

Neurolinguistics: Comparative study of language processing in English and Uzbek

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Abstract: The article analyses that neurolinguistics is the study of how first (L1) and additional languages are represented and processed in the brain. The main goals and objectives of the article are formulated. It is an interdisciplinary field with significant input from neuroscience, linguistics, psychology, speech-language pathology, and biology. Neurolinguistics plays an important role in the field of second language (L2) acquisition. The study focuses on the role of neuroscientific approaches to applied linguistics, along with many methods that can be used to study language and brain in English and Uzbek language. (1)

Keywords: neuroscience, neurolinguistics, brain and language, second language acquisition, second language proficiency, electroencephalogram, magnetoencephalography, aphasia, dyslexia

Introduction: Neurolinguistics studies the relation of language and communication to different aspects of brain function, in other words it tries to explore how the brain understands and produces language and communication. It involves attempting to combine neurological/neurophysiological theory (how the brain is structured and how it functions) with linguistic theory (how language is structured and how it functions). Apart from neurology and linguistics, psychology is another central source discipline for neurolinguistics. Neurolinguistics has a very close relationship to psycholinguistics, but focuses more on studies of the brain. Studies of language and communication after brain damage are perhaps the most common type of neurolinguistic studies. In addition, neurolinguistics has a fundamental clinical impact for assessment and treatment of patients suffering from aphasia and other language pathologies.(2) Language processing can vary across different languages because each language possesses its own phonological, morphological and syntactic feature. English an analytic language that relies heavily on word order, whereas Uzbek is an agglutinative language in which grammatical meanings are expressed through affixes. The study investigates these structural differences are represented and processed in the brain.

Literature review: Even the briefest of overviews of the history of neurolinguistics (much older a scientific field than the modern name would suggest, dating back to antique) must include the names of Pierre Paul Broca (1824-1880) and his famous patient monsieur Leborgne, more commonly known as monsieur Tan. Due to severe epileptic attacks, monsieur Leborgne was unable to produce any language, except for the syllable 'tan' (hence the nickname), but seemed to have otherwise perfectly normal cognitive abilities and his non-verbal responses were both coherent and appropriate.

Postmortem examination of monsieur Tan's brain revealed a lesion in the posterior part of the frontal left-hemisphere lobe, later called Broca's area (Fig. 1). Broca concluded that this brain area is responsible for language processing. The type of aphasia - inability to produce language, with retained comprehension abilities, is still referred to as Broca's aphasia. Some decades later Carl Wernicke (1848-1905) researched for his doctoral thesis patients suffering aphasia different from Broca's - while able to speak rapidly and fluently (though incomprehensibly) these patients seemed unable to comprehend language, with the inability varying in degree and specificity. Postmortems revealed lesions in the temporal area of the left hemisphere. Based on this discovery, Wernicke posited that the

two areas are involved in different aspects of language processing, with Broca's area being mostly responsible for language production and Wernicke's area - the center of language comprehension.(3)

Method: This research focuses on the comparative analysis of neurolinguistics in English and Uzbek language. Neurolinguistic theories explain how our brains process language. Learners' proficiency is a crucial aspect, which must be dealt with by any research on the neuro-cognition of the teaching-acquisition interface. In neurolinguistics studies, proficiency is often utilized as a variable in order to explain changes in the brain following instruction. It can be generally agreed that the term proficiency refers to the extent to which L2 learners master the second language at definite points in time. (4) There are different approaches to studying language processing, including behavioral, electrophysiological, and neuroimaging methods. Behavioral methods involve observing language processing through tasks, such as sentence comprehension or word association. Electrophysiological methods involve recording electrical activity in the brain, such as with an electroencephalogram (EEG) or magnetoencephalography (MEG). Neuroimaging methods involve imaging the brain, such as functional magnetic resonance imaging (fMRI) or positron emission tomography (PET). (5) These different methods allow researchers to examine different aspects of language processing, from the initial perception of sounds to the comprehension of sentences.

Results: The analysis revealed several key findings regarding typological differences that matter for brain.

1. **Syntax and word order:** English language investigates Subject - Verb - Object. For example, "The cat chased the mouse." In Uzbek language Subject - Object - Verb. For example, "Mushuk sichqonni ta'qib etdi." Studies show that languages with different canonical word orders (SVO vs SOV) produce different activation patterns during sentence comprehension.

2. **Morphological complexity:** In English language; relatively simple, with limited inflection. For instance, go - went - gone. Uzbek morphology investigates agglutinative, with extensive affixation. For instance, kitob-lar-imiz -dan = ("from our books") where kitob - book, -lar = plural, -imiz = our, -dan = from. Agglutinative morphology tends to require greater morphological decomposition. Processing of morphemes might recruit more posterior temporal and inferior frontal regions.

3. **Orthographic Transparency / Phonology:** English is relatively opaque: irregular spellings, inconsistent mapping between graphemes and phonemes (e.g. though, through, tough). Stress patterns also irregular. Uzbek orthography is more regular, phoneme-grapheme correspondence clearer; vowel harmony and predictable affixation. Neuroimaging work comparing transparent vs opaque orthographies (e.g. English vs Italian / Hindi) shows different patterns of brain activation - more phonological assembly, less lexical/semantic reliance in transparent cases.(6)

Discussion: Research has shown that different aspects of language, such as grammar and semantics, are processed in different regions of the brain. For example, the left inferior frontal gyrus is involved in syntactic processing, or the processing of sentence structure, while the left temporal lobe is involved in semantic processing, or the processing of meaning. This information can be used to develop new approaches to language learning and therapy that target specific aspects of language processing.

Aphasia is an important object of study in neurolinguistics, and sensory aphasia is one of its main types. Unlike Broca's aphasia, sensory aphasia arises as a result of damage to the area of the brain responsible for phonological analysis, disrupting the phonemic level of speech production. In English: Aphasia often disrupts word order and the use of function words (e.g., articles, prepositions). For example: Broca's aphasic speaker may produce "boy... chase... dog" instead of "The boy is chasing the dog." English patients with morphological impairments typically struggle with irregular

forms (go-went, run-ran), plural -s, and tense -ed.(7) In Uzbek: Because Uzbek is agglutinative and relies on affixes, aphasia often disrupts suffixation and case marking. For example, A patient may say kitob... o‘qimoq (“book... read”) instead of the correct kitobni o‘qidim (“I read the book”), omitting case (-ni) and person/tense endings (-dim). Errors often involve dropping or misusing affixes, which may lead to grammatically “bare” stems. Aphasia research in different typologies reveals that the brain regions damaged (e.g., Broca’s area, left temporal cortex) may be the same across languages, but the surface symptoms depend on the linguistic structure.

Dyslexia is a developmental disorder that impairs accurate and fluent reading, often linked to phonological processing deficits. In English: English has deep orthography (irregular spelling-sound mapping). Dyslexic readers struggle with inconsistent words (cough, tough, though) and irregular stress patterns. Neuro-imaging shows reduced activation in left phonological decoding and occipito-temporal “visual word form area.” In Uzbek: Uzbek has a transparent orthography (letters map consistently to sounds). Dyslexic readers in Uzbek show fewer irregular word errors but still struggle with phonological segmentation, syllable structure, or morphological parsing. For example: A dyslexic reader may mis-segment kitoblarimizdan (“from our books”), skipping affixes or confusing morpheme boundaries.(8)

Conclusion: Neurolinguistics is a multidisciplinary field that combines linguistics, psychology, neuroscience, and computer science to understand the neural mechanisms that underlie language processing. It has led to a greater understanding of how the brain processes different aspects of language, such as grammar and semantics, and has important implications for language learning and therapy. By understanding how the brain processes language, we can develop more effective and efficient approaches to language learning and therapy that target specific aspects of language processing.(9) The comparative analysis of neurolinguistics in English and Uzbek highlights the intricate relationship between language typology and brain mechanisms of processing. Although the fundamental neural architecture of language - involving regions such as Broca’s area, Wernicke’s area in which these networks are engaged vary depending on the structural features of each language.(10)

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