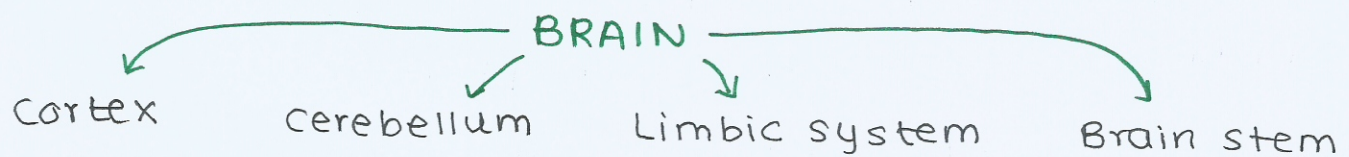
## LOCALIZATION

Every behaviour has its specific place in the brain and is associated with a certain brain area. This is known as localization of function.

## BRAIN STRUCTURE:-

**Nervous system:** is a system of neurons - cells that perform the function of communication in the body.

The Central Nervous system (CNS) consists of the spinal cord and the brain.



### Cortex

- It is the layer of neurons with a folded surface covering the brain on the outside.
- Largest part of the human brain.
- Associated with high-order functions - abstract thoughts, voluntary actions.

### CORTEX

- Frontal lobes • Parietal lobe • Occipital lobe
- Temporal lobes



## FRONTAL

- reasoning, planning, thinking, decision-making, voluntary actions, complex emotions



## PARIETAL

- movement, orientation, perception, recognition, speech, mathematical computation.



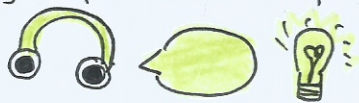
$$12 + 3 = 15$$

## CEREBELLUM

- has 2 hemispheres and a folded surface.
- co-ordination of movement & balance.

## TEMPORAL

- processing auditory information, memory, speech



## OCCIPITAL

visual processing  
oo



There is a deep furrow along the cortex which divides the brain into left and right hemispheres.

**corpus callosum:** A structure of neurons that connects the 2 hemispheres.

## Limbic system:

It is a sub-cortical structure that is referred as the 'emotional brain'.

## LIMBIC SYSTEM

- Thalamus
- Hypothalamus
- Amygdala
- Hippocampus



## THALAMUS



- sensory functions
- nerves from all sensory organs meet here before connecting to the cortex.

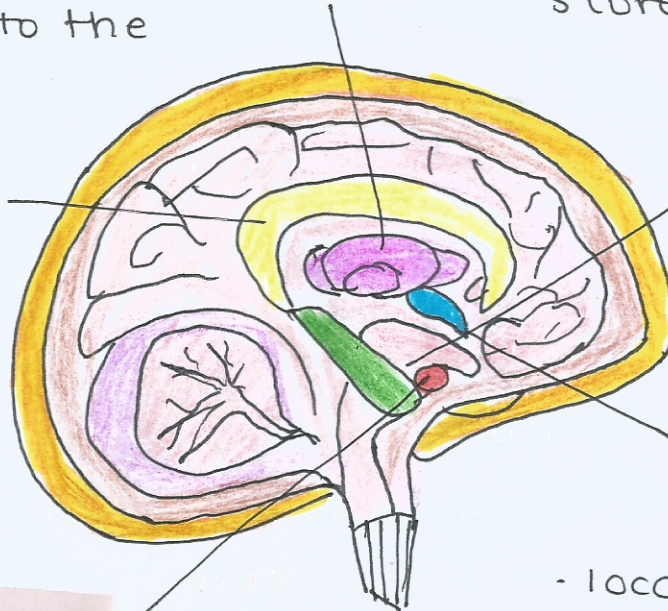


## HIPPOCAMPUS

- learning, memory, transferring short-term memory to a permanent store, spatial orientation.

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Short term → long term

## HYPOTHALAMUS

- located below the thalamus
- hunger, thirst and emotions.



## AMYGDALA

- memory, emotion and fear.



## BRAIN STEM

- underneath the limbic system
- regulation of basic vital processes.
- connects brain to the spinal cord.



## MID BRAIN:

- vision, hearing, motor control, temperature regulation, sleep wake cycle.

## MEDULLA

### OBLONGATA:

- respiration, vomiting, heart rate, breathing, blood pressure.



## PONS:

- It serves a bridge between various parts of the nervous system.
- dream generation



## Research supporting Localization:

→ Researches were performed with patients with brain damage.

### Paul Broca (1861) - Louis Leborgne (Tan) case study

→ Tan lost his ability to speak at 30.

→ He developed gangrene and went through a surgery that was performed by Broca.

→ The only word Louis could utter was Tan and used expressive hand gestures.

→ His intelligence and ability to understand remained the same.

**Broca's aphasia** - loss of articulated speech - tan's condition.

After Louis's autopsy it was revealed that there was a lesion in the frontal area of the left hemisphere.

**Broca's area** - posterior inferior frontal gyrus.

He asserted that speech articulation is controlled by the left frontal lobe.

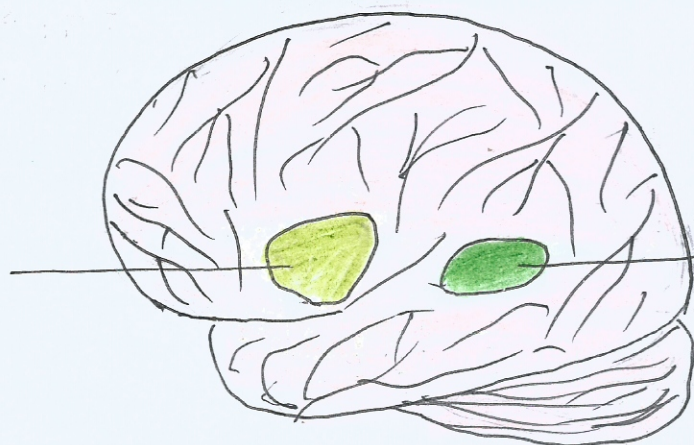


He described 25 additional patients with the same problem before publishing his conclusions.

His findings suggested that other functions can also be mapped onto specific brain areas.

### Wernicke's area

**BROCA'S  
AREA**



**WERNICKE'S  
AREA**



Wernicke's area was discovered by Carl Wernicke in 1874.

→ It is located in the temporal lobe of the dominant hemisphere (left hemisphere for most people).

→ Responsible for comprehension of written and spoken language.

**Wernicke's aphasia** - general impairment of language comprehension but their speech production is intact.

↳ What they speak sounds fluent and natural but it is meaningless.

### Similarity Between the research of Broca and Wernicke

→ method: Studying a patient with a naturally occurring brain lesion and conducting an autopsy after the death.

#### Drawbacks:

→ Naturally occurring brain lesion is rarely confined to a specific area.

→ You can't examine the patient while he is alive.

### Wilder Penfield

↳ Responsible for mapping of brain functions on a larger scale.

He used to treat patients with severe epilepsy by destroying the nerve cells that initiated the seizure.

He created a map of

sensory & motor cortex known as the **CORTICAL HOMUNCULUS**.

It shows the relative representation of various parts of the body in the sensory cortex.

#### method of Neutral stimulation:

He would stimulate various parts of the brain while the patient was still conscious & observe the effects of the stimulation had on behaviour.

All these researches supported that psychological functions have directly corresponding regions in the brain.



# RESEARCH OPPOSING THE IDEA OF LOCALIZATION

Karl Lashley (1890-1958) (read T.B. for more details)

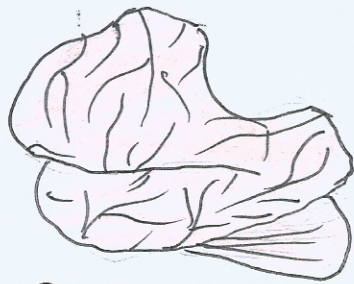
He measured the behaviour of rats before and after a specific carefully controlled induced brain damage (lesioned various portions) in the cortex of rats.

He concluded that memory and learning was not localized but distributed across the cortex.

observations:

→ Principle of mass action

- The proportion of the brain that is injured is directly proportional to the decrease in memory functions.
- Performance deterioration depends on the percentage of cortex removed but not on the location of the destroyed cells.



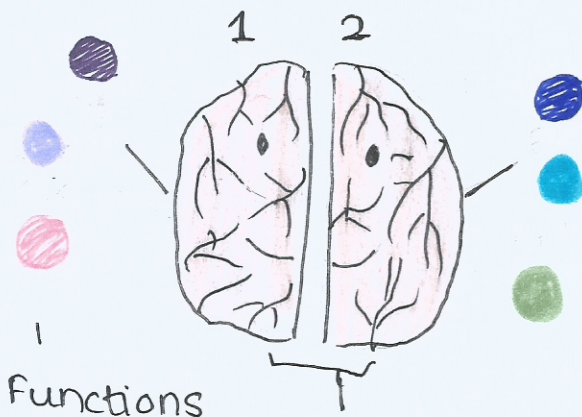
BRAIN DAMAGE



°° MEMORY ABILITIES

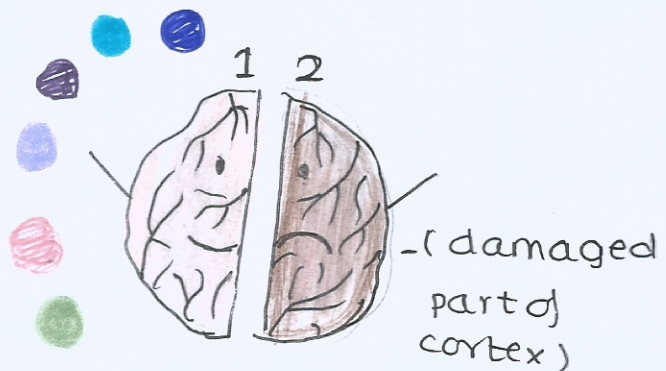
→ Equipotentiality

- The ability of one part of the cortex to take over the functions of another part of the cortex.



Functions

Parts of the cortex



[taking over of the functions]



## Limitations of Research supporting Localization

- It relied on aphasia resulting from brain damage.
- The lesion in Tan's brain was broader than what Broca had documented.
- They had to study the brain after the autopsy.

## Limitations of Research opposing Localization

- Learning to run through a maze involves motor and sensory functions that are complex. (may not be suitable for the study of localization).

## RELATIVE LOCALIZATION - The Split Brain Research



It admits localization for some functions under some conditions, but it outlines the limits of localization as well.

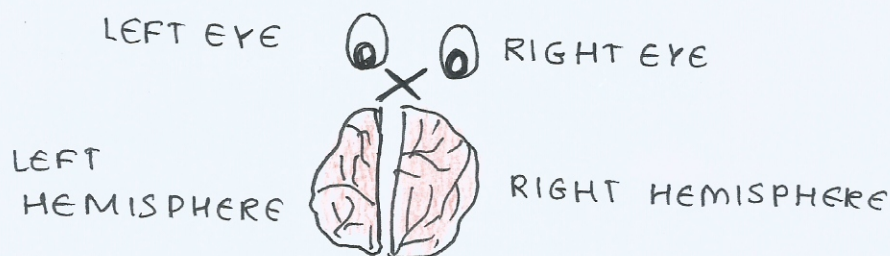
**Aim:** To test the theory of lateralization and see if the 2 hemispheres have uniquely different functions.

**Independent variable:** - whether the individual had split brain or not.

**Dependent variable:** - their performance on the tests.

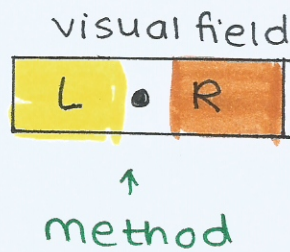
**Sampling:** 11 patients who had epilepsy and had undergone a surgery where their corpus callosum was removed to cure the epilepsy.

**Background:** optic nerves from the left eye are connected to the right hemisphere and vice versa.





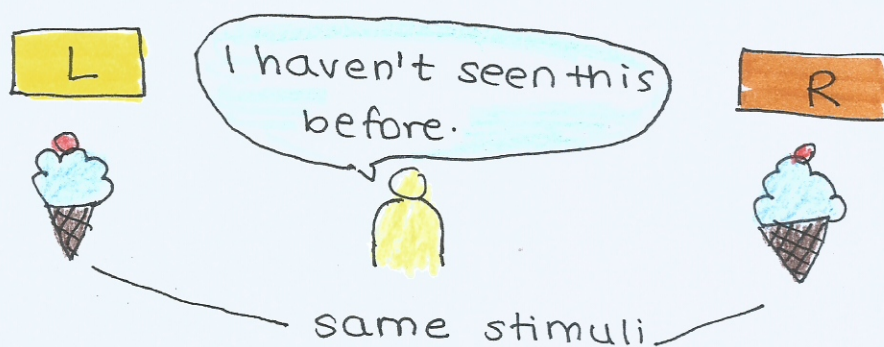
Dot drawn in the center. The patient was asked to look at it.



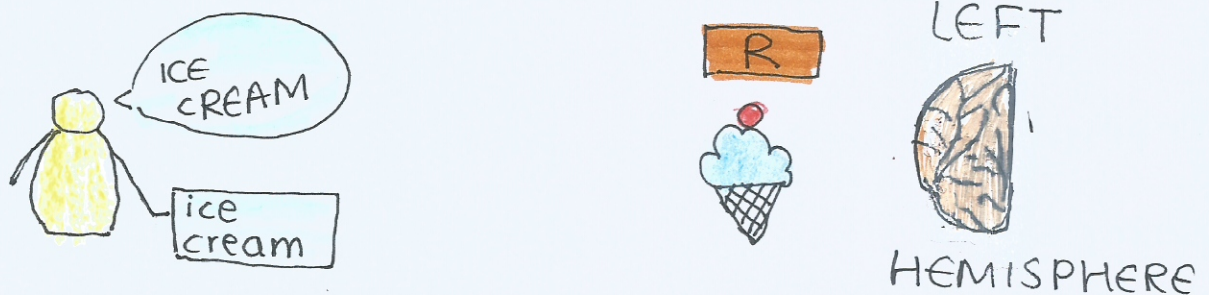
visual stimuli would be presented on left or right visual field.

## Observations:

→ If the participants were shown stimuli in the right visual field and the same stimuli in the left visual field, they would claim to have not seen it before.



→ Information presented on the right visual field could be described in speech & writing (right hand).  
The information was processed by the left hemisphere.



→ Information shown on the left visual field could be pointed out with the left hand to a matching picture/object.

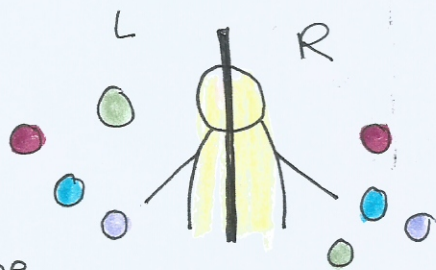
This is processed & controlled by the right hemisphere





## Tactile tasks:

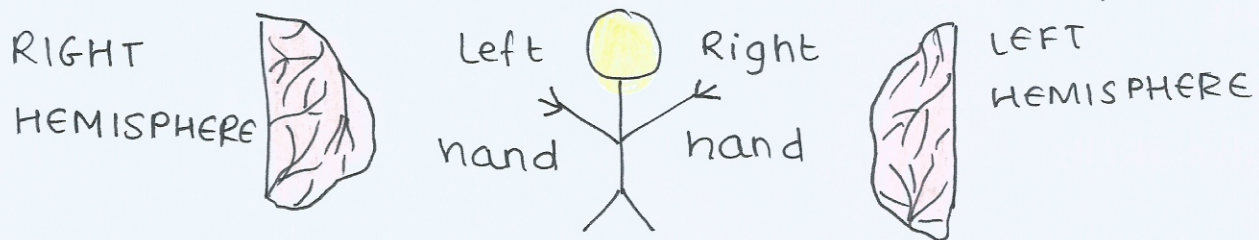
Participants put their hands under the tachistoscope.



The participants couldn't see the objects. The objects were placed in their hands.

## Background:

Objects placed in the right hand are processed in the left hemisphere and vice versa.

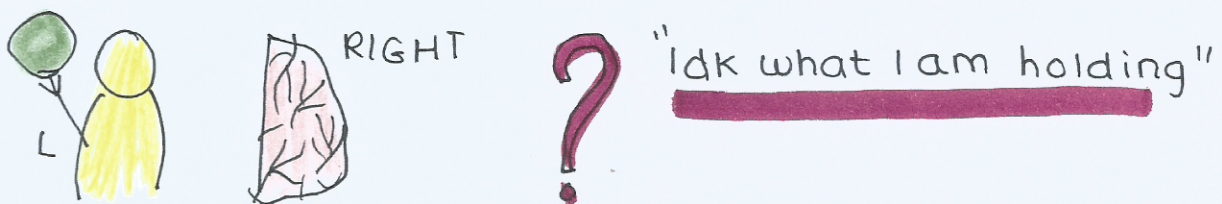


## Observations:

- Objects placed in the right hand could be described in speech or writing (right hand)
  - controlled by the left hemisphere

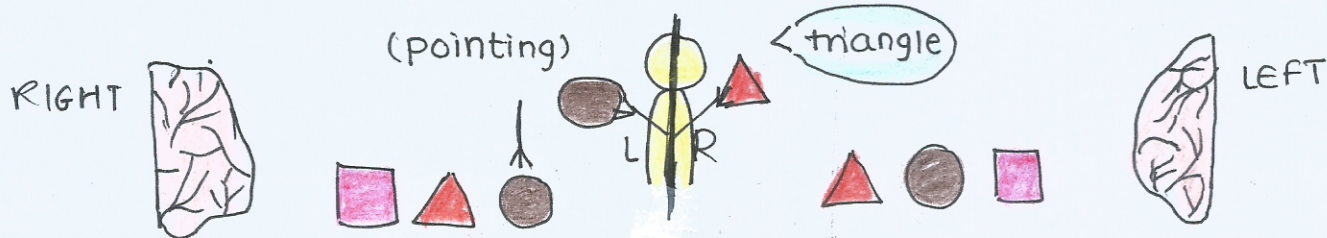


- Objects placed in the left hand weren't recognized.
  - They felt as if they weren't holding anything.
  - controlled by right hemisphere.



- When 2 objects were placed simultaneously in each hand & then in a pile of objects, both hands selected their own object and ignored the other.

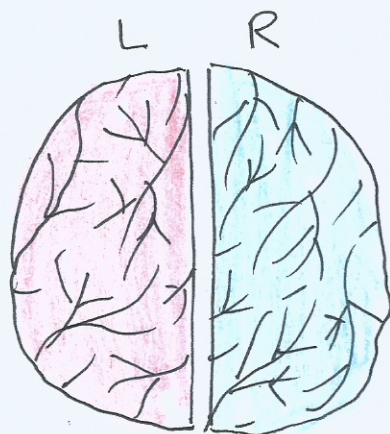




## CONCLUSION:

Lateralization of language

- writing
- Logic
- scientific skills



Better with visual constructions.

- spatial awareness
- imagination
- creativity

- Both hemispheres are capable of emotional response.
- Right hemisphere can comprehend language but cannot produce it.
- Split-brains lack cross-integration where the 2nd hemisphere doesn't know what the 1st one is doing.