Neurolinguistics is the study of how language is represented in the brain: that is, how and where our brains store our knowledge of the language (or languages) that we speak, understand, read, and write, what happens in our brains as we acquire that knowledge, and what happens as we use it in our everyday lives. Neurolinguists try to answer questions like these: What about our brains makes human language possible – why is our communication system so elaborate and so different from that of other animals? Does language use the same kind of neural computation as other cognitive systems, such as music or mathematics? Where in your brain is a word that you've learned? How does a word ‘come to mind’ when you need it (and why does it sometimes not come to you?)

If you know two languages, how do you switch between them and how do you keep them from interfering with each other? If you learn two languages from birth, how is your brain different from the brain of someone who speaks only one language, and why? Is the left side of your brain really ‘the language side’? If you lose the ability to talk or to read because of a stroke or other brain injury, how well can you learn to talk again? What kinds of therapy are known to help, and what new kinds of language therapy look promising? Do people who read languages written from left to right (like English or Spanish) have language in a different place from people who read languages written from right to left (like Hebrew and Arabic)? What about if you read a language that is written using some other kind of symbols instead of an alphabet, like Chinese or Japanese? If you're dyslexic, in what way is your brain different from the brain of someone who has no trouble reading? How about if you stutter?

As you can see, neurolinguistics is deeply entwined with psycholinguistics, which is the study of the language processing steps that are required for speaking and understanding words and sentences, learning first and later languages, and also of language processing in disorders of speech, language, and reading.

How our brains work

Our brains store information in networks of brain cells (neurons and glial cells). These neural networks are ultimately connected to the parts of the brain that control our movements (including those needed to produce speech) and our internal and external sensations (sounds, sights, touch, and those that come from our own movements). The connections within these networks may be strong or weak, and the information that a cell sends out may increase the activity of some of its neighbors and inhibit the activity of others. Each time a connection is used, it gets stronger. Densely connected neighborhoods of brain cells carry out computations that are integrated with information coming from other neighborhoods, often involving feedback loops. Many computations are carried out simultaneously (the brain is a massively parallel information processor).

Learning information or a skill happens by establishing new connections and/or changing the strengths of existing connections. These local and long-distance networks of connected brain cells show plasticity that is, they can keep changing throughout our lives, allowing us to learn and to recover (to some extent) from brain injuries. For people with aphasia (language loss due to brain damage), depending on how serious the damage is, intense therapy and practice, perhaps in combination with transcranial magnetic stimulation (TMS), may bring about major improvements in language as well as in movement control.

Where is language in the brain?

This question is hard to answer, because brain activity is like the activity of a huge city. A city is organized so that people who live in it can get what they need to live on, but you can't say that a complex activity, like manufacturing a product, is 'in' one place. Raw materials have to arrive at the right times, subcontractors are needed, the product must be shipped out in various directions. It's the same with our brains. We can't say that language is 'in' a particular part of the brain. It's not even true that a particular word is 'in' one place in a person's brain; the information that comes together when we understand or say a word arrives from many places, depending on what the word means. For example, when we understand or say a word like ‘apple’, we are likely to use information about what apples look, feel, smell, and taste like, even though we aren’t aware of doing this. So listening, understanding, talking, and reading involve activities in many parts of the brain. However, some parts of the brain are more involved in language than other parts.

Most of the parts of your brain that are crucial for both spoken and written language are in the left side of the cortex of your brain (the left hemisphere), regardless of what language you read and how it is written. We know this because aphasia is almost always caused by left hemisphere injury, not by right hemisphere injury, no matter what language you speak or read, or whether you can read at all. (This is true for about 95% of right-handed people and about half of left-handed people.) A large part of the brain (the 'white matter') consists of fibers that connect different areas to one another, because using language (and thinking) requires the rapid integration of information that is stored and/or processed in many different brain regions.

Areas in the right side are essential for communicating effectively and for understanding the point of what people are saying. If you are bilingual but didn’t learn both languages from birth, your right hemisphere may be somewhat more involved in your second language than it is in your first language. Our brains are somewhat plastic – that is, their organization depends on our experiences as well as on our genetic endowment. For example, many of the ‘auditory’ areas of the brain, which are involved with understanding spoken language in people with normal hearing, are used in (visually) understanding signed language by people who are deaf from birth or who became deaf early (and do not have cochlear implants). And blind people use the ‘visual’ areas of their brains in processing words written in Braille, even though Braille is read by touch. Bilingual speakers develop special skills in controlling which language to use and whether it is appropriate for them to mix their languages, depending on whom they are speaking to. These skills may be useful for other tasks as well.

Aphasia

What is aphasia like? Is losing language after brain damage the reverse of learning it? People who have difficulties speaking or understanding language because of brain damage are not like children. Using language involves many kinds of knowledge and skill. People with aphasia have different combinations of things that they can still do in an adult-like way and things that they now do clumsily or not at all. In fact, we can see different patterns of profiles of spared and impaired linguistic abilities across different people with aphasia.

Therapy can help aphasic people to improve on or regain lost skills and make the best use of remaining abilities. Adults who have had brain damage and become aphasic recover more slowly than children who have had the same kind of damage, but they continue to improve slowly over decades if they have good language stimulation and do not have additional strokes or other brain injuries.

Dyslexia and stuttering

What about dyslexia, and children who have trouble learning to talk even though they can hear normally? Why do people have reading difficulties? Research suggests that dyslexics have trouble processing the sounds of language and have difficulty relating the printed word to sounds.Genetic differences and genetically-based brain differences have been found in families with dyslexia and developmental language disorders, and research in this area is helping us understand how genes act in setting up the initial ‘wiring’ of all of our brains. There is solid evidence that appropriate language-based therapy is effective for children with developmental disorders of reading and language, including stuttering.

How neurolinguistic ideas have changed

Many established ideas about neurolinguistics – in particular, roles of the traditional ‘language areas’ (Broca’s area, Wernicke’s area) in the left hemisphere of the brain - have been challenged and in some cases overturned by recent evidence. Probably the most important recent findings are 1) that extensive networks involving areas remote from the traditional language areas are deeply involved in language use, 2) that the language areas are also involved in the processing of non-language information, such as some aspects of music that the correlations of particular areas of the brain with particular language impairments are much poorer than had been thought. This new information has become available because of major improvements in our ability to see what is happening in the brain when people speak or listen, and from the accumulation and analysis of many years of detailed aphasia test data.

How neurolinguistic research has changed

For over a hundred years, research in neurolinguistics was almost completely dependent on the study of language comprehension and production by people with aphasia. These studies of their language ability were augmented by relatively crude information about where the injury was located in the brain. Neurologists had to deduce that information, such as it was, by considering what other abilities were lost, and by autopsy information, which was not often available. A few patients who were about to undergo surgery to relieve severe epilepsy or tumors could be studied by direct brain stimulation, when it was medically needed to guide the surgeon away from areas essential for the patient’s use of language.

Early-generation computerized x-ray studies (CAT scans, CT scans) and radiographic cerebral blood-flow studies (angiograms) began to augment experimental and observational studies of aphasia in the 1970s, but they gave very crude information about where the damaged part of the brain was located. These early brain-imaging techniques could only see what parts of the brain had serious damage or restricted blood flow. They could not give information about the actual activity that was taking place in the brain, so they could not follow what was happening during language processing in normal or aphasic speakers. Studies of normal speakers in that period mostly looked at which side of the brain was most involved in processing written or spoken language, because this information could be gotten from laboratory tasks involving reading or listening under difficult conditions, such as listening to different kinds of information presented to the two ears at the same time (dichotic listening).

Since the 1990s, there has been an enormous shift in the field of neurolinguistics. With modern technology, researchers can study how the brains of normal speakers process language, and how a damaged brain processes and compensates for injury. This new technology allows us to track the brain activity that is going on while people are reading, listening, and speaking, and also to get very fine spatial resolution of the location of damaged areas of the brain. Fine spatial resolution comes from magnetic resonance imaging (MRI), which gives exquisite pictures showing which brain areas are damaged; the resolution of CT scans has also improved immensely. Tracking the brain’s ongoing activity can be done in several ways. For some purposes, the best method is detecting the electrical and magnetic signals that neurons send to one another by using sensors outside the skull (functional magnetic resonance imaging, fMRI; electro-enecephalography, EEG; magnetoencephalography, MEG; and event-related potentials, ERP). Another method is observing the event-related optical signal, EROS; this involves detecting rapid changes in the way that neural tissue scatters infra-red light, which can penetrate the skull and see about an inch into the brain. A third family of methods involves tracking the changes in the flow of blood to different areas in the brain by looking at oxygen concentrations (BOLD) or at changes the way in which the blood absorbs near-infrared light (near-infrared spectroscopy, NIRS). Brain activity can also be changed temporarily by transcranial magnetic stimulation (stimulation from outside the skull, TMS), so researchers can see the effects of this stimulation on how well people speak, read, and understand language. NIRS, EROS, ERP, and EEG techniques are risk-free, so they can ethically be used for research on normal speakers, as well as on people with aphasia who would not particularly benefit by being in a research study. TMS also appears to be safe.

It is very complicated to figure out the details of how the information from different parts of the brain might combine in real time, so another kind of advance has come from the development of ways to use computers to simulate parts of what the brain might be doing during speaking or reading.

Investigations of exactly what people with aphasia and other language disorders can and cannot do also continue to contribute to our understanding of the relationships between brain and language. For example, comparing how people with aphasia perform on tests of syntax, combined with detailed imaging of their brains, has shown that there are important individual differences in the parts of the brain involved in using grammar. Also, comparing people with aphasia across languages shows that the various types of aphasia have somewhat different symptoms in different languages, depending on the kinds of opportunities for error that each language provides. For example, in languages that have different forms for masculine and feminine pronouns or masculine and feminine adjectives, people with aphasia may make gender errors in speaking, but in languages that don’t have different forms for different genders, that particular problem can’t show up.

Neurolingistics may be chatracterised as the study of the neural basis of Language, the role neurons play in Linguitic Processes is the focus of this field. Neurons may be described as a class of cells biologically programmed to receive and transmit information from neighbouring nerve cells, gland cells and muscles to the brain for interpretation and processing, they also transmit information from the Brain to the rest of the body. The Human Brain is constituted of about a 100 billion neurons at birth, these are the basis for the functioning of the Brain of any species, thus a study of the neural basis of Language is more or less a study of Language in relation to the Brain. The human possession of a Central Nervous System which can acquire and process Language gives the Human species his most unique feature.

NLP in review :

Get a better understanding of what makes you and others tick Essential NLP gives you straightforward access to understanding NLP and helps you to put the ideas and techniques into practice in your personal and professional life, both in behavior and in important relationships.Neuro-linguistic programming is a way of changing someone’s thoughts and behaviors to help achieve desired outcomes for them.

The popularity of neuro-linguistic programming or NLP has become widespread since it started in the 1970s. Its uses include treatment of phobias and anxiety disorders and improvement of workplace performance or personal happiness.

NLP can be used for personal development, phobias, and anxiety.

NLP uses perceptual, behavioral, and communication techniques to make it easier for people to change their thoughts and actions.

NLP relies on language processing but should not be confused with natural language processing, which shares the same acronym.

NLP was developed by Richard Bandler and John Grinder, who believed it was possible to identify the patterns of thoughts and behaviors of successful individuals and to teach them to others.

Despite a lack of empirical evidence to support it, Bandler and Grinder published two books, The Structure of Magic I and II, and NLP took off. Its popularity was partly due to its versatility in addressing the many diverse issues that people face.

How does it work?

The varying interpretations of NLP make it hard to define. It is founded on the idea that people operate by internal “maps” of the world that they learn through sensory experiences.

NLP tries to detect and modify unconscious biases or limitations of an individual’s map of the world.

NLP is not hypnotherapy. Instead, it operates through the conscious use of language to bring about changes in someone’s thoughts and behavior.

For example, a central feature of NLP is the idea that a person is biased towards one sensory system, known as the preferred representational system or PRS.

Therapists can detect this preference through language. Phrases such as “I see your point” may signal a visual PRS. Or “I hear your point” may signal an auditory PRS.

An NLP practitioner will identify a person’s PRS and base their therapeutic framework around it. The framework could involve rapport-building, information-gathering, and goal-setting with them.

Techniques

NLP is a broad field of practice. As such, NLP practitioners use many different techniques that include the following:

Psychologist during therapy session with female patient

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One of the techniques of NLP is to attempt to remove negative thoughts and feelings linked to a past event.

Anchoring: Turning sensory experiences into triggers for certain emotional states.

Rapport: The practitioner tunes into the person by matching their physical behaviors to improve communication and response through empathy.

Swish pattern: Changing patterns of behavior or thought to come to a desired instead of an undesired outcome.

Visual/kinesthetic dissociation (VKD): Trying to remove negative thoughts and feelings associated with a past event.

Examples

NLP is used as a method of personal development through promoting skills, such as self-reflection, confidence, and communication.

Practitioners have applied NLP commercially to achieve work-orientated goals, such as improved productivity or job progression.

More widely, it has been applied as a therapy for psychological disorders, including phobias, depression, generalized anxiety disorders or GAD, and post-traumatic stress disorder or PTSD.

Does NLP work?

smiling young man holding coffee cup

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So far, there has not been any rigorous research to prove the effectiveness of NLP.

Determining the effectiveness of NLP is challenging for several reasons.

NLP has not been subject to the same standard of scientific rigor as more established therapies, such as cognitive behavioral therapy or CBT.

The lack of formal regulation and NLP’s commercial value mean that claims of its effectiveness can be anecdotal or supplied by an NLP provider. NLP providers will have a financial interest in the success of NLP, so their evidence is difficult to use.

Furthermore, scientific research on NLP has produced mixed results.

Some studies have found benefits associated with NLP. For example, a study published in the journal Counselling and Psychotherapy Research found psychotherapy patients had improved psychological symptoms and life quality after having NLP compared to a control group.

However, a review published in The British Journal of General Practice of 10 available studies on NLP was less favorable.

It concluded there was little evidence for the effectiveness of NLP in treating health-related conditions, including anxiety disorders, weight management, and substance misuse. This was due to the limited amount and quality of the research studies that were available, rather than evidence that showed NLP did not work.

In 2014, a report by the Canadian Agency for Drugs and Technology in Health found no clinical evidence for the effectiveness of NLP in the treatment of PTSD, GAD, or depression.

However, a further research review published in 2015 did find NLP therapy to have a positive impact on individuals with social or psychological problems, although the authors said more investigation was needed.

The theoretical basis for NLP has also attracted criticism for lacking evidence-based support.

A paper published in 2009 concluded that after three decades, the theories behind NLP were still not credible, and evidence for its effectiveness was only anecdotal.

A 2010 review paper sought to assess the research findings relating to the theories behind NLP. Of the 33 included studies, only 18 percent were found to support NLP’s underlying theories.

So, despite more than 4 decades of its existence, neither the effectiveness of NLP or the validity of the theories have been clearly demonstrated by solid research.

Also, it is worth noting, that research has mainly been conducted in therapeutic settings, with few studies into the effectiveness of NLP in commercial environments.

Studying how well NLP works has several practical issues as well, adding to the lack of clarity surrounding the subject. For example, it is difficult to directly compare studies given the range of different methods, techniques, and outcomes.

Take home

NLP has become very popular over the years. This popularity may have been driven by the fact that practitioners can use it in many different fields and contexts.

However, the broad ideas that NLP is built upon, and the lack of a formal body to monitor its use, mean that the methods and quality of practice can vary considerably. In any case, clear and impartial evidence to support its effectiveness has yet to emerge.

For these reasons, it is possible that good marketing has also contributed to the widespread popularity of NLP, particularly in the commercial sector.