Neurolinguistic Study of Atypical Language Use Groups

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Abstract

Neurolinguistics, with its aim of exploring the neural basis of language ability and the biological nature of language, has been of great significance in deepening the study of brain science and differences in language ability. This article focuses on the links between language use and neural mechanisms in two major groups of atypical language users, aphasia and deafness, to help us gain insight into language processing. In turn, it explores the limitations of neurolinguistic development to help advance the discipline.

Keywords

Neurolinguistics; Language; Aphasia; Deafness.

1. A Study of the Relationship Between Language and the Brian

1.1. What Is Neurolinguistics

Neurolinguistics is one of the branches of modern linguistics, which aims to study the neural mechanisms underlying language, and is a fringe discipline spanning neuroscience, psychology and linguistics. Generally speaking, linguistics studies the relationship between human language and speech, and in the nervous system, the brain is the most closely related to speech, and the neural mechanism of speech is mainly the brain mechanism, so the object of neurolinguistics is the relationship between the human nervous system and human language and speech. From the perspective of neuroscience, neurolinguistics belongs to the category of cognitive neuroscience, which focuses on the biological basis of the cognitive process to elucidate the neural mechanisms of this process, and its main research areas include language, auditory, visual, memory, attention and other mental phenomena. From the perspective of psychology, neuropsychological tests and neurological examinations are used to study the relationship between psychological disorders and brain injury sites in brain injured patients, thus revealing the anatomical basis of mental activity in the brain. To make hypotheses about the psychological and neural mechanisms of speech activity from a linguistic theory, especially psycholinguistic theories of language comprehension, production, acquisition and learning, and then to test them with neuroscientific research methods.

1.2. The Study of Neurolinguistics and Its Development History

Neurolinguistics originated from the empirical study of the phenomenon of aphasia by Western scientists in the 19th century, and for a long time it was also called the Aphasiology of language. 1836, Marc Dax proposed that impaired speech activity was caused by damage to the left hemisphere of the brain. 1861, Broca proposed that the ability to localize speech sounds was related to the posterior frontal gyrus in the left hemisphere of the brain. 1874, Wernicke discovered that auditory speech comprehension was caused by the damage in the superior temporal gyrus in the left hemisphere of the brain. In 1926, the British neuroscientist Hedder introduced the concept of linguistics, and through linguistic analysis of aphasia caused by localized brain damage, he came up with "syntactic aphasia" and "naming aphasia", which are corresponding to localized brain damage. "This was the first linguistic analysis of speech disorders. In the middle of the 20th century, with the emergence and development of neuroscience and psycholinguistics, scholars in the United States, Russia and other countries

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conducted extensive research on the brain mechanism of speech activity, the basic problems of neurolinguistics have been partially addressed by Chomsky's theory of "language ability" and "deep structure". In the 1960s and 1970s, scholars widely used the term "neurolinguistics" to replace the old terms "brain and language" and "neural basis of language". In the 1960s and 1970s, the term "neurolinguistics" was widely used to replace the terms "brain and language" and "neurological basis of language", which marked the emergence of neurolinguistics as a marginal discipline, and at the same time, the Russian school of neurolinguistics gradually moved away from the Western school's medical expert-led model to a collaborative and complementary research by experts from different fields. This view brought new voices and thoughts to the Western academic debate, and together with the later neo-classical framework, became the most influential research theory on the relationship between language and brain in the functional theory of the brain.

Compared with the active development of neurolinguistics in the West, neurolinguistic research in China started late, and research related to the neural mechanisms of language began to appear only in the second half of the 20th century, mainly with clinical neuroscientists' research on aphasia and psychologists' exploration of the psychological mechanisms of language processing, which on the whole were necessary and effective in their own fields, but the purpose was not yet to reveal the neural mechanisms of language. neural mechanisms. In the 1980s, a small number of linguists began to translate foreign neurolinguistic research results, but no real neurolinguistic research had been conducted in the linguistic community at that time. In the mid-to-late 1990s, linguistics began to branch out into neurolinguistics, and scholars used contemporary advanced linguistic theories as a background to explore the neural mechanisms of language, including semantic, grammatical, phonological, and pragmatic components, and the research methods involved were newly applied from the traditional clinical neuropsychological sequencing to neuroimaging and neurophysiology with normal subjects as the research objects. The research methodologies have been expanded from traditional clinical neuropsychological sequencing to non-invasive techniques such as neuroimaging and neurophysiology in normal subjects.

2. Usage of Atypical Language

2.1. Atypical User Groups

Neurolinguistics, on the one hand, has opened up a wide range of research areas due to its highly interdisciplinary nature, including the study of pathological groups, which has led to the understanding of Dysgraphia as a physiological disorder, and the study of psychological activity mechanisms, which has led to the exploration of language acquisition and the neurolinguistic system of bilingual speakers. In turn, a high degree of research on language mechanisms can be reversed to target the development and evolution of artificial intelligence. On the other hand, since neurolinguistics is mainly based on speech-language pathology and the interaction between neural and language mechanisms, the main groups to be studied in neurolinguistics are those with language malfunctions or disorders caused by lesions or injuries in different parts of the brain, and these atypical language groups include aphasia, deafness, dyslexia, and so on, compared to normal unimpaired language users. In addition to providing new ideas for the further development of medicine and psychology, their study also serves as a reference point to help us better understand human neurological thinking and psychological and linguistic mechanisms. This is a two-way promotion on the interaction and innovation between science and linguistics.

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2.2. Aphasia

Aphasia is simply a deficit in speech production, comprehension or repetition caused by brain injury. Stroke, tumors, brain injury, and progressive degenerative diseases can all lead to aphasia. Symptoms of aphasia are usually the inability to recognize nouns or verbs, and have difficulty on pronouncing words correctly, and the lost of grammatical structure. Unlike congenital disorders, hearing problems, and developmental defects, aphasia directly affects the language system.

The existing classification of aphasia is based on the Wernicke-Lichtheim-Geschwind "house" model, in which "M" represents the language planning and production center, i.e., Broca's area, "A" represents the phonological center, i.e., Wernicke's area, and "B" represents the semantic center. M" represents the language planning and production center, i.e., Broca's area, "A" represents the phonological center, i.e., Wernicke's area, and "B" represents the semantic center. The arrows in the figure indicate the flow of information, and the red horizontal line indicates the possible types of brain damage.

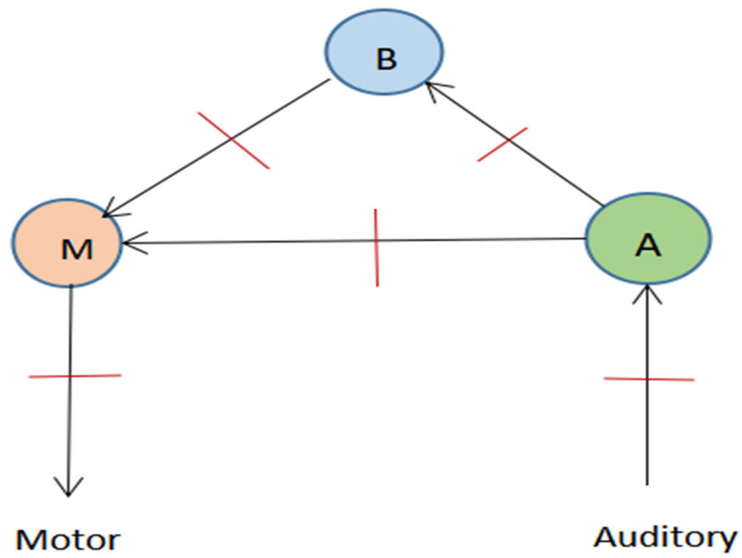

Figure 1. Wernicke-Lichtheim-Geschwind "house" model

Based on this model, aphasia can be classified into the following categories.

1. Broca's aphasia, BA, mainly refers to the impairment of the "M", which is manifested by the lack of fluency in speaking, the impairment in repetition, and the obvious grammatical defects.

2. Wernicke's aphasia, WA, also known as sensory aphasia, refers to damage to the "A". It is also a widely recognized form of aphasia. Wernicke's aphasia was first described by Carl Wernicke in 1874

3. Conduction aphasia (CA), mainly refers to the damage of the conduction pathway from "A" to "M", and can understand the content of the plural but cannot repeat it accurately. 4. Transcortical motor aphasia (TCMA), also known as anterior isolation syndrome, is an impairment of the pathway from "B" to "M" and has the basic characteristics of anterior aphasia. It is characterized by relatively good comprehension and repetition ability, poor oral fluency, and a high number of pauses.

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5. Transcortical sensory aphasia (TCSA) is an impairment of the "A" to "B" pathway. TCSA is a common type of clinical aphasia, which is characterized by good oral speech, good repetition, and poor comprehension with articulation deficits.

6. Mixed transcortical aphasia (MTA), also known as isolation of the speech area, refers to the impairment of both the "B" to "M" and "A" to "B" pathways. MTA, also known as isolation of the speech area, refers to the impairment of both the "B" to "M" and "A" to "B" pathways, and can be seen as a combination of transcortical motor aphasia and transcortical sensory aphasia. Patients with transcortical mixed aphasia are less common and usually have problems with speech production and comprehension.

7. Global aphasia (GA), also known as mixed aphasia, is the most severe of all aphasia types. It refers to damage to the entire system, manifesting as a total loss of listening, speaking, reading and writing skills.

8. Anomic aphasia (AA), also known as amnestic aphasia, is an aphasia syndrome in which the inability to name (anomia) is the only or main symptom. Naming aphasia and naming disorder are two different concepts. All patients with aphasia have naming disorders to varying degrees, and naming disorders are also seen in many patients with diffuse encephalopathy, but naming aphasia is a separate aphasia syndrome in which naming disorders are predominant and the sites of brain damage can occur in different regions.

Modern scientific methods for the study of aphasia are abundant, supplemented by medical means such as hemodynamic imaging techniques, functional near-infrared light spectrometry measurements, electromagnetic techniques, event-related potentials, etc. In the case of patients with named aphasia, for example, since the distribution of the damaged areas is uncertain, PET (positron emission tomography) techniques can be used to locate the specific damaged areas. What does positron emission imaging mean? It is the isotope of high school chemistry, where the radioactive isotope15 O is injected into the human body to participate in the metabolic process of the human body.15 O decays in the human body and releases positrons, which are annihilated and transformed into a pair of photons when they meet with negative electrons in the human body, which are detected by the detector and processed by the computer to produce a clear image. Because the isotope will be uniformly distributed in the brain in a short period of time after injection in the body, when the subject performs a specialized task, the blood supply to the corresponding brain working area will increase , so that the isotope in the area will increase with the increase in blood supply and release a large number of positrons, and then these positrons collide with electrons to release gamma rays, that is, the annihilation effect, a certain brain area working intensity The greater the intensity of work in a particular brain region, the greater the intensity of gamma rays, and the images presented on the computer are also evident, so that it is possible to locate the areas of brain activity involved in different linguistic roles and restricted areas

2.3. Deafness

Among deaf patients, those with hearing impairment due to congenital anomalies or present in infancy are classified as prelingual deafness. The etiology of prelingual deafness is relatively complex and is known to be genetic, pharmacological, congenital and post-meningitis hearing impairment. Most patients with prelingual deafness have a cochlear lesion, and the onset of the disease is accompanied by hearing loss, which in severe cases may even affect speech function. If not treated effectively after the onset of the disease, the patient's ability to speak will be impaired.

In clinical medical studies, it has been found that deaf people who use sign language have weaker connections to auditory cortex and other brain areas than normal people, but appear to have enhanced connections to visual cortex and language processing areas, a prominence that may be due to the experience of using sign language, a plasticity that also largely influences

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the success of cochlear implant surgery. Some studies have shown that the degree of integrity of the auditory association cortex and higher cognitive-related brain areas prior to cochlear implantation affects postoperative hearing levels, but the help of cochlear implantation surgery, for example, on language development in deaf people should not be overstated. Hearing compensation can be achieved with hearing aids, but this method allows patients to perceive hearing to sounds, but it does not mean that they can fully understand them. Current clinical medical technology does not yet allow deaf children to acquire spoken language as effortlessly as able-bodied children, and even if some patients have better spoken language rehabilitation with cochlear implants, the variability in rehabilitation outcomes and the possible psychological and physical effects of cochlear implant surgery on some deaf children cannot be ignored. The best option for them may be to acquire sign language as a native language and spoken language as a second language, with planned stimulation of the patient's auditory organs in conjunction with auditory language rehabilitation, thus establishing a connection and slowly forming a kind of training for hearing, a method that stimulates the child's awareness of the existence and importance of sound, as well as cognition of what is around them, thus promoting the development of auditory function.

3. Problems and Challenges in Neurolinguistics

3.1. Compatibility Between Linguistic and Neuroscience

The paradox of compatibility between linguistics and neuroscience. First, the disciplinary models differ. Transformational-generative grammar treats language as an innate "device" and believes that inferences about the material features of language (i.e., the brain) can be made through theoretical assumptions and experimental verification. The approach of testing theories through the speech of native speakers is often subjective. The basic idea of neuroscience is that the psyche is embodied in the nervous system and that neurophysiological processes are equivalent to ongoing mental processes. (Grimaldi 2012) Although neuroscience requires theoretical speculation, it places greater value on data obtained through controlled experiments. In contrast to linguistic research that proceeds along the direction from theory to validation, neuroscience is based on empirical observations and studies and builds corresponding theories based on data.

3.2. The Complexity of Neurolinguistics Study

In contrast to visual and other cognitive activities, language is both a perceptual and output activity, and more of an intricate combination of the two. Language is unique in that it takes a series of a finite number of linguistic units and combines them in an almost infinite number of ways to continuously form more complex and meaningful linguistic units, forming a complex structure and semantic relations, which means that a series of continuous and constantly changing sound waves of language can be translated into individual neural representations through a certain computational process, which in turn is associated with the brain's different memory mechanisms.

The processing of language is very complex, and the brain is even more complex. First of all, we have a limited knowledge of the brain structure, although we can describe different parts of the brain in different ways according to the external appearance of the brain (e.g., lobes, sulci and gyrus, left and right hemispheres, etc.), or identify the parts of the brain in the form of linguistic descriptions (e.g., temporal lobes, etc.). But these descriptions are based on our knowledge of brain function and its roughness, and do not have a precise component, which is not necessarily accurate. To make matters worse, beneath the cerebral cortex are crisscrossing nerve fibers that link various parts of the brain, and our current knowledge of these nerve fibers is extremely limited. There are still many uncharted challenges awaiting neurolinguistics, and more talented people are needed to contribute to its development.

4. Conclusion

With the development of our technology, the interaction between contemporary technology and contemporary linguistics shows that technology, culture and humanities are bound to flourish in the future. Although neurolinguistics start comparatively late, it happens to be a new popular in line with the trend of the times. During the process with more and more people devoted to the study of neurolingustic, it has helped us to better focus on the differential existence of various groups and to explore and understand the diversity of life and to promote the development of diverse social structures.

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