



Neurobiological Nature of Speech Problem and Experimental Analysis

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Abstract: Dyslexia is a specific reading disorder characterized by difficulties in accurate and fluent word recognition, as well as in decoding and spelling skills, and is a significant problem in education worldwide. The article emphasizes the need to take into account sociocultural factors and calls for international exchange of experience to improve the identification and support of individuals with dyslexia worldwide.

Keywords: Dyslexia, diagnosis, diagnostic tests, assessment methods, bilingualism and multilingualism.

Introduction: Regardless of cultural and linguistic boundaries, dyslexia affects a significant percentage of the population of children and adults, seriously affecting their academic performance, social adaptation and future life opportunities. Statistics from different countries show that the prevalence of this neurobiological condition is high, ranging from 5% to 17% of the population, according to various estimates. These figures highlight that dyslexia is not only an individual problem, but also a global challenge that requires serious attention from educators, researchers, policymakers and society as a whole. Lack of timely diagnosis and adequate support can lead to frustration, low self-esteem, mental health problems and limited educational and professional trajectories for millions of people worldwide (1).

Thus, a comprehensive international study and comparative analysis of existing dyslexia diagnostic methods is a necessary step towards developing more effective and universal strategies for identifying and supporting individuals with this common reading disorder.

The fundamental understanding of dyslexia as a neurobiological and often heritable disorder has provided the basis for many studies aimed at identifying its cognitive and linguistic markers. Despite the general definition, the phenotypic manifestation of dyslexia can vary depending on the specific characteristics of the language. For example, in languages with transparent orthographies, where there is an unambiguous correspondence between letters and sounds (such as Finnish or Italian), difficulties may mainly manifest themselves in reading speed and fluency. In languages with opaque orthographies, where the relationships between letters and sounds are complex and unclear (such as English or French), decoding and spelling errors may predominate.

These linguistic differences directly affect which aspects of language skills are assessed in the diagnostic process. Tests developed to detect dyslexia in one language may be invalid or ineffective when used in another language environment. In addition, cultural norms and expectations regarding reading and writing achievement may also influence how reading difficulties are recognized and interpreted. In this regard, studying the different methods of diagnosing dyslexia in a global context allows us to identify potential universal indicators and best practices that can be adapted to different linguistic and cultural environments, while also identifying existing differences. Understanding these nuances is crucial to ensuring that everyone who needs help, regardless of their background or language of instruction, receives a fair and timely diagnosis (2, 56).

A brief overview of the concept of dyslexia and its impact on education and society. Dyslexia is a neurobiological disorder characterized by persistent difficulties in reading, writing, and spelling, despite adequate intellectual ability and adequate educational conditions. At its core, dyslexia is associated with a deficit in phonological processing - the ability to recognize and manipulate speech sounds. This makes it difficult to establish associations between sounds and letters (graphemes), which are extremely important for acquiring reading and writing skills. It is worth noting that dyslexia is not a consequence of a lack of motivation, vision, or hearing problems, but rather a specific feature of cognitive development.

The impact of dyslexia extends far beyond academic achievement. In terms of education, children and adults with dyslexia may experience significant difficulties in mastering a curriculum that requires the active use of reading and writing. This can lead to a decrease in mastery of various subjects, a loss of interest in reading, the development of a sense of

inferiority, and ultimately a limitation of educational opportunities. Undiagnosed and uncompensated dyslexia can be a serious obstacle to higher education and professional growth.

The impact of dyslexia on the social side is also quite significant. Difficulties in reading and writing can make it difficult to communicate in everyday life, understand instructions, complete documents, and participate in various social activities that require literacy. The frustration, shame, and low self-esteem that often accompany undiagnosed dyslexia can negatively affect interpersonal relationships, social adjustment, and overall quality of life. In adulthood, dyslexia can hinder professional growth and limit opportunities for full participation in society.

Thus, dyslexia is not only a learning problem, but also a factor that has a profound and multifaceted impact on the trajectories of a person's educational and social development. Timely and accurate diagnosis, taking into account linguistic and cultural characteristics, plays an important role in providing the necessary support to people with dyslexia and creating conditions for them to fully realize their potential (5, 98).

The main methods of diagnosing dyslexia in different countries. North America (USA and Canada). In the USA and Canada, the diagnosis of dyslexia is usually carried out within the school system or by private specialists (psychologists, neuropsychologists, speech therapists). Diagnostic methods are characterized by several key features:

Emphasis on psychometric assessment: The diagnostic process often involves standardized tests that assess a variety of cognitive and language skills known to be associated with dyslexia. These include:

Reading skills: Reading accuracy of individual words and text, reading fluency (speed and expressiveness), and reading comprehension. Tests such as the Woodcock-Johnson IV Tests of Achievement, the Wechsler Individual Achievement Test (WIAT-III), and the Test of Word Reading Efficiency (TOWRE) are used.

Phonological skills: Phonological awareness (the ability to recognize and manipulate speech sounds), phonological memory (the ability to store and reproduce sound information), and phonological access speed (the speed at which phonological information is retrieved from long-term memory) are assessed. Examples include the Comprehensive Test of Phonological Processing (CTOPP-2). The ability to write individual words and texts, as well as knowledge of spelling rules, is assessed.

Intellectual abilities: Although dyslexia is not associated with low intelligence, general intellectual level is often

assessed (for example, using the Wechsler Intelligence Scale for Children - WISC or Woodcock-Johnson IV Tests of Cognitive Abilities) to exclude intellectual disability as the main cause of reading difficulties. The difference between intellectual abilities and reading and writing achievement is one of the diagnostic criteria.

Response to Intervention (RTI) model: In recent decades, the Response to Intervention (RTI) model has become widespread in the United States and, to a lesser extent, in Canada. RTI is a multi-level approach to early identification and support for students with reading difficulties, including those at risk for developing dyslexia. Within the framework of RTI, the learning of all students is regularly monitored, scientifically based teaching methods and interventions are provided at varying levels of intensity, and the student's response to this intervention is assessed. Lack of adequate progress despite intensive intervention may be an indicator of possible dyslexia and a basis for further in-depth diagnosis.

Role of professional organizations: Organizations such as the International Dyslexia Association (IDA) play an important role in developing and disseminating evidence-based recommendations for the diagnosis and treatment of dyslexia. Their definitions and criteria are often used as a reference by professionals.

Legislation and educational standards: In the United States, federal legislation, such as the Individuals with Disabilities Education Act (IDEA), guarantees the right of children with dyslexia to receive special education and related services. This legislation also affects diagnostic procedures and the identification of educational needs. In Canada, educational standards and diagnostic methods may vary by province. In general, the diagnosis of dyslexia in North America is characterized by a comprehensive approach based on the use of standardized testing of cognitive and language skills, combined with an assessment of response to educational intervention.

Europe (UK, Germany, France, Scandinavian countries). The methods of diagnosing dyslexia in Europe show considerable diversity, reflecting linguistic differences between languages, the specificities of national education systems and historical traditions in special education.

UK: Strong emphasis on phonological awareness: In the UK, the diagnosis of dyslexia has traditionally placed a strong emphasis on the assessment of phonological skills, such as phonemic segmentation, blending, sound manipulation and phonological memory. Deficits in these areas are considered to be a

key factor underlying dyslexia. Screening tests are often used in schools to identify children at risk of developing dyslexia early. These tests can assess the basic skills of reading, writing and phonological abilities. Diagnosis is usually carried out by qualified educational psychologists or dyslexia specialists, who use a comprehensive approach that includes history taking, observation of learning and results from standardised tests. In the UK, the broader term "Specific Learning Difficulties" (SpLD) is often used, which includes dyslexia, dysgraphia and dyscalculia. The diagnostic process aims to differentiate between these conditions and identify the specific needs of the learner. Organisations such as the British Dyslexia Association (BDA) play an important role in developing diagnostic guidelines and standards.

Germany: Focus on linguistic analysis of errors: In Germany, diagnosis often involves a detailed analysis of reading and writing errors, identifying specific patterns such as phonics errors, letter omissions or additions. There are a number of standardized tests in German that assess various aspects of reading, writing, phonological skills, and visual-spatial abilities. The diagnosis is usually carried out by school psychologists in collaboration with teachers and special educators. In some cases, a doctor's opinion (e.g. a pediatrician or child psychiatrist) may be required to confirm the diagnosis and determine the need for medical intervention or further testing.

France: Influence of the specific features of the French language: Although French has a relatively transparent orthography, there are certain difficulties with pronunciation and grammatical rules. The diagnosis takes these linguistic features into account. In addition to reading accuracy, great attention is paid to reading speed and comprehension of the text read. In France, speech therapists play an important role in the diagnosis and correction of dyslexia and other speech and language disorders. They conduct a comprehensive examination of language and cognitive skills. Diagnosis is often made in collaboration between school doctors, psychologists, and speech therapists.

Scandinavian countries (Sweden, Norway, Denmark, Finland, Iceland): High level of awareness and support: Scandinavian countries have a high level of awareness of dyslexia and a well-developed system of support for students with special educational needs. There is a strong emphasis on early identification of children at risk of developing dyslexia through screening programs in preschool and primary schools. Standardized tests have been developed taking into account the specific features of the orthography and phonetics of the Scandinavian languages. For example, in Finnish, which has a very transparent orthography, diagnosis can focus

on reading speed and decoding automation. Diagnosis is often carried out by a team of specialists consisting of teachers, special educators, school psychologists and speech therapists. In Scandinavian countries, there is a strong desire to create an inclusive educational environment where students with dyslexia receive the necessary support within the regular classroom, rather than in special institutions.

In general, the methods of diagnosing dyslexia in Europe are characterized by diversity, which is related to linguistic and cultural factors. However, the general trend is towards early identification, the use of standardized assessments and interdisciplinary collaboration of specialists to provide adequate support to students with dyslexia.

Effective diagnosis of dyslexia on a global scale requires further international cooperation and exchange of experience. The development of neurobiological research, the potential of using information technologies, the development of universal diagnostic principles and the standardization of specialist training open up promising opportunities for improving the identification and support of people with dyslexia worldwide. Taking into account cultural and linguistic characteristics, as well as striving to create an inclusive educational environment, which ensures equal opportunities for all, regardless of neurobiological characteristics and language background, should be priorities in further research and practical work.

Despite the differences, the analysis revealed some common trends, such as the recognition of the importance of phonological skills, the use of psychometric assessment, and the pursuit of interdisciplinary collaboration. However, the lack of uniform international standards, difficulties in adapting instruments, and unequal access to diagnostic services remain serious challenges.

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