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Language & the Brain: Broca & Wernicke's Aphasia

Introduction

Humans are the only species that can produce language. To execute such a complex task, one is subconsciously aware of grammatical rules and must have a brain healthy enough to ensure adequate comprehension. When in poor health, speech production is hindered. This concept may seem like second-nature, but was not always so straightforward. In David Caplan's "Neurolinguistics and Linguistic Aphasiology: An Introduction", he introduces the theories that existed about language and the brain in the mid-nineteenth century, and how Paul Broca (1824-1880) and Carl Wernicke (1848-1905) revolutionized the study of the brain. Because of implementing the scientific method, Broca pinpointed the region responsible for speech production and Wernicke identified the area for language comprehension.

Historical Context

Phrenology is the study of the skull's size and shape in relation to its function. Before Broca and Wernicke, phrenologists, including Franz Joseph Gall (1758-1828) and Johann Gaspar Spurzheim (1776-1832), insisted "...the size of the brain area responsible for a given ability determined the degree of development of that ability or faculty in an individual" (Caplan 43). According to this evidence, these men believed that the brain's ability depended on brain size. This claim became false as further examinations were performed. That evidence essentially argues that the brain performed as a one unit instead of in designated regions. An additional

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proposal made by Jean-Baptiste Bouillaud (1796-1881) and Ernest Aubertin (1825-1893) suggested the opposite: "...language was located in the frontal lobes of the brain, in particular in the portion just above the eye socket (the supra-orbital portion)" (Caplan 43). Localization—the idea that specific areas of the brain have control over certain actions— was believed to be true, but needed to be tested. That is when Broca and Aubertin analyzed Broca's patient, Lebourgne.

Broca's Advancements

Through observation, Broca saw his patient only able to produce the word, "Tan"—no other expressive language existed. However, his comprehension skills were intact and he could communicate his understanding of external speech non-verbally. Based upon that, he generalized the issue was due to "an isolated problem in…the 'faculty of articulate language'" (Caplan 45). He theorized language would be localized in the region of the brain now known as "Broca's area". Toward the end of Tan's life, a series of paralyses spread throughout his body and Broca performed an autopsy of his brain after he passed. Broca found "...the brain showed a lesion in the left frontal lobe…The lesion consisted of a cyst located at the foot of the inferior frontal convolution" (Caplan 44). Through autopsy, Broca confirmed that the lesion lay in the left frontal lobe—verifying Bouillaud and Aubertin's theory.

While closely inspecting the brain's different regions, he noted:

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> The brain was softer than it should have been…the softness extended into the region of the parietal operculum…and Broca found that the brain became more normal in consistency as the probe moved more posteriorly. (Caplan 44)

These findings confirmed that damage was done to specific regions, and not the entire brain—as Broca predicted. Language loss was related to the areas where the brain was softer than usual. This refuted phrenology because Broca proved consistency with brain convolutions is the determinant of poor speech. The shape of the skull was not relevant at all. Most importantly, Broca repeated these experiments and reached the same results each time they were executed, which cemented all of his ideas. The phrenologists who had their theories about language and the brain had a significantly flawed approach to conducting such experiments which was a major reason why their theories were disproved. Broca believed speech deficits would be associated with left frontal lesions, which was in fact true.

As time went on, medical experts and scientists were trying to "...confirm or disconfirm Broca's claim that the faculty of articulate language was located in the posterior portion of the left third frontal convolution" (Caplan 49). His proposal became questioned when patients had lesions in the left hemisphere of the brain, but possessed no issues relating to language production. That is when the studies of Carl Wernicke became popularized.

Wernicke's Advancements

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Wernicke was responsible for delivering a "...classification of aphasic syndromes, and a general model of how language is represented in the brain from which new syndromes could be predicted" (Caplan 49). He provided those two efforts to science because he came across patients who were speaking with ease, but the subject matter of their phrases didn't make any sense and often included neologisms—completely new words that do not exist.

Based on these observations, Wernicke used inductive reasoning to determine that comprehension processing must occur in the section next to the primary auditory cortex. On that basis, "Wernicke suggested…it was reasonable to think of the gray matter around the Sylvian fissure as constituting a single gyrus related to language, with an auditory, sensory pole in the temporal portion and a speech, motor pole in the frontal portion" (Caplan 54). This prediction suggests that language does not correspond to one area, like Broca had thought, but rather a whole network of connections. Wernicke believed regions associated with auditory skills and motor language skills must both be functionally sound to guarantee proper speech production and comprehension. Wernicke's theories and predictions were tested by examining patients with aphasia. Many cases in the future proved that language and comprehension are separate functions, linked by information transmission.

Conclusion

Because of a properly conducted understanding of the scientific method, Broca and Wernicke effectively explained the relationship between language and the brain. Both

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professionals offered insight that medical professionals can use today to treat not only aphasic patients, but also any person dealing with poor brain health in some capacity. The legacy of these men and their scientific research has forever changed the way the brain is studied.

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Works Cited

Caplan, David. *Neurolinguistics and Linguistic Aphasiology: An Introduction*. *Cambridge University Press*, 1985. pp. 43-55.