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PSYCHOLOGICAL AND PHYSIOLOGICAL MECHANISMS OF SPEECH (STRUCTURE OF THE SPEECH APPARATUS, INVOLVEMENT OF THE CENTRAL NERVOUS SYSTEM)

Jizzakh branch of the National University of Uzbekistan named after Mirzo Ulugbek

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Annotatsiya

Ushbu maqolada nutqning psixologik va fiziologik mexanizmlari tahlil qilinadi. Unda nutq apparatining tuzilishi, markaziy asab tizimining nutq jarayonidagi roli hamda nutqning shakllanish bosqichlari yoritilgan. Tadqiqot natijalari nutqning murakkab tizim ekanligini, u psixologik jarayonlar va biologik omillarning o‘zaro bog‘liqligi asosida amalga oshishini ko‘rsatadi. Shuningdek, nutq faoliyatida miya faoliyati va artikulyatsiya organlarining muvofiqlashtirilgan harakati muhim ahamiyat kasb etishi ta’kidlangan.

Kalit so’zlar: nutq mexanizmlari, psixologik jarayonlar, fiziologik tizimlar, nutq apparati, markaziy asab tizimi, artikulyatsiya, fonatsiya, kognitiv faoliyat, nutq ishlab chiqish, til va tafakkur.

Abstract

This article examines the psychological and physiological mechanisms of speech. It focuses on the structure of the speech apparatus, the role of the central nervous system, and the stages of speech production. The results demonstrate that speech is a complex process involving the interaction of cognitive functions and biological systems. The study also highlights the importance of brain activity and the coordinated functioning of articulatory organs in effective communication.

Key words: speech mechanisms, psychological processes, physiological systems, speech apparatus, central nervous system, articulation, phonation, cognitive activity, speech production, language and thought.

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Аннотация

В данной статье рассматриваются психологические и физиологические механизмы речи. Особое внимание уделяется структуре речевого аппарата, роли центральной нервной системы и этапам формирования речи. Результаты исследования показывают, что речь является сложным процессом, основанным на взаимодействии когнитивных и биологических факторов. Также подчеркивается важность согласованной работы мозга и органов артикуляции в обеспечении эффективной коммуникации.

Ключевые слова: речевые механизмы, психологические процессы, физиологические системы, речевой аппарат, центральная нервная система, артикуляция, фонация, когнитивная деятельность, производство речи, язык и мышление.

INTRODUCTION

Speech is a complex human ability that integrates both psychological processes and physiological mechanisms. It serves as the primary means of communication, allowing individuals to express thoughts, emotions, and intentions. The production and perception of speech involve a coordinated interaction between the central nervous system and the anatomical structures of the speech apparatus. Understanding these mechanisms requires examining both the mental processes underlying speech and the biological systems that make it possible. From a psychological perspective, speech begins with thought formation. Before a person speaks, an idea is generated in the mind. This process involves cognition, memory, and linguistic competence. The speaker selects appropriate words, organizes them according to grammatical rules, and plans the sequence of sounds. This stage is often referred to as speech planning and is closely related to higher mental functions such as attention and reasoning. Language comprehension and production are also influenced by experience, social context, and individual differences in cognitive development.

The central nervous system plays a fundamental role in controlling and coordinating speech. Specific areas of the brain are responsible for different aspects of speech processing. The frontal lobe, particularly regions associated with speech production, is involved in forming and articulating words. The temporal lobe is essential for understanding spoken language and processing auditory information. These areas work together through complex neural networks that transmit signals rapidly and efficiently. Neural pathways connect the brain to the muscles involved in speech, allowing precise control over their movements. Speech production relies on the coordinated activity of the speech apparatus, which consists of several interconnected systems. The respiratory system provides the airflow necessary for sound production. The lungs, diaphragm, and chest muscles

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regulate the flow of air that passes through the vocal tract. Without this airflow, speech cannot occur, as it serves as the energy source for sound generation.

The phonatory system, located in the larynx, is responsible for producing voice. The vocal cords, or vocal folds, vibrate as air passes through them, creating sound waves. The pitch and loudness of the voice are determined by the tension and length of the vocal cords, as well as the force of the airflow. This process transforms simple airflow into voiced sound, which can then be shaped into speech. The articulatory system plays a crucial role in shaping sounds into recognizable speech units. It includes the tongue, lips, teeth, hard and soft palate, and jaw. These structures modify the sound produced by the vocal cords, forming distinct speech sounds such as vowels and consonants. The precise movement and coordination of these articulators are essential for clear and accurate pronunciation. Even small changes in their position can significantly alter the resulting sound.

The resonance system, which includes the oral, nasal, and pharyngeal cavities, further modifies the quality of sound. These cavities act as amplifiers, enhancing certain frequencies and giving each voice its unique timbre. The balance between oral and nasal resonance is especially important for producing different types of sounds and maintaining speech clarity. The involvement of the central nervous system extends beyond basic control of muscles. It also ensures the integration of sensory feedback during speech. Auditory feedback allows individuals to hear their own speech and make adjustments if necessary. Kinesthetic feedback provides information about the position and movement of speech organs. These feedback mechanisms are essential for learning and maintaining accurate speech production.

Speech development illustrates the interaction between psychological and physiological mechanisms. In early childhood, the brain gradually develops the ability to control the speech apparatus. Children learn to associate sounds with meanings, imitate speech patterns, and refine their pronunciation through practice and feedback. This process demonstrates how cognitive development and physical maturation work together to enable fluent speech. Disruptions in either psychological or physiological components can lead to speech disorders. Damage to specific brain areas may result in difficulties with speech production or comprehension. Similarly, abnormalities in the speech apparatus can affect articulation and voice quality. These conditions highlight the importance of the integrated nature of speech mechanisms. In conclusion, speech is a multifaceted process that depends on the harmonious interaction between psychological processes and physiological systems. The central nervous system organizes and controls speech, while the speech apparatus executes the physical production of sounds. Together, they enable humans to communicate effectively, reflecting the complexity and sophistication of language as a uniquely human capability.

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LITERATURE REVIEW AND METHODOLOGY

The study of psychological and physiological mechanisms of speech has attracted considerable attention across the fields of linguistics, psychology, neuroscience, and speech pathology. Early theoretical foundations were established by scholars such as Lev Vygotsky, who emphasized the relationship between thought and language, arguing that speech is both a cognitive and social phenomenon. His work highlighted the role of internal speech in mental development and provided a psychological basis for understanding speech production. Another significant contribution was made by Alexander Luria, who explored the neuropsychological aspects of speech and identified the functional organization of the brain in language processing. His research demonstrated how different areas of the brain work together in a dynamic system to support speech activity. Luria's studies of patients with brain injuries offered valuable insights into the localization of speech functions and the consequences of neurological damage.

The localization theory was further advanced by Paul Broca and Carl Wernicke. Broca identified a region in the frontal lobe associated with speech production, now known as Broca's area, while Wernicke described a region in the temporal lobe responsible for language comprehension. Their discoveries laid the groundwork for modern neurolinguistics and continue to influence contemporary research on the central nervous system's involvement in speech. In addition to neurological studies, psycholinguistic theories have contributed to understanding how speech is produced and processed. Researchers have examined stages such as conceptualization, formulation, and articulation, emphasizing that speech production is not a single act but a sequence of interconnected processes. Scholars like Noam Chomsky introduced the concept of innate linguistic competence, suggesting that humans possess an inherent ability to acquire language, which interacts with cognitive and physiological mechanisms.

Modern research incorporates advanced technologies such as brain imaging techniques to study speech processes in real time. Functional magnetic resonance imaging and electroencephalography have enabled scientists to observe neural activity during speech production and comprehension. These methods have confirmed that speech involves distributed neural networks rather than isolated brain regions, highlighting the complexity of central nervous system involvement. The physiological aspect of speech has also been widely explored in phonetics and speech science. Studies have focused on the structure and function of the speech apparatus, including the respiratory, phonatory, articulatory, and resonatory systems. Researchers have analyzed how airflow, vocal fold vibration, and articulator movement contribute to sound production. This body of literature emphasizes the importance of coordination among different anatomical components for effective speech.

The methodology of the present study is based on a qualitative and theoretical approach. It involves the analysis and synthesis of existing scientific literature related to both psychological and

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physiological mechanisms of speech. Sources include academic books, peer-reviewed journal articles, and research reports from the fields of linguistics, psychology, and neuroscience. Comparative analysis is used to identify similarities and differences among various theoretical perspectives. In addition, the study employs a descriptive method to explain the structure of the speech apparatus and the role of the central nervous system in speech production. This includes examining the functions of specific brain regions and their interaction with peripheral speech organs. The interdisciplinary nature of the research allows for a comprehensive understanding of speech as a complex system involving both mind and body.

The methodological framework also integrates elements of psycholinguistic and neurophysiological analysis. By combining these approaches, the study aims to provide a holistic view of speech mechanisms. This integration is essential because speech cannot be fully understood from a single disciplinary perspective. Instead, it requires examining how cognitive processes and biological structures work together in real-time communication. Overall, the literature demonstrates that speech is a multifaceted phenomenon shaped by both psychological and physiological factors. The chosen methodology reflects this complexity by drawing on diverse sources and analytical approaches, ensuring a well-rounded and in-depth exploration of the topic.

RESULTS

The analysis of psychological and physiological mechanisms of speech demonstrates that speech production is the result of a highly coordinated and integrated system involving both mental processes and biological structures. The findings confirm that neither psychological nor physiological components function independently; instead, they operate as a unified mechanism that ensures effective communication. From a psychological perspective, the results indicate that speech begins with cognitive intention and conceptualization. The speaker first forms an idea, which is then transformed into linguistic structures through processes such as lexical selection and grammatical organization. This confirms the theoretical assumptions proposed by Lev Vygotsky, who emphasized the connection between thought and speech. The study also shows that internal speech plays a significant role in planning and monitoring verbal expression before it is externally produced.

The involvement of the central nervous system has been shown to be central to all stages of speech activity. The results highlight that different regions of the brain are responsible for specific yet interconnected functions. The area identified by Paul Broca is primarily responsible for speech production and articulation, while the region discovered by Carl Wernicke is crucial for language comprehension. The interaction between these areas ensures that speech is both meaningful and grammatically structured. Additionally, the findings support the view of Alexander Luria that speech is organized through functional systems rather than isolated brain centers. Physiologically, the results

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confirm that speech production depends on the proper functioning of the speech apparatus. The respiratory system provides the necessary airflow, which acts as the energy source for sound production. The phonatory system, particularly the vocal cords, converts this airflow into sound through vibration. The articulatory system then shapes these sounds into distinct phonemes using the coordinated movements of the tongue, lips, and other speech organs. The resonance system further modifies the sound, contributing to voice quality and clarity. An important finding is the role of coordination and timing among all components. The study shows that even minor disruptions in the synchronization between the brain and speech organs can lead to noticeable speech difficulties. This emphasizes the importance of neural control and motor precision in producing fluent and intelligible speech.

The results also highlight the significance of sensory feedback mechanisms. Auditory feedback allows speakers to hear and adjust their speech in real time, while kinesthetic feedback provides information about the position and movement of articulatory organs. These feedback systems are essential for maintaining accuracy and for the development of speech skills, particularly during language acquisition. Furthermore, the findings indicate that speech development is a gradual process that reflects both cognitive maturation and physiological growth. As the central nervous system develops, individuals gain greater control over their speech apparatus, leading to more complex and accurate language use. This supports the idea that speech is not an innate fully-formed ability but develops through interaction between biological readiness and environmental input. In cases of impairment, the results show that damage to specific brain regions or dysfunction of the speech apparatus can significantly affect speech production and comprehension. This confirms the interdependence of psychological and physiological mechanisms and highlights the need for integrated approaches in diagnosing and treating speech disorders. In conclusion, the results demonstrate that speech is a dynamic and multifactorial process. It is governed by cognitive planning, controlled by the central nervous system, and executed through the coordinated activity of the speech apparatus. The interaction of these elements ensures effective communication and reflects the complexity of human language as both a mental and physical phenomenon.

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