What's in a Word?

EMMAA AFFUL

Destination: Paris, 1851

A LOOK INTO THE LIFE OF PATIENT TAN

If you could say one word for the rest of your life, what would it be? I don't think tan is the first word that comes to mind, but that was the reality for the subject of this infographic.
At the ripe age of 30, Louis Victor Leborgne lost the ability to speak. The formier (hat form maker) had suffered from epileptic seizures his entire life, but had successfully staved them off. Thus, he and his family believed this bout of speech loss was temporary.

Leborgne was admitted to the Bicêtre Hospital in 1851, where he would spend the remainder of his years. Despite his language loss, Leborgne did not exhibit any other forms of trauma. His intelligence and language comprehension remained unimpaired. Due to his partial illiteracy, Leborgne could not use writing to supplement his speaking. Besides his "tan-tan," he used a number of gestures to communicate, and could slip in a swear word on occasion.*

Unfortunately, Leborgne's condition deteriorated after ten years. Weakness in his right limbs soon developed into paralysis on his right side. This coupled with his vision problems and declining mental facilities left him bedridden for years. Towards the end of his life, he developed gangrene and an infection in his right limbs.

*It is believed that Leborgne grew up around tanneries, hence the preference.

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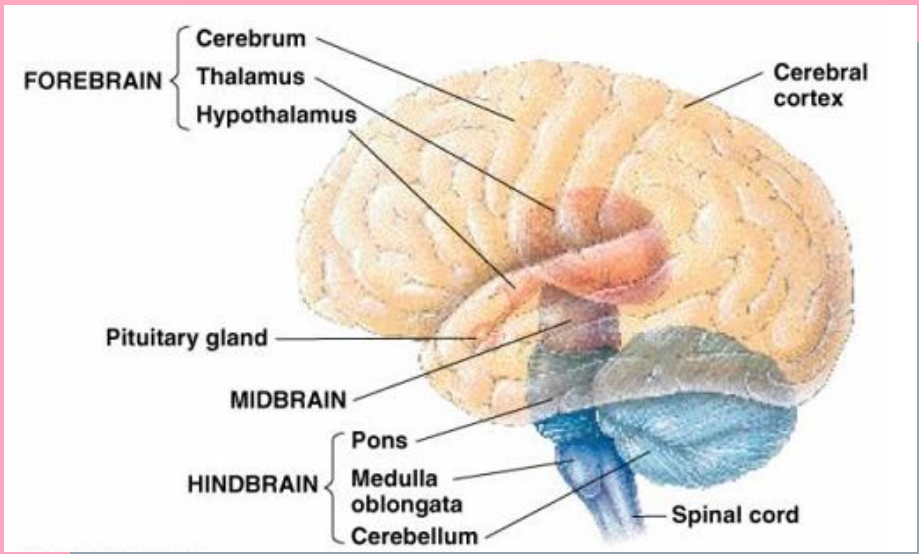
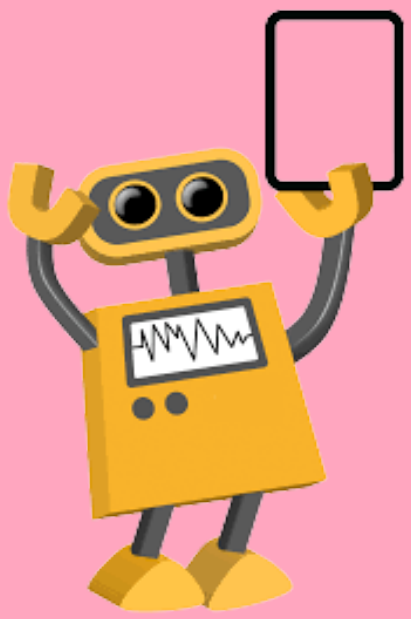
Basic Neuroanatomy

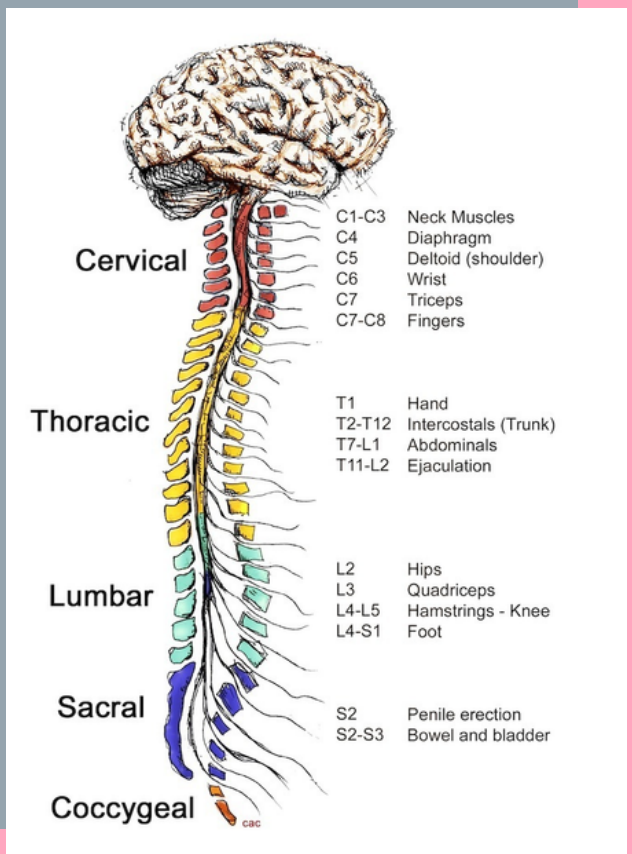




To simplify the complex organ nestled within our skull, I will divide it into three regions.

- The forebrain is linked to our cognition and executive functions.
  - Important structures: cerebral cortex (4 lobes on the outer layer of brain)
- The midbrain houses structures tied to our emotions, drives, and hormones.
  - Important structures: hypothalamus, hippocampus, amygdala
- The hindbrain controls autonomic survival functions.
  - Important structures: brain stem (pons, medulla), cerebellum

The spinal cord is a tubular structure extending from the end of the brain to the center of the back.
Acting as the brain's relayer of messages, each section of the spinal cord has a section of the body it controls.

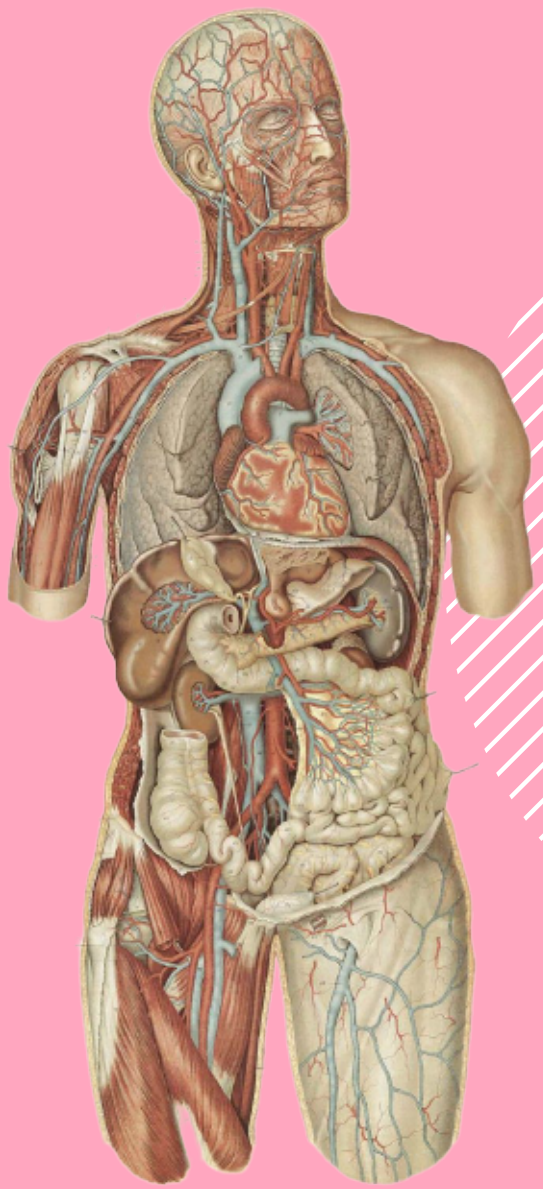


Patient Report

It wasn't until his final years that Leborgne was transferred to the care of Dr Paul Broca. Upon evaluating him, the surgeon found he was still incredibly expressive and had an adept ability to tell the time and count.

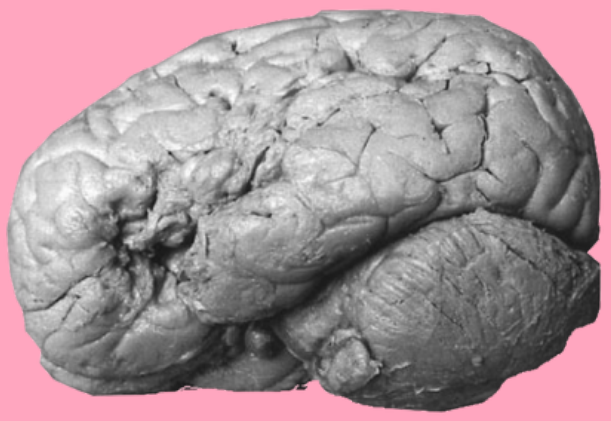
A few features of Leborgne's state when he met Broca are down below

- **Tongue**: The medulla controls the hypoglossal nerve, the 12th cranial nerve responsible for controlling the tongue.
- **Bladder**: The bladder is innervated by the sacral spinal cord. Because this region of the spinal cord is so low, a lesion in the spinal cord above this area would cause noticeable mobility issues in addition to a loss of bladder control. Thus, Leborgne's paralysis does not stem from spinal cord injury.
- **Strabismus**: This is a condition that leaves the eyes misaligned. While Leborgne had poor vision, he did not have this condition.
- **Mobility**: Leborgne's right side paralysis was most likely due to damage from the left hemisphere of his brain.



✓ = the area is functioning correctly

The End?



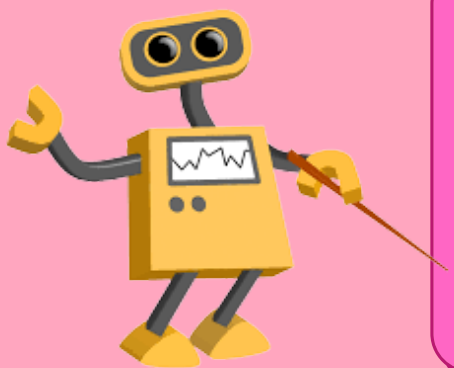
Just a week into the transition, Leborgne passed away. Yet our story does not end here. Although his life was less than ideal, Leborgne's contributions to our understanding of language will forever live on. Broca was fascinated by Leborgne's speech deficiency and performed an autopsy on his late patient. Upon examining his brain, Broca found a fluid filled cavity the size of a “chicken egg” in the left hemisphere. Broca attributed Leborgne’s language difficulties to this location. He termed Leborgne’s condition“aphemie” (the loss of articulated speech), which would later be termed aphasia to fit the current scientific lingo.
An encounter with a patient (Lelong) mirroring Leborgne's symptoms would confirm Broca’s beliefs.

Types of Aphasias

Global Aphasia: As the name implies, there is a total loss of speech comprehension and production. Both Wernicke’s and Broca’s areas are affected causing the patient to understand and speak few words.

Fluent Aphasia: Damage to the Wernicke’s area causes language comprehension deficits. While the patient can speak, it is a string of gibberish. They often struggle or are unable to read and write.

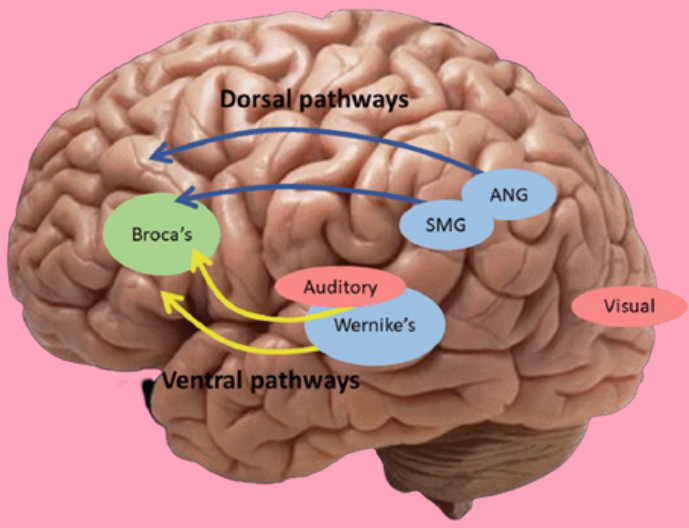
Non Fluent Aphasia: Damage to the Broca’s area produces this partial loss of speech production. The patient has trouble speaking fluently, but with effort can slowly churn out words.



Anomic Aphasia: This is a mild form of aphasia that leaves the individual unable to speak the words they want to at that moment. It is similar to the tip of the tongue phenomenon.

How do we speak?

Did you know the smallest bones in the human body are found in the ear?



Sound waves are transformed into neural impulses in the ear. These impulses are sent to the auditory cortex, where they are relayed to the Wernicke's area. At this point, the jumble of action potentials can be recognized as words. This new understanding is carried to the Broca's area via the arcuate fasciculus. A response can be formulated here via the motor cortex.

Wow! Did you know the human brain can power a lightbulb?

*This is an oversimplified schematic illustrating language production.

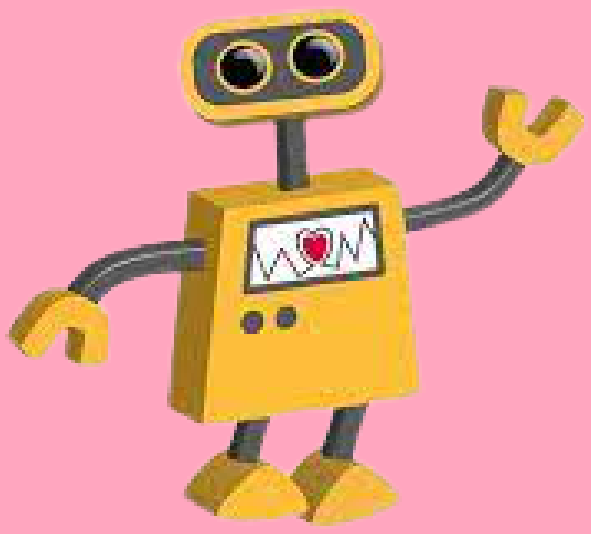
The Evolution of Science

The beauty of science lies in its malleability. It is difficult to find a theory completely set in stone, as there are constantly revisions being made to present ideas. The same is true for Broca's story. Broca decided to leave Leborgne's brain intact when examining it. As a result, he wasn't aware of the extent of Leborgne's brain trauma. Researchers as early as 1906 speculated that the damage was broader, extending into regions such as the basal ganglia, insula, and temporal lobe. Multiple MRI scans have confirmed their suspicions. Thus, injury solely to the Broca's area does not produce the severe symptoms of Leborgne. Even Broca, to an extent, knew this when he noted some patients could reduce their aphasia with time and practice.

Moreover, language is not constrained to the left hemisphere. For instance, there are centers similar to Broca's area and Wernicke's area on the right hemisphere dedicated to understanding and producing prosody.

This information does not dilute Broca's contributions to neuroscience. His work began the trail of research into the localization of functions and lateralization of the brain.

THANK YOU!



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