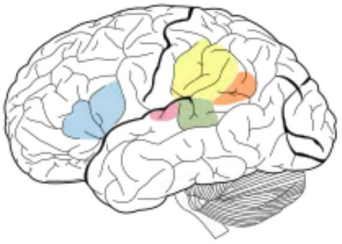
Neurolinguistics and Language processing in the brain



Language Areas of the brain. The Angular Gyrus is represented in orange, Supramarginal Gyrus is represented in yellow, Broca's area is represented in blue, Wernicke's area is represented in green, and the Primary Auditory Cortex is represented in pink.

The brain is the coordinating center of all linguistic activity; it controls both the production of linguistic cognition and of meaning and the mechanics of speech production. Nonetheless, our knowledge of the neurological bases for language is quite limited, though it has advanced considerably with the use of modern imaging techniques. The discipline of linguistics dedicated to studying the neurological aspects of language is called neurolinguistics.

Early work in neurolinguistics involved the study of language in people with brain lesions, to see how lesions in specific areas affect language and speech. In this way, neuroscientists in the 19th century discovered that two areas in the brain are crucially implicated in language processing. The first area is Wernicke's area, which is in the posterior section of the superior temporal gyrus in the dominant cerebral hemisphere. People with a lesion in this area of the brain develop receptive aphasia, a condition in which there is a major impairment of language comprehension, while speech retains a natural-sounding rhythm and a relatively normal sentence structure. The second area is Broca's area, in the posterior inferior frontal gyrus of the dominant hemisphere. People with a lesion to this area develop expressive aphasia, meaning that they know what they want to say, they just cannot get it out. They are typically able to understand what is being said to them, but unable to speak fluently. Other symptoms that may be present in expressive aphasia include problems with word repetition. The condition affects both spoken and written language. Those with this aphasia also exhibit ungrammatical speech and show inability to use syntactic information to determine the meaning of sentences. Both expressive and receptive aphasia also affect the use of sign language, in analogous ways to how they affect speech, with expressive aphasia causing signers to sign slowly and with incorrect grammar, whereas a signer with receptive aphasia will sign fluently, but make little sense to others and have difficulties comprehending others' signs. This shows that the impairment is specific to the ability to use language, not to the physiology used for speech production.

With technological advances in the late 20th century, neurolinguists have also incorporated non-invasive techniques such as functional magnetic resonance imaging (fMRI) and electrophysiology to study language processing in individuals without impairments.