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PSYCHOLOGICAL MECHANISMS OF READING ACTIVITY DISABILITY IN CHILDREN WITH DYSLEXIA AGED 9–12 YEARS

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Introduction

Data from clinical observations and epidemiological studies over the past 20 years show a sharp rise in the prevalence of borderline neuropsychiatric disorders in children and adolescents, with disorders of residual organic genesis accounting for a sizable portion of these disorders (~40%) [10; 17; 92; 98]. The disorders categorized by V.V. Kovalev [45] as "syndromes of developmental disorders of separate systems" and which, among others, include the so-called "disorders of school skills development" (the term "disorders of learning skills development" is used less frequently) are widely represented among these disorders. It has become necessary to distinguish between specific and nonspecific kinds of school skills impairments due to research on the emergence of these disorders and the genetic, biological, and other developmental elements that influence them. In ICD-10, specific school skills disorders (F81) are categorized as follows: specific reading disorder (F81.0); spelling disorder (F81.1); arithmetic skills disorder (F81.2). There are also additional categories: mixed learning disorder (F81.3); expressive writing disorder (F81.8); unspecified learning disorder (F81.9).

The significance of studying school skills development disorders is indicated by their prevalence: based on existing data, different types of these disorders are present in 5-26% of students [12; 20; 90; 278]. Disorders related to the development of school skills are often accompanied by emotional and behavioral disorders [41, p.176; 47; 243; 244; 478], delinquent behavior [321], and difficulties adapting to school [7; 8; 26; 56]. Without timely psychological intervention, these disorders can have a detrimental impact on the individual's character, willpower, and self-esteem [121; 326; 497].

Dyslexia is the most severe of the learning skill impairments. The reading skill is crucial in school learning, and any impairment in this capacity can have a significant impact on the understanding of other courses. Furthermore, dyslexia is associated with several secondary psychogenic illnesses that contribute to or worsen difficulties in adapting to school [46; 47]. Many academics, discussing the intricacy of dyslexia, its multifaceted nature, and the numerous elements contributing to its

development, have concluded that the problem has not been well researched [47; 54; 112; 368; 369; 381; 471, etc.]. Dyslexia means "states which main manifestation is a persistent selective inability to master the reading skill, despite the sufficient level of intellectual and speech development, the absence of disorders of auditory and visual analyzers and optimal learning conditions" [42, p.36]. According to A.N. Kornev's data [47; 59], 5-6% of children in the Russian population suffer from dyslexia. In the global population, dyslexia is found in different studies to affect 5-15% of children [180; 287].

Clinical research has shown a high degree of comorbidity with dyslexia. Children with dyslexia face frustrating experiences in school, feeling helpless in the face of a constantly challenging curriculum. They also experience anxiety and a sense of guilt due to their own academic struggles and lack of success.

Many researchers note that reading disorders are accompanied by affective disorders, which are more significant the later dyslexia is diagnosed. In the same regard, one cannot fail to mention the results of studies demonstrating a serious maladaptive nature of dyslexia - according to available data, dyslexia increases the risk of deviant [148] and addictive behavior, in particular drug addiction [219; 499], Overall, compared to the general population, children with speech impairment are 2 times more likely to have behavioral impairment [47; 408]. Research has shown that children with dyslexia are at a much higher risk of developing emotional disorders, such as depression and anxiety [111; 362; 402]. Research conducted on a group of individuals who speak English has also shown that dyslexia has a detrimental effect on one's self-esteem and psychological well-being [139; 264; 265; 326; 403].

It is noteworthy that there is a scarcity of research focused on the examination of psychological and emotional dimensions of dyslexia in Russian-speaking children [47; 88]. The importance of examining children with dyslexia from a systemic-psychological standpoint is clear.

The significant ramifications of dyslexia on psychological well-being are not only linked to the inability to handle the academic curriculum but also to the overall importance of reading in human existence.

Reading is one of the fundamental foundations of the existence of a modern person, with which this person regularly encounters in texts and the need to process, analyze, understand it. Personality is largely constructe through reading, amd texts affect it: they guide, teach, and provide communication. Reading activity is access to public knowledge and experience. From this point of view, children with dyslexia find themselves in the "risk group" of limiting full social adaptation. The expressed difficulties in reading not only "fence them off from the centuries-old cultural heritage, but also create serious obstacles at a utilitarian, practical level" [55].

It is noteworthy that the majority of Soviet and Russian research on reading impairments in children, including dyslexia, focuses primarily on pedagogy. Simultaneously, the vast majority of research primarily examines the "outcome of reading," which includes fluency, the quantity and kind of errors, and the level of comprehension. The investigation of the dynamic and procedural components of reading and text comprehension in children with dyslexia is lacking.

Foreign research has verified the effectiveness of using gaze movement registration as a method to examine the procedural aspects of reading and the cognitive processes involved in text processing [137; 173; 270; 273; 390; 395; 398; 412]. The methodology enables real-time study of the course of reading activity with dynamic capabilities. The Just & Carpenter hypothesis posits that an individual's gaze orientation is indicative of their cognitive attention. In other words, the text fragment that is seen by the eye is a portion of the information being evaluated [280].

The activity approach has great prospects in the study of reading and its violations [70]. Reading is an activity prompted by a motive, implying a specific purpose (comprehension, searching for necessary information, etc.) and consisting of mental actions and operations taken by the reader in order to achieve it. In order to understand the written text, the reader goes through three stages of semantic analysis of the text, involving certain cognitive processing mechanisms [18; 468]: 1) creating micropropositions based on word decoding and processing the content of sentences. At this stage, the reader selects and creates the meaning of the words,

flowing into the subsequent conclusion, connecting the content side of the read words (creating a microproposition); 2) creating a macroproprositional text structure based on the synthesis of the micropropositions extracted at the first stage. At this stage, the reader integrates the sense blocks created during the first stage into larger ones; 3) checking the logical correctness and connectivity of the constructed text model. This stage includes actions that implement self-control of comprehension. Having discovered an error in constructing a semantic connection between macro-propositional structures of the text, the reader returns to certain fragments and re-analyzes, eliminating logical inaccuracies in the built model.

Eye-tracking enables us to conduct an unbiased examination of reading activity and related abnormalities by correlating mental actions and operations with gaze movement characteristics. This approach enables the examination of reading activity from a phenomenological perspective as well as facilitates a thorough investigation of reading and comprehension impairments in dyslexic children.

The acknowledgment of the intricate nature of the process of analyzing the meaning of text brings attention to the investigation of the cognitive requirements for reading. Research on individuals with typical reading abilities has demonstrated that both working memory [330; 447] and intellect [455] contribute to the effectiveness of reading comprehension. Several studies have shown that dyslexic children have a reduced working memory capacity compared to children without dyslexia [269; 289; 437]. Research on the working memory capacity of Russian-speaking children with dyslexia and its impact on the comprehension of written text is scarce [59; 105; 106]. Furthermore, it is crucial to acknowledge that the issue regarding the precise nature of memory impairment in dyslexic children is still unresolved. Several studies have demonstrated that dyslexic children exhibit a working memory loss specifically while learning stimuli associated with letters and words [332], but other studies have indicated a general working memory impairment when memorizing any type of stimulus [194; 222]. The present study aims to address the lack of research on the relationship between working memory level and semantic analysis of text in

Russian-speaking children with dyslexia. Additionally, the study aims to investigate the heterogeneity of results in previous studies on this topic.

The necessity of developing psychologically corrective programs, based on a thorough psychological understanding of reading disorders and their detrimental effects on dyslexic children's personalities, influences the importance of studying the clinical and psychological mechanisms of dyslexia. The development of these programs necessitates considering not only the cognitive characteristics of children with dyslexia but also the text's linguistic features and the tasks assigned to the child during reading activities. Several studies have demonstrated that the genre of written text [125; 380] and the task [341; 399] conditions have an impact on the comprehension of both dyslexic and non-dyslexic children. It is important to note that these studies evaluate the impact of these characteristics solely on the level of text comprehension, without taking into account their impact on the process of analyzing the text's meaning. Our study established its aim and objectives based on the relevance and significance of addressing the described challenges.

The study's aim is to comprehensively assess the processes by which children with dyslexia experience breaches of the procedural aspects of reading activity as well as its emotional aspects.

The objectives of the study are the following:

1. Operationalize the structure of the reading activity based on the principles of the psychological activity approach and the psycholinguistic theory of speech activity;
2. To conduct a comparative analysis of the reading technique parameters and the quality of comprehension of written text in children with dyslexia compared to their typically developing peers;
3. To conduct an analysis of the cognitive requirements for reading in children with dyslexia and their typically developing peers;
4. To examine the differences in the psychological characteristics of personality traits between children diagnosed with dyslexia and their typically-developing peers;
5. To examine the procedural aspects of reading activities in children with dyslexia

and their peers with typical reading abilities. This will be done by tracking eye movements as indicators of mental processes.
6. To analyze the relationship between the structural and functional characteristics of mental acts and operations and the achievement of reading proficiency.
7. To assess how the conditions of a reading activity, such as the type of task and the genre of the text, impact the structural and functional characteristics of mental acts and processes.

The object of the study is the organization of reading activity and its mechanisms in children aged 9–12 years.

The subject of the study is the mechanisms of disturbances in the organization of reading activity in children with dyslexia aged 9–12 years old.

Study hypotheses:

1. The reading difficulties experienced by children with dyslexia can be attributed to difficulties in decoding, constructing macropropositions, synthesizing macropropositions, and checking their contextual relevance and logical coherence.
2. The cognitive prerequisites of reading have an indirect impact on the process of text comprehension. The quality of comprehension is influenced by the effectiveness of mental actions and processes.
3. Children with dyslexia often demonstrate features such as anxiety, insecurity, social shyness, and tension.

Study methodological framework: The scientific developments of the study are based on the theoretical and methodological foundations of the activity approach in domestic psychology (A.N.Leontiev), the theory of speech activity (A.A. Leontiev, I.A. Zimnyaya), the model of the formation of the reading skill of T.G. Egorov, a model for comprehension the written text of van Dijk & Kinstch, the concept of dyslexia of A.N. Kornev, models of multiple working memory (Daneman, Tardif, Shah, Miyake), cognitive models of the connection of oculomotor movements and mental operations (Just, Carpenter, 1980, Rayner, Pollatsek etc.).

Research Methods:

1. Clinical and psychological

-anamnestic

-clinical interview

-observation

2. Psychometric

-standardized methodology for the study of reading skill "SMINCH" [58]

-CFIT: culturally free intelligence test [154; 155]

-Subtest of Wexler's test " Digit span " [485]

-The "Non-word Repetition" test [222]

-12PF/CQP: Children personality questionnaire [1]

-Explicit Anxiety Scale [91]

3. Experimental-psychological.

The study used the oculographic method of studying the parameters of children's gaze movements during reading as referents of reading activity aimed at analyzing and understanding the content of the text.

4. Methods of data processing

The study used such statistical methods of data analysis as: Mann-Whitney u-criterion; correlation analysis using Ch. Spearman's rank correlation criterion; factor analysis; regression analysis.

Sample characteristics.

The study involved 40 children aged 9 to 12 years with dyslexia and 42 typically developed children.

The validity and reliability of the defense results are determined by the theoretical basis of the problem, the use of scientifically based methods of psychological research, and the processing of data using mathematical statistical methods (the IBM SPSS 20 package was employed for data calculation and analysis).

Scientific novelty of the research. A comprehensive examination of the procedural elements of reading has been conducted for the first time. The oculomotor indicators used in this study have helped identify three main types of cognitive problems in dyslexic children: decoding, making macropropositions, and checking the accuracy and coherence of the mental representation of the text. That method for studying

reading activity abnormalities in dyslexic children is supported by both theoretical and empirical evidence.

The theoretical significance of the study lies in the creation of a new psychological model for the study of reading and comprehension disorders in children with dyslexia. The model is based on an activity approach, according to which reading activity is considered as a process whose purpose is to understand what is read, and its structural components are mental actions aimed at decoding information, creating a macro-propositional structure of the text and checking its logical correctness and connectivity. Theoretical significance is also due to the use of the dynamic approach used in the study - the use of eyetracking technology made it possible to study the features of the phenomenology of reading activity in real time and expand the idea of the internal phenomenology of reading and its violations.

The study of cognitive prerequisites for reading and personal characteristics clarifies and expands ideas about the clinical and psychological characteristics of Russian-speaking children with dyslexia: a deficit in phonological working memory is described while preserving short-term and not related to the idea of the letter and word of working memory; the severity of such personality traits as anxiety, self-doubt, social timidity, tension was found.

The practical significance of the research: the clinical and psychological model developed in the present study, describing the structure of violations of reading activities in children with dyslexia, can form the basis for the creation of psychodiagnostic and psychocorrection programs and be used by psychologists of health care and education institutions in working with children with dyslexia. This model has great potential in correcting the main difficulty of children with dyslexia, which increases the risk of their full-fledged social adaptation - semantic analysis and comprehension of written texts.

The results of the study of the state of cognitive prerequisites in children with dyslexia and their personal qualities can also be taken into account when identifying the targets of psychocorrection programs and organizing psychoprophylactic care

aimed at preventing risk or reducing the level of social (in particular, school) maladaptation.

Approval of the results of the study. The research materials were presented at 17 scientific and practical conferences: the National Congress with international participation “Healthy Children – the Future of the Country” (2017, 2018, 2019, 2020, 2023); the All-Russian (with International participation) Scientific and Practical Conference “Central Speech Mechanisms” named after Prof. N.N. Traugott (2019, 2022); the International Conference “Neurobiology of Speech and Language” (2019, 2020); the Ninth International Conference on Cognitive Sciences (2021); The International Winter Symposium on Experimental Studies of Language and Speech “The Night Whites” (2018, 2020); international scientific-practical conference of the Russian Association of Dyslexia “Reading in the digital era” (2018) and “PRO reading: DYSlexia in the 21st Century” (2020); the international interdisciplinary conference “Innovative methods of prevention of correlation and interpersonal disorders of children” (2019); the International Conference « Problems of ontolinguistics – 2023: variability of speech ontogenesis» (2023); 16-th European psychological congress (2019), the International Conference “Brain, Language & Learning Conference”, (Siena, 2019)

Publications. Based on the materials of the dissertation work, 19 works have been published, including 2 publications in peer-reviewed journals recommended by the Higher Attestation Commission under the Ministry of Education and Science of the Russian Federation, 2 articles in Scopus peer-reviewed journals.

Personal contribution of the candidate. The researcher personally participated in the development of the clinical-psychological program and methodology of the experimental-psychological study, as well as in the definition of theoretical foundations and approaches to the interpretation of the results obtained. The aim, working hypothesis, and objectives of the study were formed independently.

The psychological model that explains the connection between oculomotor characteristics, mental actions, and operations involved in the act of reading has been

established and developed. All stages of examination of the subjects were independently conducted and the processing of the obtained data was carried out.

Structure and Scope of work. The dissertation contains 200 pages of typewritten text. It consists of an introduction, 3 chapters, a conclusion and conclusions, a list of references (504 sources, 397 of them in English), 10 annexes. The work is illustrated by 47 tables and 10 figures.

Main scientific results:

1. It is proven that in children with dyslexia, there is a violation of all structural-functional elements of reading activity related to both decoding processes and processes of semantic analysis and text comprehension [50; 81; 82; 84; 85; 87; 295; 296] (personal contribution not less than 80%);

2. A structural-functional model of reading activity describing and linking its main stages with the operational-activity components (mental actions and operations) included in them was developed [82; 84; 85; 86; 297] (personal contribution not less than 80%);

3. It is shown that mental actions and operations included in the structure of a reading activity can be objectivized and investigated by analyzing their oculomotor referents [50; 78; 79; 81; 82; 83; 86; 87; 295] (personal contribution not less than 80%);

4. It is shown that the quality of text comprehension is not directly determined by the level of cognitive resources but depends on the efficiency of using mental actions and operations related to the semantic analysis and comprehension of the text (not published, the results were presented at the conference “Central Mechanisms of Speech - 2019” in an oral presentation “Organization of oculomotor behavior in reading from the position of activity theory”, and at the conference “Problems of Ontolinguistics-2023: variability of speech ontogenesis” in an oral presentation “Cognitive mechanisms of reading in children with dyslexia: the role of mnestic functions in the organization of reading activity”);

5. It is shown that children with dyslexia have more pronounced personality traits such as anxiety, tension, insecurity, and social shyness [77;88] (personal contribution not less than 80%);

6. It has been proven that children with dyslexia are characterized by a deficit of phonological working memory in comparison with children with typicall development (not published, the results were presented at the conference “Central Mechanisms of Speech - 2019” in an oral presentation “Organization of oculomotor behavior in reading from the position of activity theory”, and at the conference “Problems of Ontolinguistics-2023: variability of speech ontogenesis” in an oral presentation “Cognitive mechanisms of reading in children with dyslexia: the role of mnestic functions in the organization of reading activity”);

7. It was found that children with dyslexia are also characterized by such features of the organization of reading activity as a low level of its purposefulness and flexibility, manifested in a lower sensitivity to the specifics of the task and text features in comparison with children with normal development [80; 83; 297; 298; 354; 355] (personal contribution of at least 70%).

Provisions of defended:

1. Children with dyslexia demonstrate specific characteristics in the organization of the procedural aspects of reading, including impairments in decoding mental actions, a deficiency in actions related to constructing the macropropositional structure of the text, and a lack of actions focused on verifying the logical correctness and coherence of the constructed text model.

2. Dyslexic children have difficulties with reading comprehension due to weaknesses in the structured organization of reading activity. The efficacy of mental processes and operations, rather than the cognitive prerequisites of reading, directly impacts the comprehension of text by dyslexic children.

3. The peculiarities of cognitive functioning of children with dyslexia are also reflected in the deficit of phonological working memory in comparison with healthy children.

4. The clinical and psychological characteristics of children with dyslexia are evident in their display of personality traits such as anxiety, insecurity, social shyness, and tension.

Chapter 1. THEORETICAL REVIEW OF DYSLEXIA AND ITS STUDY

1.1 Historical essay on the study of dyslexia

Dyslexia means "states whose main manifestation is a persistent selective inability to master the reading skill, despite the sufficient level of intellectual and speech development, the absence of disorders of auditory and visual analyzers and optimal learning conditions" [47; 464].

According to various sources, dyslexia affects 5-15% of children [56; 122; 180; 287].

Understanding the mechanisms of dyslexia took place gradually. In the history of the study of dyslexia, four main stages can be distinguished.

The first stage includes single descriptions of reading disorders in adult patients with predominantly aphasia [202; 208; 493, etc.]. However, according to some authors, the patients described in these studies from the position of modern psychiatry are similar to those with mental retardation, and their reading disorders were rather only an aspect of a more extensive clinical picture [168, 169]. The first mention of the term "dyslexia" occurred in 1872 by the German physician R. Berlin, who used this term to describe the case of an adult who had lost his reading skill [cit. according to 453].

The second stage can be considered the period from 1877 to 1950, during which dyslexia was isolated as a nosological unit, and clinical studies of its characteristics were launched [258; 291; 296; 360; 440]. The first isolation of reading pathology as an independent nosological unit belongs to Kussmaul [300], who defined it as the inability to read a word while being able to see it. The author proposed the term "word blindness" to describe a patient with aphasia who has lost the ability to read.

In 1892 the work of J. Dezherin [179] was published. The scientist was able to localize the damage causing reading problems in the parietal lobe, middle and lower segments of the left occipital lobe. Importantly, at this time dyslexia was considered a disability of neurological origin caused by traumatic brain injury,

which is now commonly referred to as "acquired dyslexia". This resulted in the study of reading disorders mainly in adults with brain lesions.

The next important event of this period was the publication of the British doctor P. Morgan, which described the case of a fourteen-year-old boy with a normal level of intelligence who could not master reading [338]. This publication is the first description of "innate blindness" and the beginning of research in the field of "dyslexia of development." This article also marked the beginning of a stage of active identification of dyslexics, especially by British doctors [205; 439, etc.]. There were reports of patients with reading problems in other countries: Argentina [488], USA [411], Germany [484].

A significant contribution to the creation of the clinical and social awareness necessary to consider dyslexia as a medical problem of greatest importance was made by the British ophthalmologist surgeon Hinshelwood. Between 1895 and 1911 he published a series of reports and articles describing clinical cases of dyslexia and suggesting its possible innate nature [256; 257; 258]. In 1917, Hinshelwood published a monograph on the "innate blindness of the word," which summarized contemporary data on this issue at that time [255]. According to the author's point of view, dyslexia is associated with impaired perception and storage of letters and words in memory. Disorders were determined by hereditary, curable and more common in boys.

The evolution of dyslexia research between 1925 and 1940 is primarily related to the work of the American neurologist Orton [358; 359; 360]. On the material of more than 3000 adult patients and children with mental retardation, they studied language difficulties, described the association between delay in learning to read and left-handedness. However, other authors later refuted the data: with a strict and thorough definition of the leading hand and eye, the use of a large set of tests and strict criteria for patient inclusion in the groups, no significant differences were found in the left-handedness indicator between healthy children and children with dyslexia [233; 406]. Orton showed that reading disorders are common in family members, which supported the theory put forward by the genetic nature of dyslexia

and proved the need for the final isolation of "developmental dyslexia." Orton found a large number of errors in writing and reading, which were caused by the inversion of individual letters or letters in words, which allowed the author to hypothesize about a violation of the process of perceiving the letter in dyslexics.

In such a way, this stage of the study of written speech disorders was characterized by an intensification of the clinical study of reading disorders and the final isolation of dyslexia and alexia. Alexia was understood as an acquired inability to read ("acquired dyslexia") [254], dyslexia was described as an innate inability to master reading ("dyslexia of development") [440].

The domestic history of the study of dyslexia originates with the publications of R.A. Quality "Innate Alexia" [90], in which the basis of reading violations is explained by a violation of the associative connection between letter and sound, as well as S.S. Mnukhin "On innate alexia and agraphy" [75], which first pays attention to the etiology of alexia, and defines a violation of the function of integral structure formation as a pathognomonic symptom ("gross violations in reading whole words, in the absence of violations in the operation with letters"). S.S. Mnukhin points out: "with congenital agraphy, which was considered a purely isolated defect, the study reveals a number of disorders that appear to arise on a general psychopathological basis with reading and writing disorders" [75]. According to the author, reading disorders are found not only in mentally retarded, but also in mentally complete children, although at various degrees of mental retardation they are more common, which was consistent with the observations of Morgan, Kerr, Hinshelwood, Stephenson and others. The importance of the work of S.S. Mnukhin is that for the first time in the framework of domestic psychiatry, it was suggested that violations of school skills as an independent nosological unit requiring serious study.

The third **stage** in the formation of the study of dyslexia is 1940-1970. During this period, dyslexia become the subject of study by teachers and psychologists. Due to this, the possible role of adverse environmental factors in the formation of dyslexia in children, in particular, the inefficiency of upbringing and learning

processes, began to be discussed. A number of psychologists have hypothesized the multifactorial nature of dyslexia [405; 476; 482]. In addition, psychological studies of the cognitive mechanisms of dyslexia made it possible to talk about the need to isolate and study certain subgroups of dyslexics: 1) having difficulties in visually processing information [340]; 2) having difficulties in processing audio information [271]; 3) having difficulties with abstract thinking [476].

Since the 40s and 50s of the 20th century, violations of reading and writing began to be studied by domestic psychologists, teachers, defectologists, which led to the isolation of two lines of study of dyslexia: clinical-psychological and psychological-pedagogical.

Within the framework of the psychological and pedagogical approach, considerable attention was paid to dysgraphy and its relationship with reading disorders. A certain relationship between reading and writing disorders with defects in oral speech and hearing was emphasized [9; 64; 101]. For the first time, R.M. Boskis and R.E. Levina developed scientific and practical problems related to the pathology of acoustic gnosis in children, with the determination of the role of the phonemic factor in the abnormal development of the speech system as a whole. R.E. Levina determines the central link in the violation of reading and oral speech the lack of formation of the phonemic system, which leads to the fact that at the initial stages of reading mastery in children, inaccuracy and instability of speech representations and generalizations appear, which in turn prevents sound analysis of the word. It is important to note that the first successes in the research of speech disorders are directly related to their integration with the then progressive psychological and linguistic ideas of T.A. Egorov, N.I. Zhinkin, A.N. Leontyev, L.R. Luria and others. Speech activity has been found to be a complex whole whose constituent elements interact and condition each other; for the first time, attempts were made to describe the psychological mechanisms underlying speech processes. However, studies devoted to the etiology and sources of individual differences both

in terms of the reading process itself and in terms of cognitive processes, which are the basis for mastering the reading skill, were practically not conducted.

In the field of clinical and psychological studies, A.N. Kornev [46; 47; 48; 49; 51, etc.] demonstrated that the primary factor contributing to the development of dyslexia is the lack of meta-language and successive processes. Meta-language refers to the processes of awareness of speech as an independent reality, accompanied by the transfer of attention from the semantic to its linguistic side. Successional processes are called mental operations of temporary organization or analysis of information. Furthermore, many impairments in cognitive activities, ranging in severity, have been identified in relation to reading. These include deficiencies in lexical processing and symbolization, as well as short-term and working memory. One of the most significant outcomes of fundamental research of A.N.Kornev is as multi-oxal classification of dyslexia(Table 1).

Table 1 - A.N. Kornev's multi-oxal classification of dyslexia

A. Etiopathogenetic axis:	B. Psychopathologic axis:	C. Psychological axis:	D. Functional axis:
1. Constitutional (hereditary) dyslexia	1. Cerebrasthenic infantilism syndrome	1. Dysphasic variant of dyslexia.	1. Latent dyslexia
2. Encephalopathic dyslexia.	2. Organic infantilism syndrome: a) Neuropathy-like variant;	2.Dysgnostic variant of dyslexia.	2. Severe dyslexia.
3.Constitutional encephalopathic dyslexia.	2.Organic infantilism syndrome: b) organic variant proper.	3.Mixed variant of dyslexia.	3.Alexia.

This classification reflects the biopsychosocial nature of the dyslexia phenomenon and makes it possible to fully describe the features of etiology, pathogenesis, leading syndrome and disorders of cognitive mechanisms, as well as the degree of maladaptation of a child suffering from dyslexia.

The fourth stage in the study of dyslexia can be considered the period from the 70s. XXv., Within the framework of which basic information about dyslexia, known today, is formulated. Researchers continued to find pronounced difficulties in dyslexic children in phonemic analysis [61; 97; 209]. Levinson found that general speech underdevelopment occurs in 1/3 of dyslexic children [310]. Another number of researchers tried to explain reading disorders by oculomotor regulation disorder [42; 124; 250]. However, the authors themselves and other researchers pointed out that oculomotor disorders can be a consequence, not a cause of dyslexia [169], and the experiments of Leisman [308] did not reveal any disorders of oculomotor regulation in dyslexics at all. To clarify the mechanisms of dyslexia, studies were also undertaken on individual mental functions involved in the act of reading and their deficiency in dyslexia was found: spatial orientation [325; 406], shape perception, visual-spatial memory, memorization of the sequence of arrangement of figures [185; 325], etc. In two similar studies, it was shown that children with dyslexia have a normal vocabulary, but experience difficulties with a rapid naming [181; 434]. However, the main hypotheses about disorders of the reading mechanism in dyslexia were still associated with speech deficiency or disorders of oculomotor regulation.

In domestic science by the end of the twentieth century, the dominant role of the concept of speech deficit [61; 64, etc.]. According to this concept, dyslexia is formed as a result of a shortage of phonological information processing. Factors affecting reading disorders include: articulatory disorders, underdevelopment of the phonemic and lexica-grammatical sides of speech, difficulties in generating independent utterance, violation of auditory speech memory and skills of sequencing (formation of successional series) [93].

1.2 Current state of the dyslexia research problem

Anticipating the results and highways for the development of modern reading research, A.N. Leontiev, formulating the basic prerequisites of the theory of activity, pointed out the need to "clearly distinguish mental processes on the one hand, and

physiological mechanisms implementing these processes - on the other, without which the problems of relation and connection between them cannot be solved" [70, p.26]. The internal phenomenology of the reading process is directly related and affects the psychophysiological mechanisms of reading activity on the one hand, on the other hand, the psychophysiology of reading is the foundation of the psychological content of the reading and comprehension process. Phylogenetic mechanisms constitute ready-made prerequisites for reading activities, "but only in a virtual form - as their possibility" [70, p.60]. This understanding of the reading and comprehension process, implemented at different functional levels, determined the need for interdisciplinary reading and dyslexia studies.

Therefore, thanks to modern hardware methods, understanding the nature and mechanisms of dyslexia has become more complicated [369]. According to modern ideas, dyslexia is considered as a neurobiological disorder due to impaired functions or underdevelopment of certain areas of the cerebral cortex [2; 105; 251; 404]. Thanks to studies using functional magnetic resonance imaging and tractography methods, zones and neural networks involved in the process of reading, analyzing and comprehension text information were identified [152; 228]. In particular, differences were found in the activity of the left parietal-temporal region (sound-letter analysis, decoding) and the left occipital-temporal region (rapid automated recognition of readable words) between dyslexic children and normal-reading children. It was found that compared to normal readers, in people with dyslexia, information processing during reading occurs in slightly different areas of the brain, that is, when performing tasks related to reading, the brain reacts differently, developing alternative adaptive mechanisms, but the speed of processing text information remains slow. Evidence of such compensatory mechanisms was the results of studies that established hyperactivation in dyslexics in many areas involved in reading, but in the right, not the left hemisphere [165; 422; 423]. At the same time, the dorsal and ventral pathways of the left hemisphere, which are key for success in reading, demonstrate less activation in dyslexics [417; 423]. Given the results of such studies, demonstrating the depth of violations and the fact that written

speech is at the heart of the education system, it can be argued that the disorder of educational skills in the form of dyslexia has long-term and even lifelong consequences for a person [15; 27; 53].

Furthermore, the utilization of fMRI in cross-cultural studies has provided valuable insights into the extent to which dyslexia mechanisms are influenced by cultural (linguistic) factors. A study conducted by Morton and Frith on a diverse sample of students with dyslexia revealed that the underlying physiological characteristics are consistent across different countries [339].

The totality of the interdisciplinary data obtained contributed to the final identification of currently relevant theories of the formation of dyslexia, among which the following can be distinguished:

- ***The theory of phonetic and phonological impairment***, which is currently one of the prevailing views [64; 133; 313]. This idea suggests that dyslexia is primarily caused by specific impairments in the representation, storage, and reproduction of speech sounds and their related phonemes. Dyslexia should also manifest challenges in establishing the correlation between graphemes and phonemes, which is a fundamental phase in acquiring reading skills.

- Theories related to deficits in the processing of information of a certain modality: the theory of deficits in fast classroom processing of information according to which auditory deficits suppress or inhibit the perception of short and rapidly changing sounds [449; 452], which prevents the formation of a reading skill; visual processing deficit theory, the supporters of this view attribute the development of dyslexia to the disruption of numerous visual functions involved in the reading process, such as visual identification and tracking gaze movements [438].

- Double deficit theory [495], according to which dyslexia is associated with two types of difficulties: a) in the process of processing phonological information; b) with the processes of operational actualization of iconic information from long-term memory

All approaches to the study of dyslexia, depending on the interpretation of the pathogenetic mechanisms of reading disorders, imply different interpretations of the errors and difficulties that arise in reading, however, all researchers recognize the violation of a particular mental function as the basis for the formation of dyslexia. Nevertheless, special experimental psychological studies of reading activities, revealing the connection between a lack of mental functions and reading disorders, are few. In domestic science, within the framework of the pedagogical branch, such studies were undertaken by Inshakova [40], Rusetskaya [93], Levashov [62], Guzii [16], Velichenkova [11], Khabarova [100] etc. Within the framework of the clinical and psychological approach, such studies were carried out by A.N. Kornev [46; 47; 48; 49; 51; 52, etc.], T.V. Akhutina [3; 4, etc.].

However, there is a dearth of contemporary experimental psychological research on reading in Russian-speaking children that explores the connection between cognitive impairments and reading difficulties [21; 186].

1.3 Emotional and personal traits of children with dyslexia

Personality is a fundamental aspect of psychology, which is considered a scientific discipline. The perspective of Russian psychology on personality as a psychological phenomenon was principally formed by the contributions of A.N. Leontiev, S.L. Rubinstein, L.S. Vygotsky, B.G. Ananyev, and A.G. Kovalev. The main postulates of the domestic school can be summarized as follows: Personality is viewed as a "systemic social quality of an individual (a socialized individual)" or as "the combination of internal conditions that shape the way external influences are perceived" [95, p. 3]. Internal conditions refer to certain traits such as compliance, negativism, aggression, anxiety, internality-externality, level of pretensions, neuroticism, extraversion-introversion, and self-esteem. Personality traits are developed through the process of socialization, which involves internalizing societal norms and experiences. Simultaneously, socializing can only occur through collaborative activities or conversation. The writings of A.N. Leontiev [70, p.89-

101] explain the fundamental connection between activity, personality, and its emotional traits.

According to Leontiev (1975), a person's personality is primarily determined by their social contacts with the world, which are expressed through their many activities [70, p.89]. Therefore, the process of personality development involves the growth and proliferation of its activities. A.N. Leontiev focuses on explaining the concept of the "totality of activities," which refers to the coordination of different human activities by prioritizing the most significant ones and subordinating the rest. "This intricate and protracted process of individual growth follows a series of distinct stages." The formation of awareness and self-consciousness is closely intertwined with this process [70, p.92]. According to Leontiev (1975), the structure of personality refers to a stable arrangement of the primary motivational lines that are internally organized in a hierarchical manner [70, p.110].

The key aspect of subordination and hierarchization of activities is the internal linkage of different motives and needs. An individual is born with inherent wants, which can only be expressed and developed through engaging in activities. A personality motive is created by a determined need. A.N. Leontiev identified two primary types of personal reasons: meaning-forming motives, which stimulate activity and give it personal significance, and stimulus motives, which lack the role of building meaning and are driven by positive or negative elements. The correlation between motives and the potential for achieving successful execution of the relevant action by the individual reflects human emotions. They occur following the realization of the purpose (need) and before the subject's logical assessment of their actions.

As an illustration of the complex connections between behavior, motivation, and personality characteristics, we can provide the following example: Anxiety, as a personality trait, is strongly linked to avoidance motivation and, consequently, a decrease in a person's ability to adapt [95, p. 9]. This means that it reduces opportunities for engaging in activities and interacting with others.

From this standpoint, it appears logical that school skills development

difficulties exhibit a significant level of comorbidity with mental health disorders. Research has established a strong correlation between low academic performance and the likelihood of developing psychopathological symptoms. Specifically, several studies have shown that children with school skill impairments are more susceptible to experiencing anxiety and depression disorders [322; 350]. Francis and colleagues conducted a meta-analysis using data from 34 trials and 16275 participants. Their findings provide strong evidence that children with dyslexia are very prone to experiencing anxiety and depression disorders [210]. The correlation between dyslexia and emotional disorders is predominantly attributed to common contextual causes rather than similar genetic predispositions [489]. The emotional well-being of dyslexic children is negatively affected by the combination of rising academic expectations, a rise in assignments requiring independent reading, a lack of opportunities for cognitive engagement, and regular assessments. They encounter elevated levels of stress in their academic lives due to their educational and social challenges [56; 77; 111]. The persistent challenges encountered in fulfilling academic tasks are significant stressors that contribute to feelings of anxiety and depression [421].

This is particularly applicable to dyslexic children between the ages of 7 and 12. According to D.B. Elkonin's periodization (1971), "learning" is the primary activity that influences the major direction of personality development during this period. Therefore, there seems to be a connection between dyslexia and the fundamental process of developing one's personality [314]. Therefore, children with dyslexia have a tendency to develop and use inefficient personal strategies for dealing with stress [435], specifically the strategy of avoiding failure (the avoidance motive). This, in turn, only serves to further elevate their stress levels and unpleasant emotions [371].

Research has also found evidence indicating a connection between recognized dyslexia and a postponed likelihood of developing behavior disorders, such as delinquency [444]. Furthermore, they exhibit diminished levels of personality qualities such as "openness to experience," "conscientiousness," and "sociability"

[324]. It is crucial to acknowledge that individuals with dyslexia also evaluate themselves as being less conscientious and incapable of carrying out activities precisely and seeing them through to completion. It is crucial that this self-assessment aligns with the evaluations of the parents of these youngsters, who also provide similar descriptions of their children [220].

The interpretations of the presence of these personality features in children with dyslexia do not seem to be clear-cut. One possible interpretation is that children's self-image is shaped by their family. When parents are unhappy and concerned about their children's academic struggles, they tend to have a poor view of the child's cognitive capabilities. This negative perception is then adopted by the child. Parents of children with specific learning issues commonly face stress as they strive to manage their child's condition [285], which subsequently impacts their capacity to be understanding and supportive.

Additionally, an alternative explanation for the development of maladaptive personality traits has been put forth: children, who are routinely confronted with the necessity to adjust to learning tasks that frequently surpass their capacities, unavoidably view themselves as incapable and frequently encounter emotions of inadequacy and powerlessness that extend to all activities requiring mental exertion. Their self-perception of their abilities and efficacy is frequently strengthened by the attitudes of their teachers. A significant number of dyslexic youngsters encounter distress while attending school and perceive a lack of concern or assistance from their teachers. Dyslexia has been proposed to have a significant impact on self-confidence and cognitive capacity due to its social repercussions, particularly academic failure. One notable characteristic of dyslexic youngsters is their inclination to be skeptical of others. This tendency is a natural result of their unique interactions with their loved ones and themselves [220].

Almost no research has been carried out on the emotional and personal traits of dyslexic children who speak Russian [88]. This study aims to examine the impact of dyslexia on the personality of Russian children, taking into account the significant

role played by socio-cultural factors [496], which may vary across different national and cultural contexts.

1.4 Studying comprehension of written texts in psychological research

From the very birth of philological sciences, the study of language and speech was reduced to attempts to identify the means by which comprehension is achieved [19], however, in the natural science paradigm, the text and its understanding as subjects of research were realized much later.

The release of I.R. Galperin's book "Text as an object of linguistic research" [13] marked the start of an era with limited fundamental investigations on written text comprehension in Russian science.

I. R. Galperin characterized a text as a distinct kind of speech creation that is not just oral speech transcribed onto paper. It is characterized by its spontaneity, lack of organization, and inconsistency. Furthermore, a text has its own unique parameters that differentiate it from oral speech [cited in 99].

Significant findings regarding the intricacy of the comprehension process were achieved in the research conducted by N.I.Zhinkin [24; 25] and A.N.Sokolov [94]. These studies focused on the connection between inner speech, thinking activity, and speech. Additionally, the works of A.A. Leontiev [65; 66; 67; 68; 69] and I.A. Zimnya [29; 30; 31; 32; 33] established the fundamental principles of the theory of speech activity.

The structure of the reading process, as defined in the Russian theory of speech activity, is relevant. The reading structure highlighted and described: the motivational component of reading, which contains motives and goals that organize reading activities; an analytical and synthetic component that includes an element of activity planning (quick viewing of the text, definition of the topic, making assumptions about the content); an executive component, which is a set of mental actions and operations related to the semantic processing of the text (selection and integration of the semantic units of the text).

The initial period of research into the reading and comprehension of written texts was characterized by the dominance of the model according to which reading is a simple translation from written language to oral language with its further processing [235; 260].

According to the model's creators, the comprehension of written text is achieved through two processes: decoding and comprehension of the spoken form of the word being read. The initial article presented the formula: Reading comprehension equals the product of decoding and linguistic comprehension. This paradigm proposes that there is ambiguity in the processes for comprehending written and spoken language, which reduces their distinctiveness. According to the "simple reading model," comprehending the entire text is determined by the total number of words that are correctly decoded and make up the text [235; 460].

In more recent models, reading a text is considered as a multi-level, multi-aspect and creative activity of the reader. The emergence of data was made possible largely due to the formation of the psycholinguistic theory of reading van Dijk & Kintsch [472], as well as cognitive models of comprehension of the text. According to the psycholinguistic theory of Kintsch and van Dijk, reading the text involves three main stages:

1. The step of recognizing words and sentences with the selection of individual propositions;

2. The stage of constructing a propositional text structure (text base): includes the stage of generating macro positions and the stage of their integration;

3. The stage of creating a situational model or "text image"

Among the cognitive studies that have influenced the complication of looking at the phenomenon of comprehension, a number of works can be distinguished. Studies by La Berge & Samuels [301] suggested the presence of three memory subsystems, the effectiveness of which depends on the quality of comprehension of the text: visual, phonological and semantic. In this model, understanding what is read seems to be a strictly consistent process. Visual perception ends by remembering visual

representations, which are then transformed into phonological representations and complete the transformation as semantic representations.

One of the key theories that played a role in the development of ideas about comprehension of the text was the theory of Just & Carpenter [280], which describes the complex reading implementation scheme presented in Figure 1.

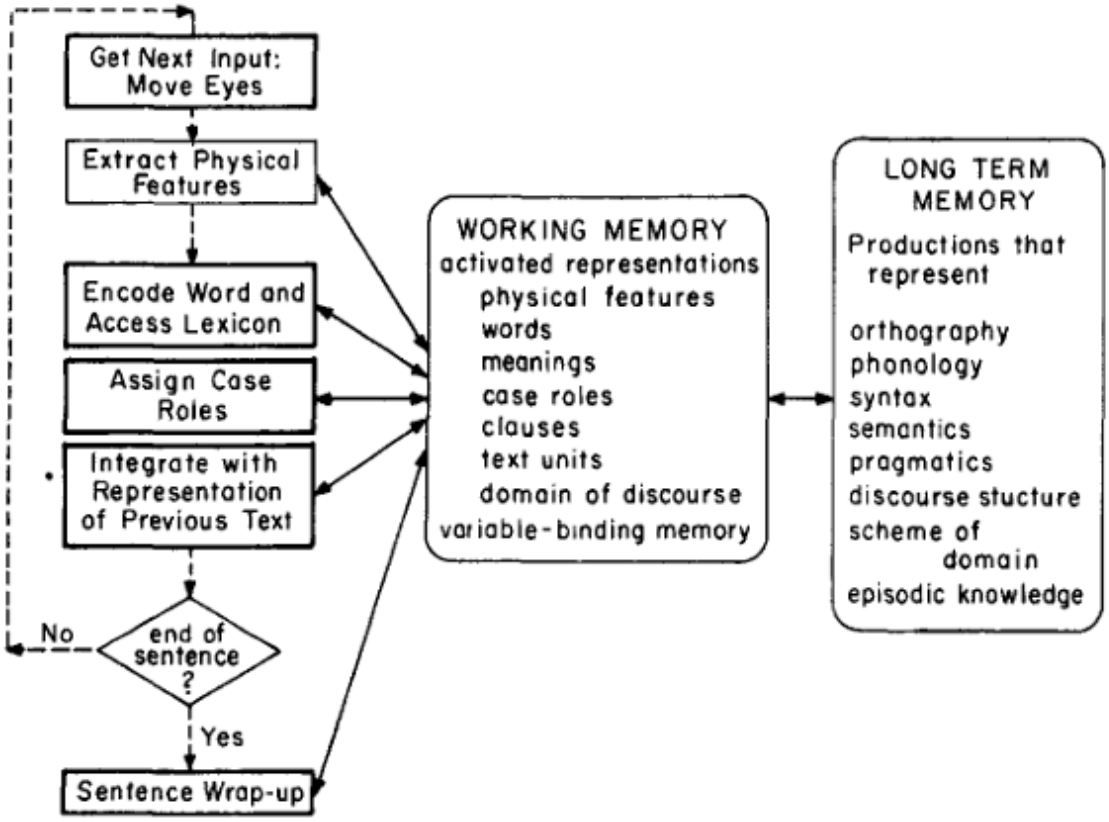

Figure 1 - Theory of comprehension the Text Just & Carpenter (1980)

The left column presents the main stages of processing and comprehension of the written text, on the right - the knowledge stored in long-term memory, necessary for the implementation of all stages of reading and comprehension (spelling and syntax rules, phonological representations, etc.). The working memory and its elements are "mediators" between the long-term memory and the text processing elements represented in the right column.

Through the work and research mentioned above, modern science views reading and comprehension as a complex, creative process that includes a large

number of cognitive and language determinants [113; 175; 302; 318; 377], the violation of which can lead to pronounced social maladaptation.

Despite the theoretical groundwork in studying reading comprehension, experimental studies of the reading features of dyslexic children rarely went beyond the simple reading model. This resulted in a large number of research results denoting difficulties in the technical side of reading (the first stage in the Kintsch and van Dyck models) dyslexics while almost completely ignoring the question of experimental study of the peculiarities of comprehension of the text as a whole and the process of analyzing it.

One of the reasons for the narrowing of the field of study of reading and comprehension is the objective difficulty in studying the hidden from the eyes that proceed internally, actions and operations aimed at comprehension. However, it is understanding that is the nodal motive of reading activity, coordinating the reading process: "the achievement of understanding is the motive of many types of human activity, and in the form of reading this motive, according to general recognition, is the main one. It is he who organizes and coordinates all interactions between the links of the chain that leads from the perception of words forming the text to the construction of a semantic image of the text "[74, p.7].

1.5 Cognitive prerequisites for the reading activity of children with dyslexia

When researching the process of text comprehension, scientists differentiate between its different processes, such as those related to the construction of text meaning or those related to the study of its content. Most contemporary researchers agree that comprehension is a complex and creative process involving the construction of a mental representation of the text. This process occurs at the interface between the reader's existing knowledge and the information provided in the text [33; 68; 73; 221; 232]. The recognition of the complex nature of reading comprehension and interpretation highlights the importance of research on the cognitive mechanisms involved in reading and their role in text comprehension.

Text comprehension is accomplished by creating a complete (logical-connected) mental text model [294]. Studies have shown that the process of building a mental model of the text is associated with various cognitive and linguistic abilities (by abilities we mean the "soil" factor, which determines the success of understanding what was read or in terms of A.N. Leontiev "ready-made prerequisites for activity".

The most common works on language abilities are studies on the role of decoding ability [262; 475] and vocabulary [146] in the process of comprehension of the text. Studies of cognitive prerequisites for reading activities in people with normalized reading skills have revealed the role of working memory [172; 330; 447] and intelligence [455] in the process of comprehension read.

The results of these studies can be explained by the Kintsch and van Dijk comprehension model: a coherent text model is built through the constant integration of newly incoming information during reading, in other words, the model is constantly updated until the end of the comprehension process [465]. The integration of incoming information takes place by establishing (making conclusions) links with already processed information. Consequently, the success of integrating incoming information with information already stored in it depends on the amount of working memory [465; 466; 467]. This pattern is established for both adults [172] and children [142; 145] with a normative reading skill.

Studies of working memory in children with dyslexia found a pronounced deficit in comparison with normally reading children [147; 217; 263; 283; 430]. It is important to note that experimental clinical and psychological works devoted to the study of cognitive processes in children with dyslexia in general, and short-term memory in particular on the material of the Russian language are few [59; 105; 106, etc.]. Most of the works are devoted to the study of short-term visual memory [27; 28; 43; 44]. A number of works are also devoted to the study of hearing-speech memory [11; 72].

However, the question of the modal-specificity of the shortage of working memory remains open, which in turn goes back to two opposite views on working memory: the theory of single (monistic) and multiple memory.

According to the theory of unified memory, memory uses uniform resources when processing stimuli of different modality [197; 198; 461], in other words, within the framework of this model, its shortage will be reflected in the low quality of remembering various stimuli.

Multiple memory theory implies the presence of different working memory subsystems with their own independent resources and processing stimuli of different modality [174; 346; 415; 491]. The data obtained in some studies suggest the presence of at least three memory systems, each of which has its own volume: phonological, visual-spatial and a system responsible for processing numerical information [174]. Therefore, within the framework of this model, a shortage of working memory of one type does not mean its presence when processing information of other modalities.

In studies of working memory in children with dyslexia and children with a normally developed reading skill, conflicting results were found. According to a study by Melby-Levrag [332, p.3], dyslexics suffer only phonological working memory, and the short-term memory of other modalities is preserved. In studies of other authors, it was found that the deficit of phonological working memory in children with dyslexia is associated with shortcomings in the processing of information and other modalities [176; 194; 222]. Such discrepancies, as well as the lack of studies on the modal specificity of short-term memory deficit in Russian-speaking children with dyslexia, update this study.

1.6 Oculomotor activity analysis in the reading study

In earlier studies, researchers primarily examined the outcomes, or "products," of the processes of comprehension and reading. These "products" refer to the end results or outcomes of reading activity, in the terms of B.G. Ananyev.

The process of the text comprehension has long been studied by low-information and insufficiently objective methods. Initially, researchers of the process of comprehension and reading focused their attention on the so-called "products" (in terms of B.G. Ananiev) of the process of comprehension, in other words, on the success of reading activities. Comprehension was assessed by the number and quality of responses received on the content of the text, the number of errors made, as well as the data provided by the subjects themselves as a result of their introspection during the reading process [166; 249]. It should also be noted that this kind of introspection was carried out in the so-called online mode: one of the most popular and systematically used was the method in which, the subject voiced all his thoughts, all the logical chains that took place in his mind as part of the process of comprehension the text. And already on the basis of the received protocols, the so-called think-aloud protocols, a certain picture of the comprehension of the text by the subjects appeared [319; 378]. Comprehension was also investigated by various methods of associations. Methods of comprehension research through the analysis of pauses, delays in answering questions posed were popular. The researchers also analyzed the volume and strength of memorization of the read text (the "better" and deeper the comprehension - the more stable memorization) [68, p.78].

The window to the phenomenon of comprehension as a process was the emergence of technology that allows you to record the movements of a person's gaze in the process of carrying out any activity - oculography (modern oculographic devices are called eye-trackers) and research based on it. Initially, these studies were devoted to the study of questions related to people's perception of images, and already later research began on eye movement when reading. The movement of the eye here was considered as the basis of this process, since intuitively scientists were based on "the belief that oculomotor activity is synchronous with cognitive dynamics" [76; 280].

Louis Emil Javal is considered the pioneer of this direction, who in 1879 drew attention to the fact that in the process of reading a person's eyes move not smoothly,

but on the contrary, that the reader constantly makes either faster than eye movement, or delays his eyes at a certain point [276]. Louis Emile Javal himself gave these phenomena the name of saccades and fixations, which in modern science are basic concepts in the study of the movement of the human gaze. For example, it became known that during saccades a person does not perceive information, which, therefore, is read during fixations.

The 150-year history of oculography is rich in important discoveries and inventions. For example, G.T. Buschwell developed the first non-invasive method for fixing the movements of a person's gaze when considering images [115; 141]. Yarbus's experiments made it possible to conclude that the process of moving the eye directly depends on the task set for the subject [107]. In addition, Yarbus was able to prove the fact that there is no strong dependence between the type of image presented and the movements of the eyes, and the object in any case selects the most informative sections of the stimulus. The conclusions made by Jarbus were consistently validated in future studies.

A number of studies of this stage using oculographic methods undertaken by a domestic group of scientists led by V.P. Zinchenko and aimed at studying the interaction of vision and touch deserve special mention [34; 35; 36, etc.]. By studying the movements of the eye when considering and manipulating objects by children of different ages, it was found that the relationship between the hand and eye undergoes a number of significant changes throughout the development of the child. Only in the third month of life does the hand of the newborn begin to act as an organ of touch (the eyes follow the hand). From five months, the function of the hand as an organ of movement is manifested, however, visual perception prompts the movement of the hand. At six to seven months, the main activity of the child is consideration. In the second year of life, the relationship between vision and touch becomes more complicated, becomes more diverse. By the age of seven, intersensory transformations between touch and vision finally add up. Their research with preschoolers showed that there are facts that indicate the educational role of touch for vision, as well as facts that claim the opposite.

K. Reiner [177; 386; 389; 390; 393; 394, etc.] established the important role of the existence of different eye movements, the role of progressive and regressive movements of the eye, performing various functions. Progressive saccades - "looking ahead" of the eyes, turned out to be associated with anticipation, anticipitation and "capturing meaning." It was also found that about 15% of all saccades made in the process of reading words and individual sentences are regressive saccades [327; 387]. Among the reasons why return movements are made, the following were highlighted:

- the reader returns to incomprehensible fragments of text (at the level of sentence, paragraph, whole text) in order to re-read and assimilate them [268];
- short regressive saccade may also be associated with incomplete lexical word processing [373; 382];
-if regressive saccades are short, then they can probably occur due to oculomotor errors [479]. Such an error is a fixation in an uncomfortable place for perception [351].

It was also found that the average fixation time when reading is about 200-250 ms (although it varies from 50 to 500 ms), that the direction of the future saccade is programmed at the time of reading the word. In addition, it was shown that the minimum required fixation time, sufficient for reliable identification of a word, is about 50 msec [393; 425], and the remaining time is spent on a higher level of reading analysis. Short words consisting of 2-4 letters for normal readers are often not perceived (there are no fixations, according to statistics this is about a quarter of all words. Long words sometimes require more than one fixation from the subject, especially in a child suffering from dyslexia and having difficulties in the syllabic skill. It was also shown that the movement of gaze through the text and stops are not constant and change not only depending on the wording of the task, but also on the type of text itself, the purpose of reading, the reader's attitudes, and his ability to get into the meaning and other factors [103; 104].

It was found that the amplitude of saccades varies widely from 40 degree seconds to 60 degrees, but in natural conditions of perception does not exceed 20

degrees [5]. By amplitude, saccades were classified into microsaccades and macrosaccades. Microsaccades are movements of the gaze along the line, associated to a greater extent with word recognition and not exceeding the amplitude of 1 degree, macro-accades - movements of the gaze whose amplitude exceeds 1 degree. If microsaccades are a reflection of the physiological level of regulation of eye movements and are less associated with the psychological component of reading, then macro accads are the main characteristic of oculomotor behavior and reflect the *search, selective tactics of text analysis, information search, hypotheses based on read information* [282] and the reader's own knowledge base.

Early studies of the oculomotor behavior of dyslexics during reading made it possible to describe the basic features of the gaze movements made by them. For example, it has been repeatedly shown that children with dyslexia make longer fixations, shorter saccades, and are also characterized by more fixations and saccades in comparison with conditionally healthy children. These are the first facts established regarding the oculomotor behavior of dyslexic children [109; 193; 307; 323]. Later, Lefton and colleagues [307] found that the normal development of oculomotor reading behavior, accompanied by a decrease in the age of child fixations and their duration, as well as an increase in the length of saccades, is not observed in children with dyslexia.

The question that eye movements in children with dyslexia have specific features when reading was not questioned from the very beginning of oculomotor studies, but it was not known whether these features are the cause or consequence of reading disorders. If the features of eye movements were the main cause of reading disorders, then this problem should have been easily diagnosed and eliminated by oculomotor training. However, this was not supported by practice [432; 454].

The question of the causal relationship between dyslexia and oculomotor disorders was the focus of Pavlidis' research [363; 364; 365]. Pavlidis argued that "defective movements" could be a serious diagnostic criterion for dyslexia [363]. However, a number of experimental attempts to test Pavlidis' findings did not

confirm his results [130; 356; 357; 436]. In other experiments, when comparing eye movements during non-reading tasks, no differences were found between conventionally healthy and dyslexic children [109; 138; 199].

Data have also been obtained showing that dyslexics processed less paraphoveal information during fixations compared to normal-reading children [203; 388]. However, in later studies, it was shown that the decrease in the volume of information processed by paraphoveal vision is also reduced in normally reading children when using texts of increased complexity. It follows from this that in itself, a decrease in the efficiency of processing paraphoveal information in children with dyslexia is only a consequence of the subjective complexity of the reading task [252; 390].

The question of the causal relationship between eye movements and dyslexia was resolved later, when the confirmed hypothesis was expressed that the investigated features of dyslexic gaze movements reflect their deficiency in language information processing (and are not the cause of disorders). The conclusions of three experimental studies are consistent with this hypothesis. Hyona and Olson [270] found an influence on the oculomotor indicators of word frequency dyslexics - the duration of fixations on low-frequency words was much longer than on high-frequency ones. A number of researchers have found that when using texts corresponding to the difficulty of reading children of dyslexics, their oculomotor indicators did not actually differ from normal-reading children [357; 370]. This fact was also confirmed by a study built on the opposite principle: when using texts of increased complexity for normally reading children, their indicators of eye movements approached the indicators of children with dyslexia in characteristics [390]. Similar results were obtained in a study by Ivanov [39], which studies the features of oculomotor activity in primary school children when reading texts of different complexity: with an increase in the complexity of the text, normal-reading children increased the number of saccades and fixations, and the duration of fixations increased.

It seems important to note that more current work analyzing the characteristics of gaze movements in dyslexic children systematically supports the findings previously found [120; 212; 336; 414; 418; 463; 487].

Eye-tracking research has provided reliable and objective results, enabling authors to design a method for evaluating the risk and severity of dyslexia [123].

On the material of the Russian language, such studies are small on the one hand [6; 28; 60], and on the other hand, they are rather psychophysiological in nature (limited only by the description of the basic characteristics of eye movements)

1.7 Theoretical and methodological analysis of reader activity and its oculomotor referents

Analysis of activity as a method of scientific psychology was born in the ideas of L.S. Vygotsky, S.L. Rubinstein and was finally formed in domestic science in the middle of the 20th century. First of all, thanks to the works of A.N. Leontiev.

According to the main provisions of the theory of activity of A.N. Leontiev, activity is "processes that carry out this or that attitude of man to the world meet the needs corresponding to them [70, p. 96]." Another definition given by A.N. Leontiev reveals other key characteristics of activity - "activity is a molar, not additive unit of life of a bodily, material subject. In a narrower sense, i.e. on a psychological level, it is a unit of life mediated by mental reflection, the real function of which is that it orients the subject in the subject world. In other words, activity is not a reaction and not a combination of reactions, but a system that has a structure, its internal transitions and transformations, its development "[70, p. 41].

Therefore, activity is:

1) a process;

2) related to the satisfaction of the need;

3) molar unit of a subject's life mediated by mental reflection;

4) aimed at the orientation of a person in the subject world;

5) has its own structure and dynamics of development.

Analysis of the structure of activity is one of the central elements of the theory of activity, which presents the structure of activity, its main units and the relationship between them.

Activity is determined by a **need**, the defined form of which becomes a **motive**. Activity, according to A.N. Leontiev, never exists without a motive, but it can be "hidden" (weak or unconscious). The implementation of the motive is carried out through **goals**, the achievement of which occurs in certain conditions and in the implementation of more specific **tasks**. Therefore, the need, motive, goals and **objectives** answer the question "for what is the activity implemented?".

Other elements of the activity are associated with the categories described above in a certain way, answering the question "how is the activity implemented?." Among these, A.N. Leontiev directly distinguishes activity, as well as action, operations and functional blocks - "grandiose physiological work of the brain" [70, p. 58]. ***Action*** is a process aimed at achieving a goal. A.N. Leontiev noted that "just as the concept of motive correlates with the concept of activity, the concept of purpose correlates with the concept of action" [70, p. 54]. Thus, the activity is carried out through a set of actions subordinate to private goals (which can be distinguished from the common goal). In turn, the implementation of the actions can be carried out through different methods called ***operations***. Operations (that is, the choice of how the action is implemented) depend on the conditions for achieving the goals.

Theoretical consideration of reading as a special type of speech activity became possible thanks to the works of A.A. Leontiev, I.A. Zimney, T.G. Egorov, N.I. Zhinkin.

According to A.A. Leontiev, speech activity is organized in the same way as other types of activity, it is characterized by a motive (the act of any activity is prompted simultaneously by several motives merged into one whole), purposefulness (the act of activity is characterized by the final, and any action is an intermediate goal), has a hierarchical structure (activity - action - operation -

psychophysiological functions). However, despite the identity of the structure of speech activity to other types of activities, A.A. Leontiev notes that the term "speech activity" is most often incorrect, since speech is almost always an activity that "serves" other types of activities, i.e. included in higher-order activities (primarily cognitive) [5, p. 25]. Speech activity as such takes place only when speech is self-important, when its underlying motive cannot be satisfied in a manner other than speech [67, p. 63].

An invaluable contribution to the empirical and theoretical study of the reading process was made by T.G. Egorov, who described the dynamics of its formation. The allocation of the stages of development of the reading skill T.G. Egorov [22; 23] undertook, based on the universal stages of the formation of any skill, namely:

1) analytical stage aimed at mastering parts of the whole;

2) a synthetic step based on the experience obtained in the first step and characterized by the irreducibility of the whole to the sum of parts;

3) the skill automation stage, which carries the function of clarifying and fixing the skill elements learned at the first two stages [23, pp. 26-27].

In relation to reading, according to Yegorov, the analytical stage is presented in two forms: in the form of mastering letters and in mastering the fusion of sounds into syllables and words. At the second stage of reading development, the child, already knowing the letters, makes the transition to slogo-synthetic reading ("syllable reading"). The third stage of the formation of the reading skill, called "the formation of holistic perceptual techniques," is characterized by the dominance of synthesis processes. At this stage, words cease to be perceived as separate from other elements of the phrase. The last stage is characterized by the achievement of perfection in synthetic reading processes, and is called the "synthetic reading stage," which is characterized by the reader's transition to comprehension the text as a whole [23, p. 37].

Following T.G. Egorov, N.I. Zhinkin describes the formation of reading as an activity through a step determined by the ratio of analysis and synthesis processes in reading. At the first stage, analysis processes dominate, at the second - synthesis, at the third there is a balancing of analysis and synthesis processes [24]. A brief description of the operation of the oculomotor apparatus during reading deserves special attention. So, N.I. Zhinkin describes the work of saccades - translational movements of the eye: "when reading, the eyes make not only translational movements (from left to right), but also reverse (from right to left). This begins the synthesizing combination of words located in different places of the phrase "[24, p. 18]. This proposal discloses the mechanism of oculomotor implementation of synthesis processes by moving the eye from one piece of text information to another.

In the works of I.A. Zimney, a systematic analysis and description of speech activity, including reading, was carried out. According to the definition of I.A. Zimney, there are three forms of speech activity - external oral (expressive and impressive), external written (writing and reading) and internal speech (provides oral and written speech). According to I.A. Zimney, the consideration of reading as a specific type of activity in the context of the theory of activity of A.N. Leontiev "is the most complete and holistic representation of it" [29, p. 83]. I.A. Zimnyaya highlights several basic provisions regarding reading as a type of activity:

1. The reader is an active subject of activity, whose activity is manifested at the motivational-target, intellectual (making conclusions), motor level (oculomotor and speech-motor aspects);

2. Text as a reading object is characterized as a multi-level education, including the subject-denotative, semantic levels and the level of means and methods of expressing its subject;

3. Comprehension of the written text is a procedural and effective multi-level education;

4. One of the elements of the subject content of speech activity is its product, what the activity is embodied in.

5. Teaching reading as an activity should be built as teaching activity, that is, from the position of management, formation and development of the reader himself, and not limited only to the formation and development of reading technique;

6. Reading activity, as well as other forms of speech activity, are characterized by a level structure and a certain structure.

Based on the theory of activity of A.N. Leontiev and the theory of speech activity, it can be concluded that reading is a purposeful activity prompted by a motive and consisting of a system of actions and operations [84; 85; 86; 87; 297].

It is legitimate to argue that, like most other activities, reading is polymotivated. Both internal and external motifs can be defined in the reading motifs system [160; 234; 492; 498]. By internal motives, relying on the theory of K. Levin [63], we mean motives caused primarily by the child's own interest (in terms of K. Levin's "natural interest"). A child may have an interest in new information (cognitive need) or the reading process itself, accompanied by certain experiences (need for pleasure). In addition, the inner interest of the child may be a consequence of the inclusion of reading activities in a significant relationship for the child with an adult or "world of adults."

By external motives we mean two types of motives: 1) related to the "situation of reward and punishment," in a school situation these motives can be indirectly manifested in the desire to get higher marks; 2) motives caused by the "field impact" of texts. In such a way, in the process of reading, getting acquainted with the content, a child may be interested in further storytelling, in other words, the space of text in which the child finds himself forms the motivation to continue reading [161].

In addition, it is important to note that reading as an activity has its own specifics: whatever motives it is prompted by, the basis of reading is quasi-need [68], reflecting the desire to touch the cultural and historical experience contained in the text. As A.N. Leontiev wrote, "linguistic consciousness in general and the meaning of the word as its fragment is a form of structuring and fixing the social experience of people, knowledge about the world" [75].

The system of motives underlying reading activities organizes a system of actions and operations aimed at achieving the goal. Action refers to activity, the subject of which is an intermediate result of activity [37; 38]. Actions, in turn, consist of operations aimed at performing more specific tasks that serve to perform the action.

The theory of comprehension of the text of Kintsch and van Dijk [18; 472], mentioned in the previous paragraph, has great potential in revealing the operational-activity components of reading activity. According to this model, the comprehension of the text proceeds through the extraction of propositions. The extraction of propositions, in turn, proceeds by: processing information explicitly expressed in the text; extracting the information needed to understand the text from the reader's knowledge base about the world. As V. Kintsch writes, " comprehension includes not only the processing and interpretation of information of perceived data, but also the activation and use of internal, cognitive information" [18, p. 162]. In this theory, three main stages of comprehension of the text can be distinguished: the stage of processing the surface structure of the text (extracting micro-positions) by decoding words; the step of creating a logical-connected text model (text base); The step of creating a situational model. In turn, the stage "creating a logically connected text model" includes two stages: generation and integration of macro positions.

The first stage is more devoted to the processing and understanding of individual words, the second and third - to the comprehension of individual phrases and the text as a whole (its main semantic blocks), and the fourth - "metatextual," represents the intersection of the knowledge base, the personality of the reader and the extracted information.

Each of the described stages is implemented through a system of actions and operations (the stages of generation and integration of macro positions are presented separately):

1) The step of processing the surface structure of the text. The task of this stage is to generate micropropositions and is carried out through the action "decoding" - "translation of the graphic word" into a speech form, ending

with the understanding of the word. In turn, decoding a word contains a number of operations: converting letters into a series of sounds, converting a number of sounds into a series of syllables, correlating a phonetic word with a lexicon. This chain of operations is one of two mechanisms described in the "two-route model" [163; 164], which describes the process of reading a word. According to this model, the process of word recognition is carried out through two routes - lexical and sublexical. Two mechanisms correspond to them: -phonological recoding (translation of a number of letters into a number of sounds, ending with synthesis); - direct access (correlation of a whole word represented in graphical form with the relevant unit of mental lexicon) [241]. In addition, this stage of text processing also includes serially organized "technical" operations, that is, not related to semantic processing - a sequential transition between recoding and decoding operations (transition from syllable to syllable, from word to word).

2) The step of processing the macro-propositional structure of the text (generation of macro-propositions). The task of this stage is to generate macro positions and is implemented through the synonymously named action "creating macro positions." The operations taken to carry out this action consist in the synthesis of micropropositions (generated in the previous stage) based on conclusions.
3) The step of creating a connected text structure. This stage is implemented through actions aimed at combining the generated early macro positions and checking the contextual adequacy and logical connectivity of the constructed text model ("self-monitoring" of comprehension). The structure of these actions includes operations to control the contextual adequacy and logical correctness of the conclusions made for the integration of macro positions.
4) The stage of creating a holistic situational mental model of text. The task of the stage is to create a personal, individual version of the semantic

content of the text by a specific reader. The creation of such a version takes place through actions involving the advancement of heuristic hypotheses about the meaning of the whole text. These actions take place at the intersection of the reader's personal experience and information explicitly and implicitly presented in the text. The nature of these actions also determines the content of operations necessary for their execution - the extraction and synthesis of information from the text and the reader's personal knowledge base.

The correlation of the stages of reading activity with its tasks and operational-activity components is presented in the table (Table 2).

Table 2 - Structure of reading activity: stages of text analysis and mental actions

Stage	Aim	Action	Operation
Processing the surface structure of the text	Generation of micropropositions	Decoding	-Recoding -Relating a phonetic word to the lexicon -Serial organization of operations
Processing the macropropositional structure of the text	Generation of macropropositions	Creating a macroproposition	Inference-based synthesis of micropropositions
Creating a coherent, cohesive structure for a whole text (text base)	Integration of macropropositional structures and control of their coherence	Synthesis of macropropositions and verification of their contextual adequacy and logical coherence	Control of contextual adequacy and logical correctness of the inferences made
Creating a holistic situational mental model of the text (situational model)	Creating a personalized version of the semantic content of a text	Producing heuristic hypotheses about the meaning of an entire text by integrating the text's information base and the reader's personal knowledge base	Extracting and synthesizing information from the information base of the text and the reader's personal knowledge base

Psychological analysis of eye movements is an adequate method for the operationalization of reader activity and the dynamic picture of its implementation. Oculomotor operations (fixations and saccades) reflect the psychological

organization of the process of analysis and comprehension of the written text, in other words, they reflect the methods of implementing mental actions committed by the reader [82].

The main goal of the reader is to create a logically related conceptual base of text (text base) on the basis of which the "image of text" is built [67, p. 96] or the "situational model of text" [6; 211]. Comprehension the reader's text is achieved by going through the main stages of text analysis and performing the corresponding actions. (achievement of intermediate goals of activities) and operations (methods of solving particular problems in the implementation of actions) The literature data allow us to consider oculomotor parameters as referents of actions that implement the stages of processing surface text processing, processing the macro-propositional structure of text and creating a connected text model [86; 157; 236; 237; 367; 480].

1. **The step of processing the surface structure of the text**, the task of which is to generate micro-positions through actions to decode words and phrases. The components of these actions are recoding operations, the oculomotor indicators of the success of which can be considered the number of fixations and their duration, as well as the parameters of progressive saccades performed within a length equal to one word [50; 81; 83]. According to research, it is during the stop of the gaze (fixation) that a significant proportion of text information is read [141; 268; 395]. The more difficult recoding turns out to be for the reader, the longer it takes him to implement it [173; 273], which is reflected in making more fixations and increasing their average duration [78; 79].

A number of studies undertaken by Irwin [274; 275] demonstrated that the operation "lexical access" is carried out by the reader both in the process of making fixations and when moving the eye (saccades). Thus, the lexical access phase does not have a direct oculomotor correlate, and therefore an attempt was made to investigate it directly as part of the analysis of gaze movements. Decoding of one fragment is completed by moving the gaze to the next fragment of the text (progressive saccade). The amplitude of the progressive saccade - the distance by which the gaze moves is directly related to the average amount of information

analyzed per unit time - the higher the amplitude of the progressive saccades, the more information was processed (decoded) by the subject during the previous fixation [137; 383; 390]. This relationship has been discovered and substantiated in research on perceptual span, a perceptual area that is "gazed upon" during fixation [328; 374; 390]. In other words, "perceptual span" is the amount of information read during the commit.

Another important element that is part of the structure of this stage is the control of errors made during decoding: incorrectly recoding a letter or syllable, the child returns for re-recoding. The inability to successfully complete the full lexical processing of a word is reflected in the commission of regressive saccades within a syllable (microregress) or word (short regressive saccade) [355; 372; 373; 382].

2. **The step of processing the macroproposition structure of the text consists of microproposition synthesis operations.** The performance of these operations, in particular, is reflected in the return to certain parts of the sentence to check and eliminate the inference error (control of the logical correctness of the generated macro position) [79; 150; 200; 279; 412].

The logical adequacy of macroproposition is manifested in the number of regressive saccades performed within the sentence (average volume of macroproposition). Such returns reflect attempts to establish a relationship between micropropositions and/or eliminate the fallacy of inference by reintegrating the macro-position structure [82; 87; 295].

3. The step of creating a logical-connected text model associated with context control operations and the logical adequacy of the acoustic structure of the text (the image of "text as a whole") is manifested in distant returns to text fragments that go beyond the sentence. Finding incomplete connectivity of the mental model of the text, the reader returns to fragments that have been misinterpreted. The success of these operations is reflected in such parameters of oculomotor behavior as the number of long regressive saccades, which reflect the need to reread misunderstood fragments of text [268; 269; 272].

The hypothetical model of analysis of reading activity developed by us on the basis of literature data, based on the phenomenology of oculomotor reading behavior [82], was used as the main analysis algorithm in our study.

Chapter 2. ORGANIZATION AND METHODS OF RESEARCH

2.1 Research Procedures

We divided the work into two distinct stages to complete the assigned tasks and achieve the research's goal:

Stage 1 of the study aimed to conduct a clinical-psychological and psychodiagnostic examination of children with dyslexia. This examination focused on assessing their cognitive abilities, reading, and comprehension skills, as well as their emotional and personal characteristics. During this stage, we evaluated various aspects, including the nonverbal intelligence of children using the culturally fair Kettell nonverbal intelligence test [154; 155], their reading skills and comprehension of written texts using the standardized "SMYNCH" research methodology [58], their anxiety levels using the "Apparent Anxiety Scale" adapted by A.M.Prikhozhan [91], and their expression of fundamental personality traits using the 12-factor personality questionnaire of Kettell adapted by E.M.Aleksandrovskaya and N.I.Gilyasheva [1]. The level of phonological working memory can also be evaluated using the method of "repetition of words" [222]. Additionally, the level of working memory for digits can be determined using the subtest "Digit span" from the children's version of the Wexler test [89; 485]. Prior to the child's inclusion in the study, parents were interviewed to gather anamnestic data. The examinations were conducted individually in a secluded room.

Prior to starting the study, a conversation was conducted with the child, with several primary objectives in mind: establishing a comfortable psychological setting to alleviate situational anxiety; understanding the child's perspective on the research situation and reading-related tasks; addressing any school difficulties associated with reading challenges; observing emotional and physical reactions during reading; fostering or developing motivation to participate in the study; and introducing the child to the upcoming stages.

Stage 2 of the study of the oculomotor behavior of children with when reading.

With all subjects, an experimental interest-tracking study of eye movements was conducted when reading 2 scientific and 2 narrative texts. The purpose of the study was to study the main characteristics of the subjects' eye movements in the process of reading written texts. The obtained parameters of eye movements during reading were subjected to qualitative and quantitative analysis.

The study was conducted in the laboratory of neurocognitive technologies of the Research Center of Saint Petersburg State Pediatric Medical University. Studies were conducted in the first half of the day, mainly on weekends (on days with the lowest educational load). If necessary (in case of signs of fatigue), the study was interrupted. The examination of children was carried out with the written permission of the parents.

2.2 Description of the study groups

The study involved 82 schoolchildren in grades 3-5 studying at SEI Secondary School in St. Petersburg. The primary selection of subjects was carried out on the basis of the laboratory of neurocognitive technologies of the scientific research center of the FSBEI HE Saint Petersburg State Pediatric Medical University.

Table 3 provides the quantity of participants in both the experimental and control groups, together with the mean age and grade.

Table 3 - Number of subjects, mean age and class

	Grade	Number of participants	Number of boys	Number of girls	Total number of participants	Mean age (M±m)
Experimental group	3	20	13	7	40	9y7m±8m
	4	10	6	4		
	5	10	5	5		
Control group	3	20	12	8	42	9y9m±9m
	4	12	5	7		
	5	10	5	5		

Note: M - group mean; m - standard deviation

The socio-demographic characteristics of children and their families are summarized in Table 4. For convenience, the data are given in percentages.

Table 4 – The socio-demographic characteristics of children and their families

Parameter	Answers	Experimental group	Control group
The parent who brought the child to the study	Mother	80%	71%
	Father	15%	19%
	Grandmother/ Grandfather	5%	10%
Type of institution where the child is enrolled	Secondary school	65%	100%
	Special (correctional) school	35%	0%
Mean age of parents	30-39	57%	62%
	40-49	28%	31%
	50-59	15%	7%
Family education level (if there are differences between parents, the highest level is given)	Secondary	5%	5%
	Specialized secondary	12%	7%
	Higher	83%	88%
Number of children in the family	1	27%	24%
	2	43%	52%
	3	25%	17%
	4	5%	7%
Parents' marital status	Married (including common-law marriage)	75%	71%
	Single	25%	29%
Material situation of the family (assessed by parents)	Highly affluent	0%	0%
	Secured	20%	24%
	Middle income	75%	71%
	Low-income people	5%	5%

As a grouping factor, the degree of formation of the reading skill was used, which was calculated through a standardized methodology for studying the reading skill [58]. The study did not consider the gender factor because there was insufficient data showing notable distinctions between boys and girls with dyslexia in the parameters studied. Additionally, the results of the pilot study did not support the necessity of including the gender factor in comparative and other forms of data analysis.

Criteria for inclusion of subjects in the study:

- Experimental group: reading technique coefficient indicators according to SMINCH method are below the age limit by - 1.5σ;
- Control group: reading technique coefficient indicators according to the SMINCH method (Standardized Assessment of Reading Skills) correspond to the age limit;

-Exclusion criteria:

- Indicators of the level of non-verbal intelligence less than 90 points according to the Kettell cultural-fair intelligence test [154; 155];
- Presence of auditory, visual and other speech disorders as well as lack of child or parental consent for a particular stage of the research.

2.3 Description of research methods of clinical and psychological features of children with dyslexia (first stage of the study)

2.3.1 Anxiety level study

The study of the subjects' anxiety level was carried out through The Children's Form of Manifest Anxiety Scale (CMAS), designed to assess the level of anxiety in children 8-12 years old. The scale was developed by A.Castaneda, B.R. McCandless, D.S. Palermo [153] based on the J. Taylor technique [450] aimed at detecting anxiety in adults. For the Russian sample, the method was adapted by A.M. Prikhoshan [91]. The basis of the questionnaire is represented by 42 questions selected from the MMPI method and related to somatic and mental manifestations of anxiety: fatigue, irritability, impatience, internal stiffness, attacks of fear and anxiety in response to minor stimuli. Subjects should mark each statement as true or incorrect in relation to themselves. 11 questions are aimed at identifying the tendency of the subject to give socially approved answers.

The primary assessment is translated into a scale by comparison with the normative indicators of the group. The assessment of the subject indicates the degree of severity of anxiety: 1-2 - the state of anxiety is not characteristic of the subject; 3-6 - normal

level of anxiety; 7-8 - somewhat increased anxiety; 9 - clearly increased anxiety; 10 - very high anxiety.

2.3.2 Personal traits research

The study of the subjects' personality qualities was carried out through the 12-factor Kettell Personality Questionnaire. The method was developed by R.B.Kettell and is a modification of the 16-factor Kettell personality questionnaire, intended for children aged 8-12 years. The work used a version of the questionnaire adapted for the Russian sample by E.M. Aleksandrovskaya and I.N. Gilyasheva [1]. The questionnaire consists of 120 questions aimed at studying the personality traits of the child and their manifestations in various aspects of life (relations with peers, family relationships, behavior in lessons, etc.). The questions are divided into 2 identical parts containing 60 questions. Each scale contains 10 questions, suggesting the choice of one of two answer options (verbal intelligence scale - three).

The primary valuation is normalized by means of regulatory tables. The minimum value is 1, the maximum value is 10. These values represent opposite values of the bipolar property of the individual.

The following is a description of the 12 personality factors used in the technique:

1. Factor A: Isolation - Sociability

   Grade A- (1-3 wall): characteristic of a child who is not distinguished by a wealth of emotional manifestations. Children often strive for loneliness, are closed to communication or are formal in them. Such children may be characterized by distrust, touchiness, negativity and self-centrism.

   Score A + (8-10 walls): characteristic of a child subject to affective experiences, characterized by a wealth of emotional manifestations, sometimes labile. High scores on this scale are characteristic of well-adapted, sociable children.

2. Factor B: Verbal intelligence

Score B- (1-3 wall): characteristic of children with low levels of verbal intelligence or emotional disorganization of thinking. Children with the appropriate assessment have difficulty mastering new concepts, perform tasks using mainly specific situational features. Often there are combinations with difficulties in attention and fatigue.

B + score (8-10 wall): Characteristic of a child showing high results on intellectual tests. High level of development of verbal intelligence.

3. Factor C: Self-doubt - Self-confidence

Grade C- (1-3 wall): characteristic of a child often feeling unable to cope with life's difficulties, helpless, tired. Often such children have fears, anxiety and resentment against others. A similar assessment occurs in children who react sharply to failures, assess themselves as less capable compared to peers. Often, such children have difficulties in educational activities.

C + score (8-10 wall): characteristic of an emotionally mature and well-adjusted child. Such children do not get upset about failures, feel self-confidence and in their abilities, calm, stability.

4. Factor D: Restraint - Excitability

Rating D- (1-3 wall): characteristic of an emotionally balanced and restrained child. Such children are less energetic in comparison with other children, they have good control of themselves even when difficulties arise.

D + score (8-10 walls): characteristic of a child with increased impulsiveness and overreaction even to weak stimuli. Anxiety and low levels of concentration are often noted. Such children have little control over their emotional state. The formation of these qualities is associated with both the peculiarities of temperament and the conditions of upbringing.

5. Factor E: Subordination - Self-approval

Grade E- (1-3 wall): characteristic of a conformal and obedient child. The child is focused on the opinion of others and is hardly able to defend his point of view. It is influenced by authorities and follows social attitudes. Behavior is characterized by passivity and subordination to duties, a lack of faith in oneself and in one's capabilities, a tendency to take the blame on oneself. Low dominance is usually associated with learning success across all age groups.

E + score (8-10 walls): characteristic of children preferring dominance and control over others in interpersonal communication. Trends towards self-assertion and independence are expressed. Often there is aggressiveness, ignoring social norms and authorities, a sense of superiority over others, which with a certain degree of probability can be accompanied by behavioral problems.

6. Factor F: Caution - Risk appetite

   Assessment F- (1-3 wall): Characteristic of an overly cautious child and indicative of restraint, concern and an excessive sense of responsibility.

   F + score (8-10 walls): Characteristic of an active and non-experiencing sense of fear in situations at increased child risk. It is often characteristic of children who overestimate their own capabilities.

7. Factor G: Uncollection - Mandatory

   Grade G- (1-3 wall): Characteristic of a child who does not show interest and obligation in relation to social norms and rules imposed by adults. Such children neglect their duties, often come into conflict with parents and teachers. Prone to volatility.

   G + score (8-10 walls): Characteristic of a child with a developed sense of responsibility. Such children are characterized by conscientiousness and commitment, strive to avoid violations of rules and norms, have developed self-control.

8. Factor H: Social timidity - Social courage

   G- score (1-3 wall): characteristic of children who are hypersensitive to any kind of threat. Such children are often timid in initiating social contacts, unsure of their abilities, shy and experiencing a sense of their own inferiority. The consequence of this kind of peculiarities is social isolation and restraint in their own manifestations.

   Assessment G + (8-10 walls): characteristic of a child who is not sensitive to social threats, decisive, showing his own initiative. Often such children easily come into contact, are not shy and have a wide circle of communication.

9. Factor I: Practicality - Sensitivity

   Grade I- (1-3 wall): characteristic of a child with practicality, realism and resilience. Such children are characterized by the dominance of logic from reason over feelings. Children are often prone to rationalization.

   Grade I + (8-10 walls): characteristic of a child who is soft, sensitive and imaginative. Such children have developed imaginations and "artistic perceptions of the world." Typical of a child are health anxiety, addiction and the need for love and support, and emotional sensitivity.

10. Factor O: Calm - Anxiety

    Grade O- (1-3 wall): Characteristic of a calm and cheerful child. Such children are not predisposed to fears, experiences of guilt and are not sensitive to external assessment.

    O + score (8-10 walls): Characteristic of an anxious, often depressed child. Often, this quality is accompanied with a reduced mood background. Such children are characterized by a developed sense of duty, exposure to the opinions of others and, accordingly, the dependence of the mood background

on approval or condemnation. Prone to fears and painful experiences about failure.

11. Factor Q3: Low self-monitoring - High self-monitoring

Q3 – assessment (1-3 wall): characteristic of children with low levels of self-control and will. Such children are able to concentrate and use their own forces economically, but they hardly organize the time and procedure for doing things. In addition, this assessment is characteristic of children experiencing difficulties in self-control of behavior in relation to social norms.

Q3 + score (8-10 walls): This score demonstrates the child's organization and ability to control their behavior. A child with high indicators for this factor is well aware of the requirements of society and tries to carefully fulfill them, taking care of the impression made on others. A high score for this fatcore can be regarded as a better social fitness, a more successful mastery of the requirements of the surrounding life.

12. Factor Q4: Relaxation - Tension

Q4- assessment (1-3 walls): this assessment is typical for children with relaxation, lack of strong motives. Such children are calm, and their desire for achievements or change is not expressed.

Assessment of Q4 + (8-10 walls): characteristic of children with excess urges if they cannot be discharged. Such children find it difficult to calm down and often feel tired even in the absence of work or in a relaxed environment. Also characteristic signs can be irritability, the predominance of a reduced mood background, problems with academic performance under normal intellectual abilities.

2.3.3 Reading and comprehension skills research

The study of the reading skill and comprehension of written texts was carried out through a standardized methodology for the study of the reading skill "SMINCH" [58]. According to the procedure for conducting the technique, children were offered to read aloud two narrative texts (see Annex 1,2).

The main characteristics of the texts are presented in Table 5.

Table 5 - Main characteristics of the texts of the "SMINCH" methodology

	Number of words	Mean length of words (number of letters)	Mean length of sentences (number of words)	Mean word frequency (ipm)*
Text 1: «How I caught crayfish»	227	4.6	8.4	5035
Text 2: «Ungrateful spruce»	213	5.3	8.5	4580

** - frequency according to the "new frequency dictionary of Russian vocabulary" [71], where ipm is the total frequency characterizing the number of uses per million words of the corpus (instances per million words)*

During reading, the number of words read in the first minute was recorded, as well as the number of erroneously read words (when self-correcting, the word is considered read correctly). Based on this indicator and data on the class (or number of years of study) in which the child is studying, the reading technique coefficient (KTP) is calculated. The calculation formula KTP = 100 + ((M - m)/m) * 50, where the M-number of words correctly read by the child in the first minute, the m-average number of words correctly read in the first minute by children of the same class. The reading technique coefficient reflects the degree of correspondence of the speed and correctness of reading a child with statistical indicators of the age norm. If 1.5 standard deviations are below the average for a given age, the reading skill is recognized as corresponding to the reading impairment level. Under the condition of dissociation of KTP and IQ, this disorder is considered as specific i.e. dyslexia.

The methodology also involves assessing the quality of reading comprehension. After reading each text, the child is asked questions about the content of the text (see Annex 3, 4).

According to the author of the technique, a violation of comprehension of the written text, requiring specialized assistance, can be diagnosed with the number of correct answers less than or equal to three. The number of correct answers from four to six can be considered the "low norm of comprehension," above seven - the normal level of comprehension.

2.3.4 Nonverbal intelligence level study

In order to assess the intellectual development of children, the Cultural-Free Kettell Intelligence Test was used [154; 155]. There are three options for this test, in this work the CFIT option was used, intended for children from 8 to 12 years old. The CFIT scale consists of two parts, each consisting of 4 subtests:

1 subtest - "supplement" - contains 12 tasks, increasing in complexity. In each task on the left are shapes in a specific logical sequence. After analyzing the logic of changes, it is necessary from 4-5 figures located on the right to select the one that corresponds to the detected pattern and can continue the logical sequence of 3 figures located on the left. It takes 4 minutes to solve problems.

2 subtest - "classification" - contains 14 tasks. Each task contains a series of five shapes, in which the four shapes are always united by some common feature. In each row, you need to find a single figure that differs from the rest. The features common to the four figures are the shape, quantity, color, spatial relationship between the elements of the figures. It takes 4 minutes to solve problems.

3 subtests - "matrix" - consists of 12 tasks, increasing in complexity. The logic of solving these problems is similar to tasks 1 subtest. The features that underlie the construction of the tasks of a given subtest are the spatial arrangement, shape, size, number, coloring, and combinations of these features. It takes 3 minutes to solve problems.

4 subtest - "topology" - consists of 8 tasks, increasing in complexity. In each task on the left is a complex reference figure consisting of simple geometric figures. There is a point inside the complex reference figure. It is necessary to analyze the position of the point in relation to individual geometric figures constituting a complex reference figure. Then, among the five complex figures located on the right, one must find one in which the point can occupy exactly the same position as in the complex reference figure. It takes 3 minutes to solve problems.

The final assessment of the test is the IQ intelligence coefficient, which is an integral indicator of the subject's intellectual development. According to the method, the value of the IQ coefficient in the range from 90 to 110 points corresponds to the normal level of intelligence.

2.3.5 Study of the level of short-term memory and running memory for number

The study of the level of running memory for numbers was carried out by subtesting the children's version of the WISC Wexler test [89; 485] "Digit span" The subtest consists of two parts - the memory and repetition of numbers in forward and backward order.

The procedure for carrying out consists in pronouncing a series of numbers by the experimenter (alternately with a length of 3 to 9 digits) and immediately following it by reproducing the test subject of this series in either forward or backward order. When the number series is correctly reproduced in 3 digits, a transition is made to a series consisting of four, etc.

When conducting the part of the "forward order" for the child, the following instruction is voiced - "Now I will tell you a few numbers, and as soon as I finish talking, repeat them in exactly the same order. Alright? Well, come on, let's try. Attention.... " When conducting part "backward order" of the following - "Now I will tell you a few more numbers, you will also repeat them. Only you will start from the end, speak in the opposite order. Look, for example, I say "one or two" (show with your hand to different places on the table), and you say "two or one" (again

show with your hand to these places, but in the opposite order). Got that? Well, let's try it. Attention... "

The numbers are pronounced clearly with an interval of one second, if the reproduction is incorrect, a different series of similar length is proposed as an additional attempt. In case of repeated incorrect reproduction, the result is recorded, in case of correct reproduction, the next row is given.

The score for each type of count (direct or reverse) is equal to the number of digits in the maximum row reproduced correctly. The total subtest score equals the sum of the scores for the direct and reverse counts.

2.3.6 Research on the level of phonological running memory

In order to study phonological memory, a test of non-existent words (pseudo-donkeys) was used [222; 224].

The repetition of pseudo-donkeys makes it possible to assess a child's ability to perceive, process and reproduce simple sequences of phonemes that do not exist in the language in which they speak, although they consist of combinations of sounds typical of the native language. Successful execution of the task implies that children have formed ideas about the differences in sounds in their native language and the skill of their correct processing in running memory. In the material of several languages (including Russian), it was shown that the task of repeating pseudo-donkeys is a reliable marker capable of identifying deviations in the trajectory of speech development [14; 114; 201]. There are 24 pseudo-words in the test (see Annex 5). A point is awarded for each correct answer. The maximum score a child can get is 24 points.

The instruction received by the child was as follows - "Now I will tell you funny words that you have never heard/a, and see if you can repeat them after me. I say: a sign, and you repeat after me: a sign. I say: nakfeta, and you repeat after me:

_____

(in case the answer is not received: I say: nakfeta, and you repeat after me: nakfeta). Well done! Let's try again: Vadavod: _____. Well done! Now I see that you can continue the game "

2.4 Description of the experimental method for studying the oculomotor reading behavior of children with dyslexia (stage 2 of the study)

2.4.1 Oculomotor reading behavior study procedure

An experimental study of eye movements as referents of mental actions and reading operations was undertaken with subjects of both groups. Gaze and eye tracking system RED500 (Gaze and eye tracking system RED500) was used to record eye movements. The error in fixing the gaze by the system does not exceed 1 degree. The frequency of the eye fixation system is 500Hz. The system allows you to track the point of view of a person on the stimulus presented to him at a particular moment in time, which allows you to track the entire path of view through the text in the process of reading and conduct a qualitative analysis of the phenomenology of reading activity.

The study was conducted with each child on a case-by-case basis. The position of the child and the recording equipment was adjusted to meet the following condition - the subject's eyes should be in the same plane with the center of the screen. This condition is necessary for the successful calibration of the recording equipment (establishing a connection between the position of the eyes and the coordinates of the gaze on the screen).

To minimize errors associated with changing the child's position, calibration was carried out before reading each of the stimuli texts. The distance between the test subject and the screen was an average of 55 cm, which complies with the standards of SanPiN 2.2.2/2.4.1340-03.

Before each of the stimulus texts was presented, the instruction was read to the child according to two types of intended tasks.

2.4.2 Stimulant material

As stimuli, 2 types of texts were used, 2 texts each: scientific and narrative. Texts of each type were selected similar in terms of complexity (see Annex. 6-9).
The descriptive characteristics of each text are presented in Table (Table 6).

Table 6 - Descriptive characteristics of stimulus texts

Text	Genre of the text	Number of words	Number of sentences	Mean sentence length (words)	Mean word length (characters)	Mean word frequency (ipm)*
Text 1	Scientific	122	9	13.5	6.3	4795
Text 2	Scientific	109	8	13.6	5.3	3912
Text 3	Narrative	128	12	10.6	5.2	5097
Text 4	Narrative	139	16	8.6	4.6	4794

** - frequency according to the "new frequency dictionary of Russian vocabulary" [71], where ipm is the total frequency characterizing the number of uses per million words of the corpus (instances per million words)*

The protocol assumed the use of 2 types of tasks (presentation of texts):

1) questions were presented twice, before and after reading. When performing this task, the following instructions were used: "Now on the screen you will see questions for the text that you will read. Try to read these questions and understand them. You can read as long as you like, just say when you are ready, and I will include you a text where you will find the answers to these questions. Good

2) questions were presented only after reading. When performing the second type of task, the following instruction was used: "Now you will see text on the screen. Your job is to read it and understand it. You can read as long as you like. When you think that you understood the text well - tell me, and I will include you questions about what was written in the text, and you will answer them, okay? "

Thus, both tasks ended with an assessment of the quality of comprehension produced through questions on the content of what was read. The number of questions in scientific texts is 5, in narrative texts - 10. Answers were given by

children in oral, open form and recorded on a recorder. As when reading the text, the subjects were not limited in time to answer questions.

Selection of texts in each of the tasks was randomized. For example, in half of the subjects, task type 1 included text №1 and task type 2 included text №2. Similarly, tasks were randomized to read narrative texts.

2.4.3 Analyzed parameters of eye movements

Human oculomotor activity consists of two main types of movements - fixations and saccades, which are oculomotor referents of mental actions and operations (Figure 2).

Figure 2 - Oculomotor referents of mental actions and operations

Fixations mean stops of sight on a certain fragment of the stimulus, during which most of the information is processed [159; 391, etc.]. Moving from fixation to fixation, a person makes eye movements called saccades. In a reading situation, two types of saccades can be distinguished - moving the eye to still unread fragments of text within one reading (progressive saccades) and returning to fragments already read (regressive saccades).

The primary processing of oculomotor indicators was carried out by the built-in software of the eye tracking system - BeGaze 2.0 and was aimed at highlighting all fixations and saccades in the process of reading a specific text, followed by the removal of artifacts and non-informative actions. For each fixation, the system

calculates the position of the eye on the stimulus screen and its duration. For saccades, the position of the beginning and end, the average duration and amplitude are calculated. Micro-fixations with a duration of less than 50 ms, insufficient for reading information [280; 392, p.376], as well as fixations resulting from an error in recording an experiment by an eye tracking system (including a point of view outside the stimulus field) were excluded from the analysis.

Secondary processing implied the isolation of progressive and regressive saccades, counting the total number of fixations and saccades performed when reading a particular text, as well as the average duration of fixations and the average amplitude of saccades.

A pilot study and literature data suggested that regressive saccades of different extents play different informational roles.

The researchers grouped regression saccades into 3 categories: 1) high - and medium-amplitude, intentionally performed and associated with difficulties in comprehension of what was read [268; 279];

2) short regressions: a) performed within the word and associated with recoding difficulties, the inability to successfully complete the full lexical processing of the word [373; 382]; b) short regressions due to oculomotor error - in the case when fixation is performed in an inconvenient place for perception [39; 351].

For these reasons, we attempted to divide regressive saccades into: 1) Microregresses are regressive saccades within 1 °, which corresponds to 2.6 characters and about half the average word length in the texts we use; 2) Short regressions with amplitude from 1 to 1.9°, corresponding to interval from 2.6 to 5.3 characters and length from half to whole word; 3) Medium regressions with amplitude from 1.9° to 5.9°, corresponding to the interval from 5.3 to 16 characters and length from 1 to 3 words; 4) Long regressions with amlitud above 5.9°, extending beyond 3 layers.

According to the procedure, 1° is 0.37 characters. For the convenience of presentation, the types of regressive saccades are presented in Annex 10.

The allocation of progressive saccades and regressive saccades of different types was carried out through additionally developed software implemented directly for the needs of research in html and 1c language programming environments.

Thus, we analyzed the following oculomotor referents of the reading activities of the subjects when reading all texts:

1. Average duration of fixations;

2. Average amplitude of progressive saccades

3. Average amplitude of regressive saccades

4. Average number of fixations (average, hereinafter, denotes the number of fixations or saccades in terms of one word);

5. Average number of regressive saccades;

6. Average number of progressive saccades;

7. Percentage of microgressive saccades relative to total number of regressive saccades;

8. Percentage of short regressive saccades relative to total number of regressive saccades;

9. Percentage of medium regressive saccades relative to total number of regressive saccades;

10. Percentage of long regressive saccades relative to total number of regressive saccades.

The question of violations of the structure of reading activity, the influence of cognitive and language determinants on its features required a separate analysis of each of the elements included in it - mental actions and operations (through the study of oculomotor referents). To assess the flexibility of the structure of actions and operations in children with dyslexia and the focus of their reading activities, the

analysis of oculomotor indicators was carried out separately for each of the texts. To the same end, we undertook an analysis of the influence of the factors "type of task set for the subject" and "genre of text" on the features of reading activities and the success of its implementation separately for the experimental and control group

In addition, the study of strategies for the implementation of reading activities involved the division of the process of processing text by children into readings. We analyzed the characteristics of the eye movements of each child taken in the process:

1) the first complete reading of the text from the first word to the last,
2) repeated readings - processing of the text produced by the child after the first complete reading of the text.

2.5. Statistical processing of study results

Quantitative indicators were processed using the statistical package SPSS 20.0. Inter-group comparison of indicators according to the SMINCH method, cognitive prerequisites for reading activities, the quality of comprehension of texts, as well as oculomotor referents of the success of reading activities was carried out using the Mann-Whitney non-parametric criterion. The analysis of the purposefulness of reading activity was carried out through factor analysis, which includes oculomotor referents of reading activity and the number of correct answers to questions to texts. Intra-group comparisons of first and repeated readings were also made through the use of the Mann-Whitney test. The relationship between oculomotor parameters and cognitive prerequisites of reading activity was established through Spearman's rank correlation criterion. The influence of cognitive parameters on oculomotor referents of the success of reading activities, as well as the influence of the factors "text number", "task type", "text genre" was established through regression analysis. Regression analysis was also used to establish the effect of the number of reads of the text on the quality of its comprehension.

Chapter 3. RESEARCH RESULTS AND DISCUSSION

This chapter describes the results of a study of the clinical and psychological characteristics of children with dyslexia: personal qualities, anxiety and cognitive prerequisites for reading activities. The results of the analysis of the quality of comprehension of the written text and reading technique are presented. The results of quantitative and qualitative analysis of reading activities in children with dyslexia and their healthy peers are presented.

3.1 Clinical and psychological characteristics of children with dyslexia

The results of conversations and observations allowed to describe typical manifestations of the emotional-personal sphere of children with dyslexia at the time of the study. In particular, we identified three main types of attitude to tasks related to reading:

1) formal, indifferent;

2) interested;

3) negative (manifested more often in an implicit form).

Subjects of the first type were characterized by indifference when reporting upcoming tasks related to reading. Such children rather showed a desire to sooner finish the study, continue the conversation with the experimenter on distracted topics, etc. The emotional background of the children did not undergo significant changes in the study process. Also, they were often characterized by an external motive associated only with the need (need) to fulfill the instructions of an adult. Among both children with dyslexia and children of the normal group, this type of test subjects was the most common (50% of children in the experimental group and 42% of children in the control group).

The test subject of the second type showed interest in relation to the tasks. In such a way, the interest was manifested in "immersion in tasks", distraction from the presence of adults, the continuation of discussions about the content of the text even after the completion of reading, questions from children about words they do not

know, as well as the desire to read other texts, etc. The emotional background of children of this type, on the one hand, varied from child to child, and on the other, underwent certain changes in some children from the beginning of the study to its end (from increased anxiety to pronounced interest and joy). 26% of experimental subjects and 39% of control subjects were assigned to this type of test.

Subjects of the third type reacted negatively to voicing the nature of future tasks "today we read several texts with you" - the children sighed, showed disinterest, were upset or spoke directly about their unwillingness to undergo research. Often, this type of reaction was accompanied by attempts by parents to force the child to start/continue the study, which, in turn, required the experimenter to interrupt such attempts and contribute to the appearance of the slightest signs of interest in the child. Subjects of this type represent the smallest group: 24% of experimental children and 19% of control children.

Importantly, the results of follow-up and conversations suggested increased levels of anxiety in dyslexic children. In the process of completing tasks (reading texts and answers to questions), anxiety manifested itself in the difficulties of focusing on instructions, insensitivity, characteristic hand-picking of personal items, concern about the results of the study and sensitivity to the reaction of an adult (psychologist, parents). Also noteworthy is the following observation: clarifying the lack of a rating and scoring procedure ("we do not rate, on the contrary, it will be great if you read as if you are at home and alone with the book") largely reduced anxiety in most test children with dyslexia. Follow-up results demonstrating an increased level of anxiety in children with dyslexia are consistent with the results of methods aimed at studying the level of anxiety and personality qualities of children with dyslexia.

3.1.1 Level of anxiety and personality traits in in children with dyslexia and their healthy peers

A comparative analysis of the results of the Explicit Anxiety Scale revealed a higher level of anxiety in the dyslexic group compared to the control group (Table 7).

Table 7 - Assessment of anxiety level in children of the control and experimental groups

	Control group (M±m)	Experimental group (M±m)	Significance of differences (p=)
Anxiety	6.0±1.06	8.25±1.58	0.006

Note: M - group mean, m - standard deviation

According to the normative values [71], the results obtained in the groups allow us to conclude that in children of the control group anxiety corresponded to the "normal level." The value obtained in the dyslexic group of children corresponds to anxiety at a level between "somewhat elevated" and "clearly elevated anxiety".

It can be assumed that one of the reasons for the increased level of anxiety in children with dyslexia is the systematic difficulties they face at school [46; 56]. Psychological studies have convincingly shown the role of learning difficulties in experiencing psychological discomfort. In particular, an association was found between the experience of school difficulties and the formation of clinically pronounced symptoms of anxiety and depression [182; 247]. Systematic failures in school assignments (or failure to complete them) are stressors contributing to anxiety and depression [420; 421]. Our findings are consistent with other work that found high levels of anxiety in dyslexic children and adolescents [195; 349; 459].

Clinical observations and studies show that dyslexia affects not only the likelihood of the formation of concomitant emotional disorders, but also often plays a negative role in the process of personality formation (threat to the formation of adequate self-esteem, initiative, motivation, etc.) [314; 331].

The results of a comparative analysis of personality traits in children with dyslexia and their healthy peers revealed differences between children of the control and experimental groups in the severity of such qualities as "verbal intelligence", "self-confidence", "social courage", "anxiety", "tension" (Table 8).

Table 8 - Comparative analysis of Kettell's 12-factor questionnaire methodology indicators

Factor	Control group		Experimental group		Significance of differences (p=)
	M±m	Score	M±m	Score	
Sociability	4.88±1.76	A	4.12 ±1.12	A	0.406
Verbal intelligence	7.05±2.10	B	5.20±1.66	B	0.031
Self-confidence	4.53±1.66	C	2.85±1.46	C-	0.037
Excitability	5.76±1.71	D	6.25±1.48	D	0.511
Self-approval	5.35± 2.39	E	6.00±1.60	E	0.374
Risk appetite	5.47±2.26	F	5.87±1.96	F	0.628
Mandatory	4.35±1.76	G	4.75±2.05	G	0.754
Social timidity	4.93±2.73	H	2.80±1.80	H-	0.047
Sensitivity	6.47±2.00	I	5.37±1.76	I	0.140
Anxiety	6.47±1.94	O	8.12±1.64	O+	0.043
High self-control	4.18±2.06	Q3	4.37±1.99	Q3	0.754
Tension	6.53±1.90	Q4+	8.25±1.98	Q4	0.037

Note: M - group mean, m - standard deviation, p - significance coefficient

According to the results of the study, children with dyslexia are characterized by higher levels of anxiety ($p < 0.05$) and tension ($p < 0.05$). In addition, dyslexic children show less social courage compared to normal group children ($p < 0.05$). Also, children with dyslexia were less confident ($p < 0.05$). The value of the factor "verbal intelligence" was also less in comparison with the control group ($p < 0.05$), however, the average score does not go beyond the "B" score.

Qualitative analysis of the questionnaire results allows us to talk about the presence of such personality qualities in children with dyslexia as self-doubt (C-), social timidity (H-), anxiety (O +) and tension (Q4 +) [88].

A number of papers consistent with our findings found that children with dyslexia were characterized by self-doubt and low self-esteem, as well as their associated high levels of tension and anxiety [111; 140; 350]. In particular, the threat to the formation of adequate self-esteem is associated with a constant experience of their own failure when comparing a child with classmates and other peers [331].

In addition, Humphrey [264; 266] studies examining the I-concept and its manifestations in behavior in dyslexic children have found that they are more likely than healthy children to have timid behavior ("timid behavior"), as well as avoiding educational work and potentially stressful situations that are associated with social (in particular school) maladaptation.

3.1.2 Cognitive prerequisites for readership in children with dyslexia and their healthy peers

One of the tasks of our study was to assess the state of some cognitive functions, which are considered important prerequisites for the reading and comprehension skill [151; 223; 224; 315; 445; 467, etc.]: short-term memory (repetition of unweights and inverted repetition of a number of digits) and short-term memory for serially organized verbal material (Digit span in forward order). Statistical analysis showed that despite the fact that all three tasks are related to mnestic functions, significant inter-group differences were found in only one of them: the repetition of non-words (Table 9)

Table 9 - Results of the "Nonword repetition" and "Digit span" tests

Test	Control group	Experimental group	Significance of differences (p=)
	(M±m)	(M±m)	
Nonword repetition	20.2±2.42	18.1±3.54	0.021
Digit span (forward order)	4.7±0.64	5.1±1.0	0.149
Digit span (backward order)	3.3±0.8	3.1±0.7	0.450

Note: M - group mean, m - standard deviation; p - significance coefficient

The results of a comparative analysis of the indicators of mnestic functions indicate a shortage of phonological running memory while preserving short-term and modal-nonspecific short-term memory in children with dyslexia. In order to assess the relationships between the indicators of the methods " Digit span" and "Nonword repetition (operative phonological memory and short-term and random

memory per numerical categorical material), we undertook correlation analysis (Table 10, 11).

Table 10 - Correlation analysis of the results of the test subjects performing the methods "Digit span" and "Nonword repetition": control group

	Digit span (forward order)	Digit span (backward order)
Nonword repetition	r=0.373 p=0.105	r=-0.105 p=0.661
Digit span (forward order)		r=0.276 p=0.226

Note: r - correlation coefficient, p - significance coefficient

Table 11 - Correlation analysis of the results of the test subjects performing the methods "Digit span" and "Nonword repetition": experimental group

	Digit span (forward order)	Digit span (backward order)
Nonword repetition	r=0.264 p=0.383	r=-0.343 p=0.251
Digit span (forward order)		r=-0.145 p=0.607

Note: r - correlation coefficient, p - significance coefficient

The analysis revealed the absence of a relationship between the results of the methods "Digit span" and "Nonwords repetition" in both groups, which, on the one hand, suggests that violations of phonological working memory are characteristic for children with dyslexia, and on the other, it allows us to talk about the independence of two memory blocks - modal-nonspecific (numerical) and phonological.

The results of the inter-group comparative analysis of the indicators of the digit span test are consistent with the results of studies [176; 261; 426], which also did not find a difference in the indicator of modally nonspecific short term memory

between readers with a reading skill appropriate to the norm and dyslexic. However, it should be noted that in several works using the subtest "digit span" a shortage of short-term and working memory was found in children with dyslexia [483, etc.].

The results of our study are consistent with the findings of a large number of papers that found phonological working memory deficits in dyslexic children [176; 194; 222; 259, etc.]. However, there are two different psychological models, which interpret differently the mechanisms behind the implementation of the "nonwords repetition" test. The first model implies that the repetition of weeds is a direct indicator of the level of memory [223], associated with other types of working memory (for numbers and words). Within the framework of this model, phonological working memory is considered only as part of the general mnestic abilities ("domain general"), which are one of the most important components of learning to read [227; 481].

The second model describes the specificity of the mechanisms of the phonological working memory block in comparison with other types of memory ("domain specific"). This model implies the absence of a direct connection between the level of phonological working memory and other types of memory, as well as the quality of text comprehension. The central link of the model is not just the level of working memory, but the quality of phonological representations (representations) and the ability to access them [428; 429; 431]. I.e.. since "non-words" have not previously been encountered, the subject needs to segment and analyze them based on other phonological representations available to him.

From the above, it can be concluded that if the first model is correct, then the difference between dyslexics and healthy peers would be manifested in all three tasks. If the second model is correct, then the efficiency of phonological working memory and short-term memory per number may differ [239, p.3], with which the results obtained by us are consistent.

It is important to note that the first and second models are a special case of larger and essentially alternative approaches to understanding working memory - the

theory of single and multiple memory theory. According to the theory of single memory, single resources are used to remember stimuli of different modality [197; 461]. Then the lack of working memory resources will be reflected in the low quality of reproduction of stimuli of different modality.

Multiple memory theory implies the presence of different working memory subsystems with their own independent resources and processing stimuli of different modality [175; 344; 415; 491]. The question of the number of systems and subsystems remains open. The data obtained in some studies suggest the presence of at least three memory systems, each of which has its own volume: phonological, visual-spatial and a system responsible for processing numerical information [174]. Thus, the results of the analysis are consistent with the theory of multiple memory: children with dyslexia detect a deficit in phonological working memory (in phonological analysis and access to phonological representations) in comparison with healthy children and do not demonstrate difficulties in the operation of the numerical subsystem of memory.

Intergroup comparative analysis of nonverbal intelligence, revealed no differences between groups (Table 12).

Table 12 - Results of the Culturally fair Kettell Intelligence Test: General IQ

	Control group	Experimental group	Significance of differences (p=)
	(M±m)	(M±m)	
Intelligence level (raw scores, correctly completed tasks)	28.3±5.2	27.1±5	0.441
Intelligence level (coefficient)	113.7±13.1	107.8±14.3	0.158

Note: M - group mean, m - standard deviation; p - significance coefficient

The results of the comparative analysis of non-verbal intelligence are explained by the specifics of dyslexia and the lack of direct connection with intellectual development. According to modern understanding, dyslexia is a persistent selective impairment of the ability to master the reading skill in the normal level of intellectual development and the absence of auditory and visual impairment

[46; 47; 316; 464]. However, a comparative analysis of the number of correct answers for each of the subtests revealed certain differences between children with dyslexia and the normal group (Table 13).

Table 13 - Results of performing subtests of the "Cultural-free Kettell intelligence test" method (number of correct answers)

	Control group	Experimental group	Significance of differences (p=)
	(M±m)	(M±m)	
Subtest №1. «Supplement»	8.1±1.2	7.6±1.6	0.427
Subtest №2. «Classification»	7.7±1.5	7.3±1.5	0.612
Subtest №3. «Matrix»	9.4±2.0	8.1±1.7	0.049
Subtest №4. «Topology»	5.6±1.6	4.6±1.5	0.046

Note: M - group mean, m - standard deviation; p - significance coefficient

Children with dyslexia worse than children of the normal group coped with subtests No. 3 ("matrix") and No. 4 ("topology"). Subtest 3 implies that the participant must recognize the rule underlying the construction of the figures represented in the matrix and choose from five alternatives a suitable figure to fill the matrix. In subtest No. 4, each element is built in accordance with a certain reference configuration, in which a point is located according to some topological conditions. The subject must choose from the alternatives another configuration in which the point could be placed with the same topological relationship to other parts of the configuration as in the base configuration (e.g. inside a square but outside a circle).

According to the author of the test, subtests No. 3 and No. 4 are more reliable indicators of fluid intelligence ("ability to flow") in comparison with the first two [156, p.16]. Fluid intelligence is more dependent on the biological capabilities of the brain, and its main function is to quickly and accurately process current information [102; 155]. Fluid intelligence is actually an indicator of the subject's ability to operate with models of objects. Current research has demonstrated a strong

relationship between "fluid intelligence" and control functions - a collection of highly organized cognitive processes that modulate the dynamics of cognitive activity and behavior. The most influential model of performing functions of Miyake and Friedman describes three important components of executive functions - working memory, inhibitory control and cognitive flexibility [214; 335]. The most important in the context of the present study are the results of work where a strong relationship was established between "fluid intelligence" and working memory in both children and adults [215, 216; 284; 407; 462, etc.], which may explain the results we obtained, namely, lower fluid intelligence indicators in the subtests of the CFIT test No. 3 and No. 4 for phonological working memory deficiency in dyslexic children.

3.2 Analysis of reading technique parameters and quality of comprehension of written texts in children with dyslexia

The results of Standardized Assessment of Reading Skills by children with dyslexia differed from the normal group both in terms of reading speed and in terms of text comprehension quality (Table 14).

Table 14 - Reading fluency, reading coefficient and quality of reading comprehension in dyslexic children and their healthy peers

Parameter	Text	Control group (M±m)	Experimental group (M±m)	Significance of differences (p=)
Reading fluency (words per minute)	Text 1 ("How I caught crayfish")	99.7±28.3	46±17.5	0.001
	Text 2 ("Ungrateful Spruce")	84.1±24.1	32.4±12	0.001
Coefficient of reading fluency	Text 1 ("How I caught crayfish")	105.5±16.5	73.3±8	0.001
	Text 2 ("Ungrateful Spruce")	104.7±18.1	69.5±5.4	0.001
Quality of comprehension (percentage of correct answers in %)	Text 1 ("How I caught crayfish")	91±10	85±17	0.076
	Text 2 ("Ungrateful Spruce")	78±15	56±29	0.001

Note: M - group mean, m - standard deviation; p - significance coefficient

The reading speed of both texts by children with dyslexia was more than half that of their healthy peers. The reading technique coefficient calculated based on this parameter, as expected, distinguished subgroups, revealing a 1.5-fold difference between dyslexics and normal-reading children. A significant difference in the level of comprehension was found only in text No. 2, which, according to the method, is more complex, which is reflected, in particular, in the greater average length of words and their lower average frequency (Table 5).

The number of errors made during reading also distinguished groups when comparing indicators for both texts. Children with dyslexia made significantly more errors compared to healthy peers (Table 15).

Table 15 - Number of errors in reading texts by dyslexic children and their healthy peers

Parameter	Text	Control group (M±m)	Experimental group (M±m)	Significance of differences (p=)
Number of errors	Text 1 ("How I caught crayfish")	1.0±1.1	1.9±1.2	0.043
	Text 2 ("Ungrateful Spruce")	1.4±1.4	2.8±2.3	0.026

Note: M - group mean, m - standard deviation; p - significance coefficient

Among the mistakes made by children with dyslexia, errors were more common, manifested in the replacement of vowels (i-y, e-a, etc.) and consonants (t-d, k-g, etc.), as well as in the permutation of sounds. Often there were guesses at the sublexical and lexical level, which, for example, was often manifested in an erroneous reading of the same word within a specific text ("thorn" - "thorn" - "thorns").

In addition, a comparative intra-group analysis of reading techniques and quality of comprehension of texts No. 1 and No. 2 revealed significant differences in both groups (Table No. 16).

Table 16 - Comparative analysis of reading speed, quality of comprehension and number of errors in reading texts

Parameter	Group	Text 1 ("How I caught crayfish")	Text 2 ("Ungrateful Spruce")	Significance of differences (p=)
		(M±m)	(M±m)	
Reading fluency (words per minute)	Control group	99.7±28.3	84.1±24.1	0.001
	Experimental group	46±17.5	32.4±12	0.001
Quality of comprehension (percentage of correct answers in %)	Control group	91±10	78±.15	0.001
	Experimental group	85±17	56±29	0.001
Number of errors	Control group	1.0±1.1	1.4±1.4	0.001
	Experimental group	1.9±1.2	2.8±2.3	0.001

Note: M - group mean, m - standard deviation; p - significance coefficient

Reading text No. 2 by children of the norm group was characterized by lower speed, lower quality of comprehension and more errors when reading words in comparison with reading text No. 1. Similar differences were identified in the group of children with dyslexia. It can be assumed that the accuracy of reading words, the speed of reading and the quality of comprehension is influenced by the complexity of the text. As mentioned above, text No. 2 is characterized by a smaller average frequency and a longer length of words included in it.

The degree of comprehension of the reading was independent of the technical parameters and did not correlate with the above reading parameters in either the control or experimental group (Table 17, 18).

Table 17 - Correlation of text comprehension and reading fluency parameters in children of control group

	Reading fluency. Text 1	Coefficient of reading fluency. Text 1
Number of right answers. Text 1	r=-0.19 p=0.223	r=-0.305 p=0.47
	Reading fluency. Text 2	Coefficient of reading fluency. Text 2
Number of right answers. Text 2	r=-0.46 p=0.769	r=-0.17 p=0.274

Note: r - correlation coefficient, p - significance coefficient

Table 18 - Correlation of text comprehension and reading fluency parameters in children of experimental group

	Reading fluency. Text 1	Coefficient of reading fluency. Text 1
Number of right answers. Text 1	r=0.13 p=0.955	r=-0.89 p=0.687
	Reading fluency. Text 2	Coefficient of reading fluency. Text 2
Number of right answers. Text 2	r=0.16 p=0.482	r=0.17 p=0.438

Note: r - correlation coefficient, p - significance coefficient

This is consistent with the data of other authors who have established the absence or weak correlation between the quality of comprehension and reading technique [46; 47; 342; 343; 442; 500].

Analysis of the answers to the questions revealed certain features in children with dyslexia in comprehension. Therefore, in text No. 1, the most difficult questions for children were:

1. "where do crayfish live?" (62% of dyslexic children and 33% of normal group children answered incorrectly);

2. "what was the boy afraid to do?" (57% of dyslexic children and 14% of normal group children answered incorrectly).

Among the erroneous answers to the first question, the most common were such as "under the roots", "between stones", "in the river". In general, these responses also occurred in children of the control group, but the incidence of such errors was lower. The second question also proved difficult for children with dyslexia, with the most common misguided answer being "afraid to touch pincers." When building the macro-propositional structure of the text, the content of the boy's fear was ignored, the answer was given on the principle of guesswork, formulated after reading the text ("cancer weapons are pincers, therefore the boy was afraid of pincers").

Analysis of the answers to the questions to text No. 2 revealed significant differences between the groups not only in the number of correct answers, but also in their content. So children with dyslexia experienced difficulties in the following issues:

1) "where did the spruce grow?" (83% of dyslexic children and 66% of normal group children answered incorrectly);

2) "what struck a small spruce in spring?" (69% of dyslexic children and 52% of normal group children answered incorrectly);

3) "what did you like in the fall?" (73% of dyslexic children and 49% of normal group children answered incorrectly);

4) "What relationship did you have with the thorn?" (61% of dyslexic children and 19% of normal group children answered incorrectly);

5) "What did the thorn man answer her?" (61% of dyslexic children and 35% of normal group children answered incorrectly).

The answers to the first question were often characterized by the inaccuracy of the description ("spruce grew in the forest," "next to the thorn"). The most common error on the second and third questions was that children confused the seasons with each other, and, as a result, "white flowers" with "blue fruits." Erroneous answers to the fourth and fifth questions often reflected difficulties in understanding the context containing the dynamic side of the relationship of the main characters. In such a way, children with dyslexia often answered the question of the relationship between spruce and thorn - "bad," "they swore," ignoring the fact of friendship, quarrel,

resentment and deterioration of relations. The fifth question was more often unanswered.

For children of the control group, errors on the first, second and third questions were characteristic. The most common errors were the inaccuracy of the description of the place ("in the forest"), as well as errors in the correlation of the time of year with the "white flowers" and "blue fruits."

Summarizing the results of a qualitative analysis of answers to questions, it can be assumed that children with dyslexia have difficulty in processing the implicit content of the text. Implicit means content that is not directly represented in the text. The implicit content of the text can be learned from establishing a relationship between explicitly presented facts in the text or from a context that is processed with the involvement of personal experience of the reader [184].

Therefore, based on the model of comprehension of the text of Kintsch and van Dijk, it can be assumed that children with dyslexia are characterized not only by violations of the processing of the "surface level of text" (lexical), but also by violations of the level of creation of text representation (textbase) (syntactic organization of text) and the level of "creation of a situational model of text" (logical-content component of text, text connectivity).

Therefore, difficulties in processing the second and third levels reveal themselves primarily in ignoring certain propositional structures that carry explicit information ("where did the spruce grow?," "What was the boy afraid to do?," "Where do the crayfish live?," "What struck the small spruce in spring?," "What did you like in autumn?"). Dyslexic children pay more attention to narrative text components, actions, events, ignoring blocks containing the descriptive part necessary to understand the context of the situation in particular and build a coherent text model in general.

Our observations are consistent with the results of other studies focusing on texts comprehension in children with reading and speech disorders. Similar results were found by studies on the ability of children with dyslexia to understand

metaphors [242; 286; 347] and other forms of utterances containing implicit information [477]. Importantly, in studies where the subject of the study was adults with dyslexia, similar results were also found - like children with dyslexia, adults suffering from reading disorders show pronounced difficulties in understanding the context and processing implicit information [261; 433]. Similar difficulties in reading implicit information in children with dyslexia were found in the study of A.N. Kornev and I.Balchuniene, devoted to the comprehension and generation of narratives [57].

Analysis of quantitative indicators of comprehension of incentive texts (the proportion of correct answers to questions) revealed significant differences between groups in texts No. 2 (scientific) and No. 3 (artistic, narrative). Children with dyslexia in these texts gave fewer correct answers (Table 19).

Table 19 - Percentage of correct answers to the questions for stimulus texts

Parameter	Text	Control group	Experimental group	Significance of differences (p=)
		(M±m)	(M±m)	
Percentage of right answers (%)	Text 1	69±27	63±28	0.450
	Text 2	70±22	52±16	0.039
	Text 3	88±22	73±23	0.050
	Text 4	95±10	92±11	0.322

Note: M - group mean, m - standard deviation; p - significance coefficient

Of independent interest is the ratio of the results of assessing the quality of comprehension of the texts-stimuli and comprehension of the texts of the Standardized Assessment of Reading Skills methodology. Differences in comprehension between children of the control and experimental groups were found in half of the texts of both the Standardized Assessment of Reading Skills methodology and the texts of stimuli, despite the differences in the conditions for the implementation of reading activities.

Therefore, according to the instructions of the Standardized Assessment of Reading Skills methodology, children had to read the text aloud, stop at a certain

moment at the direction of the experimenter and answer questions about the content. Reading electronic texts in an experiment using an aytreker implied slightly different conditions: children read the text to themselves, and the experimenter was waiting for the child's instructions about his readiness to move on to questions about the content. In other words, when reading the texts of stimuli, children could read the text to themselves and reread it for as long as they needed to understand.

Thus, despite the different conditions for the implementation of reading activities, the quality of comprehension of texts did not undergo significant changes in children with dyslexia. On the one hand, this may indicate the depth of violations (the possibility of free re-reading of the text did not change the quality of comprehension) and insensitivity to the conditions for the implementation of reading activities, and on the other, it may indicate the non-formation of the self-monitoring comprehension skill (i.e. the skill of self-assessment of the quality of comprehension) [354; 355]. In other words, the possibility of resorting to re-reading can be used only if such a need is realized, i.e. if the child realizes that a fragment of the text or the text as a whole is poorly understood (or not understood at all).

In addition, the lack of change in the quality of comprehension when changing the conditions of activity can be explained by the difficulties of children with dyslexia in goal setting (that is, in the difficulty of realizing comprehension as the main purpose of reading). Despite a small number of studies on the direct role of goal setting as an comprehension of the text by children with dyslexia, there is a large amount of data describing the system-forming role of the goal in the organization of reading and the strategies used for analyzing text in children [196; 413], as well as adults with reading disorders [131] and learning skills [240].

Noteworthy is the study by Schunk & Rice [413], which compared the quality of comprehension of the text by children 9-13 years old with the reading norm when setting three different tasks before reading: 1) Answer questions after reading the text (setting for comprehension); 2) Learn how to use the reading strategy proposed by the early teacher during the reading process (setting to a more efficient reading);

3) "Work more productively" (abstract task for the control group). According to the results of the study, it was found that children who were assigned the first and second tasks: 1) rated themselves as more effective in reading; 2) demonstrated significantly higher indicators in assessing the quality of comprehension of the written text. The study results suggest a role for goal-setting in the effectiveness and quality of reading in dyslexic children. In addition, they reflect the impossibility of children with dyslexia (without including a teacher) to self-monitor the efficiency of reading and the quality of comprehension of the text, which partly confirms our assumptions about the reasons for the absence of significant differences in reading in different conditions.

3.3 Relationship between cognitive prerequisites of reading activity, quality of comprehension and reading technique

In order to assess the relationships between the level of formation of the studied cognitive prerequisites for reading and comprehension of the texts, we undertook a correlation analysis between the indicators according to the scales of the methods "Nonword repetition," "Digit span," "Kettell's intelligence test" and the number of correct answers. In addition, regression analysis was undertaken to determine the quality of text comprehension by the cognitive parameters studied.

In the control group, direct relationships were found between the indicators of the test "Repetition of unweeds" and the number of correct answers in texts "No. 2 and No. 3, as well as between the indicators of the test" Direct and reverse counting "and the number of correct answers to text No. 2 (Table No. 20).

Table 20 - Relationship of cognitive preconditions and comprehension: control group

Parameter	Text 2	Text 3
	Percentage of right answers (%)	Percentage of right answers (%)
Nonword repetition	r = 0.366 p = 0.043	r = 0.368 p = 0.042
Digit span (forward order)	r=0.478 p=0.033	r=-0.050 p=0.834

Table 20 continuation

Digit span (backward order)	r=0.326 p=0.161	r=0.021 p=0.930
IQ	r=0.108 p=0.579	r=-0.118 p=0.541

Note: r-correlation coefficient, p-coefficient of significance

Regression analysis revealed a significant effect of the level of short-term memory on serially organized material (repetition of numbers in forward order) on the comprehension of text No. 2 (Table No. 21).

Table 21 - The impact of cognitive predispositions on comprehension: control group

Independent variable	Dependent variable	Text 2		
		F	R^2	P
Nonword repetition	Percentage of right answers (%)	3.355	0.104	0.077
Digit span (forward order)	Percentage of right answers (%)	5.654	0.239	0.029
Digit span (backward order)	Percentage of right answers (%)	2.801	0.135	0.111
IQ	Percentage of right answers (%)	0.447	0.016	0.510

Note: F – Fisher criterion, R2 – determination factor, p-coefficient of significance

In the experimental group, positive correlations were found between the indicators of the test "Repetition of unweeds" and the number of correct answers in the texts "No. 1 and No. 2 (Table No. 22).

Table 22 - Relationship of cognitive preconditions and comprehension: dyslexic children

Parameter	Text 1	Text 2
	Percentage of right answers (%)	Percentage of right answers (%)
Nonword repetition	r = 0.588 p = 0.031	r = 0.519 p = 0.048
Digit span (forward order)	r = -0.013 p = 0.963	r = 0.027 p = 0.924
Digit span (backward order)	r = -0.390 p = 0.151	r = -0.056 p = 0.864
IQ	r = -0.320 p = 0.245	r = 0.132 p = 0.638

Note: r-correlation coefficient, p-coefficient of significance

Regression analysis confirmed the significant influence of the level of phonological working memory on the comprehension of texts No. 1 and No. 2 (Table 23). There was no significant effect of other cognitive prerequisites on the quality of comprehension.

Table 23 - The impact of cognitive predispositions on comprehension: dyslexic children

Independent variable	Dependent variable	Text 1			Text 2		
		F	R^2	P	F	R^2	P
Nonword repetition	Percentage of right answers (%)	3.990	0.26	0.050	5.202	0.29	0.040
Digit span (forward order)	Percentage of right answers (%)	0.223	0.017	0.645	0.059	0.005	0.811
Digit span (backward order)	Percentage of right answers (%)	2.240	0.147	0.158	0.112	0.006	0.741
IQ	Percentage of right answers (%)	2.362	0.154	0.148	0.762	0.055	0.399

Note: F – Fisher criterion, R2 – determination factor, p-coefficient of significance

In addition, we undertook an analysis of the relationships between the indicators of the Standardized Assessment of Reading Skills technique, reflecting the state of the art of reading and the cognitive prerequisites studied. Correlation analysis performed cumulatively for the control and experimental groups revealed significant positive correlations between phonological working memory and reading technique parameters (Table 24).

Table 24 - Relationship of cognitive prerequisites and reading fluency (combined analysis of control and experimental groups)

Parameter	Text 1: «How I caught crayfish»		Text 2: «Ungrateful spruce»	
	Number of correctly read words in one minute	Coefficient of reading fluency	Number of correctly read words in one minute	Coefficient of reading fluency
Nonword repetition	r = 0.391 p = 0.008	r = 0.356 p = 0.016	r = 0.382 p = 0.010	r = 0.345 p = 0.020
Digit span (forward order)	r = -0.057 p = 0.747	r = -0.042 p = 0.812	r = -0.088 p = 0.619	r = -0.090 p = 0.613
Digit span (backward order)	r = 0.144 p = 0.416	r = 0.131 p = 0.460	r = 0.164 p = 0.354	r = 0.074 p = 0.679
IQ	r = 0.132 p = 0.386	r = 0.191 p = 0.209	r = 0.226 p = 0.135	r = 0.234 p = 0.122

Note: r-correlation coefficient, p-coefficient of significance

A similar analysis of the relationships undertaken in the norm group also revealed positive correlations between the indicators of phonological working memory and the number of words read in texts No. 1 and No. 2 of the Standardized Assessment of Reading Skills method, as well as the reading technique coefficient in text No. 1 (Table 25).

Table 25 - Relationship of cognitive prerequisites and reading fluency: control group

Parameter	Text 1: «How I caught crayfish»		Text 2: «Ungrateful spruce»	
	Number of correctly read words in one minute	Coefficient of reading fluency	Number of correctly read words in one minute	Coefficient of reading fluency
Nonword repetition	r = 0.399 p = 0.024	r = 0.341 p = 0.050	r = 0.385 p = 0.030	r = 0.329 p = 0.066
Digit span (forward order)	r = 0.390 p = 0.080	r = 0.385 p = 0.085	r = 0.335 p = 0.137	r = 0.310 p = 0.171
Digit span (backward order)	r = 0.194 p = 0.399	r = 0.207 p = 0.368	r = 0.207 p = 0.222	r = 0.100 p = 0.667
IQ	r = 0.162 p = 0.394	r = 0.252 p = 0.180	r = 0.285 p = 0.126	r = 0.275 p = 0.142

Note: r-correlation coefficient, p-coefficient of significance

In the group of children with dyslexia, there were no relationships between reading technique parameters and cognitive prerequisites (Table 26).

Table 26 - Relationship of cognitive prerequisites and reading fluency: experimental group

Parameter	Text 1: «How I caught crayfish»		Text 2: «Ungrateful spruce»	
	Number of correctly read words in one minute	Coefficient of reading fluency	Number of correctly read words in one minute	Coefficient of reading fluency
Nonword repetition	r = 0.142 p = 0.644	r = 0.176 p = 0.566	r = 0.172 p = 0.574	r = 0.059 p = 0.849
Digit span (forward order)	r = 0.003 p = 0.992	r = 0.131 p = 0.669	r = 0.033 p = 0.915	r = 0.045 p = 0.885
Digit span (backward order)	r = -0.207 p = 0.497	r = -0.265 p = 0.381	r = -0.139 p = 0.652	r = -0.262 p = 0.387
IQ	r = 0.343 p = 0.251	r = 0.243 p = 0.447	r = 0.435 p = 0.105	r = 0.246 p = 0.378

Note: r-correlation coefficient, p-coefficient of significance

Regression analysis of the influence of phonological working memory and other reading prerequisites on the parameters of the technique did not find reliable determination either in the cumulative analysis (the entire sample) or in the intra-group analysis.

Reader activity, the set of actions and operations included in it, require a certain cognitive resource for its implementation [118; 409]. Text processing is a complex and multi-component process that includes a large number of different actions. These include actions related to the perception of the graphical space of the process text - "visual recognition of patterns of letters, syllables and words, distribution of visual attention when the eye moves along the line" [57, p.84], and with the transcoding of graphic information into language, and with the processing of the semantic space of the text (synthesis of recognized fragments into an integer), and with control over the correctness of actions (correctness of re- and decoding, correctness of conclusions, assessment of connectivity, etc.), etc. In other words, in the process of reading and comprehension, various types of actions are simulatively implemented. At the same time, each of the actions implemented requires the involvement of a certain amount of cognitive resources. In case of limited or shortage of certain resources, competition arises between various actions in the struggle for resources [400]. For example, a number of studies have convincingly demonstrated the competition for resources between working memory and visual attention [248; 303; 304]. It was found that the accompanying visual search greatly reduced the effectiveness of attention. In the case of Han & Kim experiments [248], the inverse of the given number was chosen as such a task, and Lavie studies [303; 304] used the retention of a number in memory during visual search.

Therefore, the theory of cognitive resources explains the results we have obtained. Children with dyslexia who are deficient in phonological working memory naturally find a greater effect on the quality of comprehension of texts in comparison with children of the control group.

The results of our study demonstrate the important role of phonological working memory in the process of comprehension of written text. According to the concept of Baddeley & Hitch [116], the working memory has a limited amount, that is, only a piece of information can be held in it per unit of time. The amount of working memory determines how much information can be used for communication and integration with newly received information [167; 337; 457]. In other words, the level of short-term memory determines the number of propositions that a reader can simultaneously operate to create an information (propositional) text base [18; 305; 306; 419; 501]. Therefore, the level of short-term memory directly affects the process of processing the content of the text and the quality of its comprehension.

Our findings are consistent with other studies investigating phonological working memory in dyslexic children [147; 217; 263; 430]. In addition, a deficit in phonological working memory was found in children with nonspecific reading disorders (the so-called "poor readers") [134; 135; 265], and later studies by Baddeley and Gathercole demonstrated the important role of working memory deficits in other language impairments [117; 226].

Moreover, our results, which found a relationship between phonological working memory and reading technique, are consistent with works in which a similar connection was established [187; 345, etc.], as well as studies that revealed a connection between a shortage of phonological working memory in reading disorders and difficulties in automating reading skills and comprehension [292; 409].This relationship is due to the involvement of phonological working memory in the process of establishing grapheme-phoneme connections during reading [162; 253]. However, the lack of a reliable influence of phonological working memory on reading techniques may only indicate its indirect involvement in the implementation of decoding actions.

3.4 Comparative analysis of oculomotor readership referents in children with dyslexia and their healthy peers

Statistical analysis of the indicators of eye movements during reading revealed significant differences between the control and experimental groups in all studied parameters: the number and duration of fixations; the number and amplitude of both progressive and regressive saccades (the only exception was the average amplitude of regressive saccades recorded when reading text No. 1) (Table 27).

Table 27 - Oculomotor indicators of mental actions and operations in children with dyslexia and their healthy peers

Parameter	Text	Control group	Experimental group	Significance of differences (p=)
		(M±m)	(M±m)	
Number of fixations (per word)	Text 1	2.4±1.0	4.9±2.5	0.001
	Text 2	2.2±0.7	4.4±2.0	0.001
	Text 3	2.3±0.7	4.4±2.0	0.001
	Text 4	1.9±0.6	3.6±1.8	0.001
Average duration of fixations (ms)	Text 1	245±55	344±107	0.001
	Text 2	248±64	342±138	0.007
	Text 3	258±61	327±140	0.021
	Text 4	252±67	369±199	0.008
Number of progressive saccades (per word)	Text 1	1.6±0.5	3.2±1.4	0.001
	Text 2	1.4±0.5	3.0±1.5	0.001
	Text 3	1.4±0.5	3.3±1.9	0.001
	Text 4	1.2±0.4	2.4±1.2	0.001
Number of regressive saccades (per word)	Text 1	1.0±0.6	2.5±1.8	0.001
	Text 2	0.9±0.5	2.9±2.0	0.001
	Text 3	0.9±0.5	3.1±2.3	0.001
	Text 4	0.7±0.4	2.1±1.6	0.001
Average amplitude of progressive saccades (degrees)	Text 1	2.6±0.6	2.2±0.8	0.013
	Text 2	2.4±0.5	2.1±0.5	0.032
	Text 3	2.4±0.5	2.1±0.3	0.001
	Text 4	2.3±0.5	2.0±0.3	0.030

Table 27 continuation

Average amplitude of regressive saccades (degrees)	Text 1	4.0±1.3	3.4±1.2	0.114
	Text 2	3.8±1.0	2.9±0.8	0.007
	Text 3	3.9±0.9	2.9±0.5	0.001
	Text 4	4.2±1.0	3.2±0.8	0.003

Note: M - group mean, m - standard deviation; p - significance coefficient

As noted, oculomotor operations (fixations and saccades) reflect the psychological organization of the process of analysis and comprehension of the written text, in other words, they reflect the methods of implementing mental actions committed by the reader. From this point of view, differences in all basic indicators of eye movements may indicate the presence of significant differences in the organization of reading activities between children with dyslexia and children of the control group.

We undertook a more detailed analysis of oculomotor referents of mental actions and operations (separate analysis of decoding, generation of macro positions, checking the logical correctness and connectivity of the text model).

3.4.1 Indicators of success of decoding action: comparative analysis of the average number and duration of fixations, the average number and amplitude of progressive saccades

Reading texts by children with dyslexia was characterized by more fixations (Figure 3) exceeding the indicators of the normal group by two times.

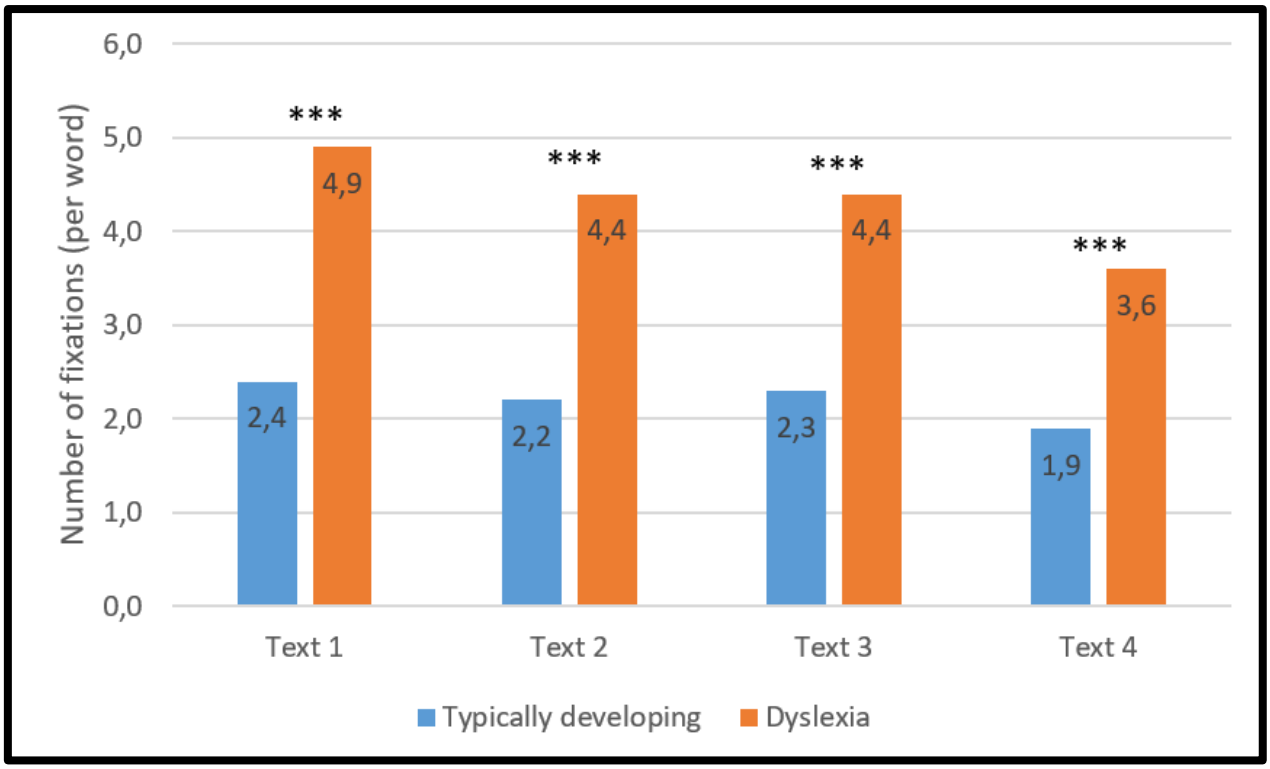

Figure 3 – Average count of fixations during text reading

*Note: * - p<0.05; ** - p<0.01; *** - p<0.001*

In addition, the duration of the fixations made by them was also reliably higher when reading all texts (Figure 4)

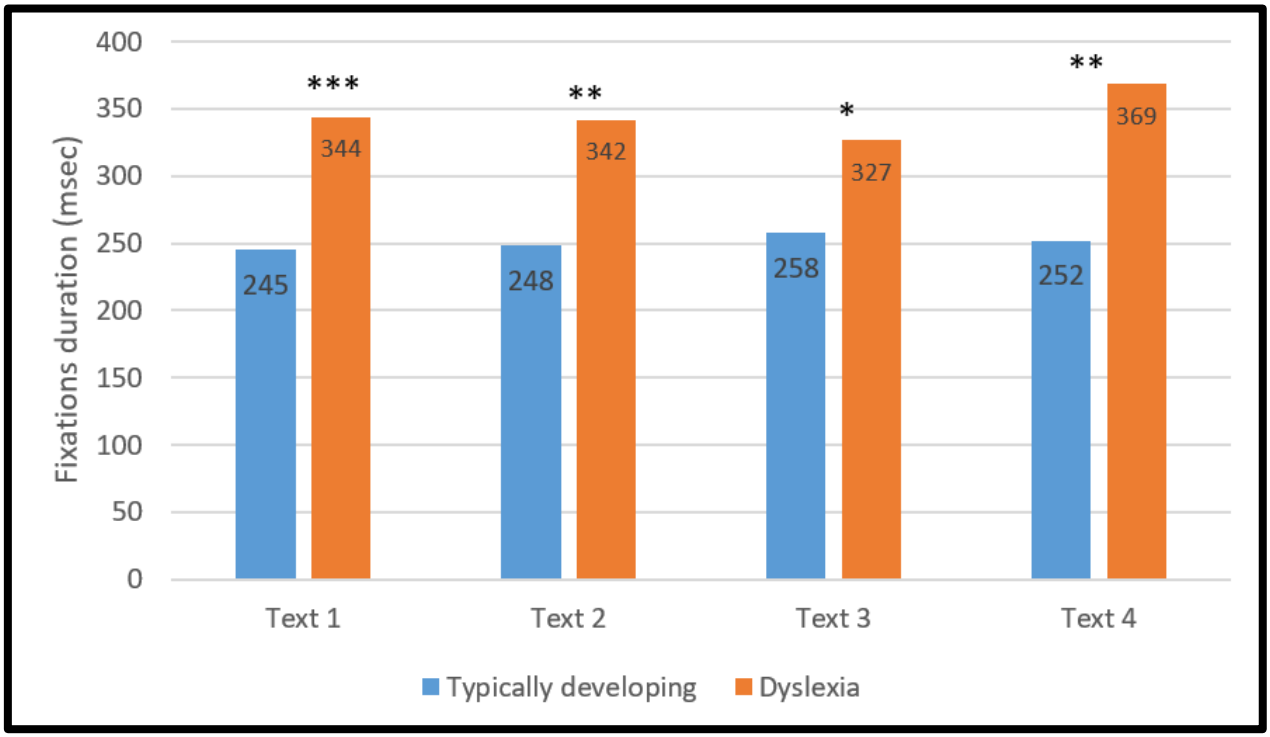

Figure 4 – Average duration of fixations during text reading

*Note: * - p<0.05; ** - p<0.01; *** - p<0.001*

A similar pattern was obtained when comparing the number of progressive saccades - their average number per word in dyslexics significantly exceeded the indicators of a group of healthy children when reading all texts (Figure 5). In other words, they had a higher operational load in decoding actions.

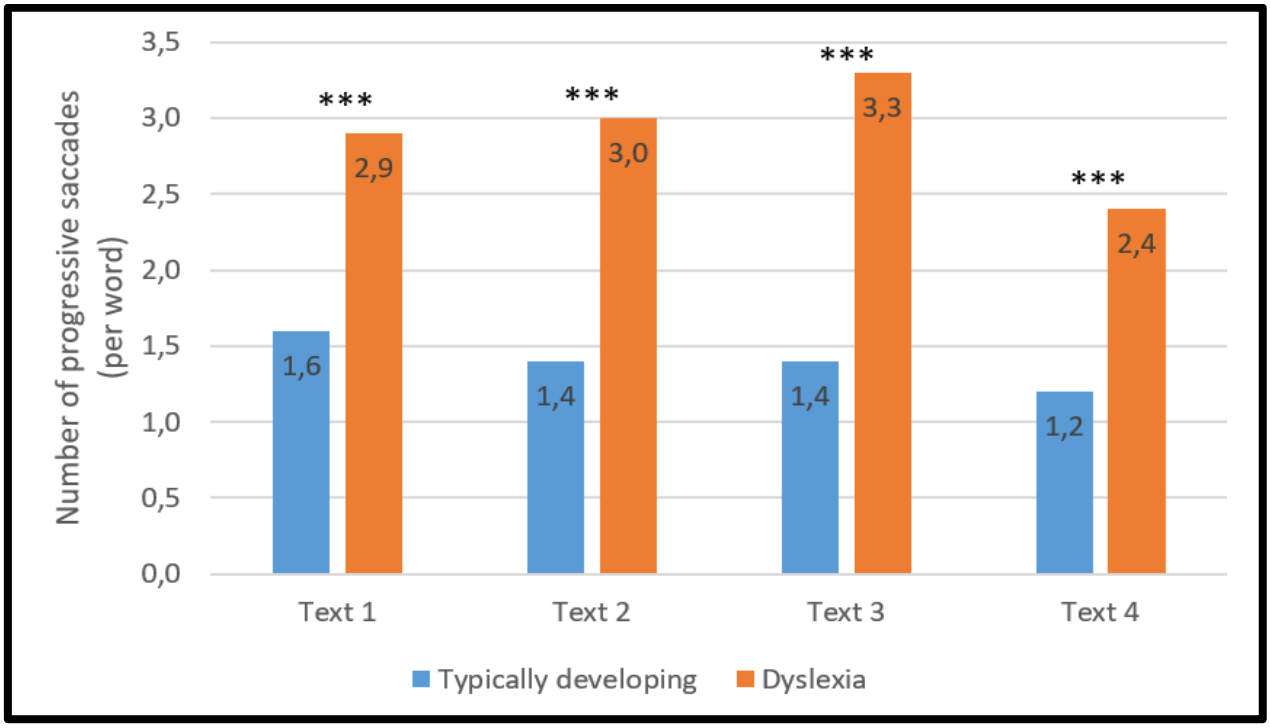

Figure 5 – Average count of progressive saccades during text reading

*Note: * - p<0.05; ** - p<0.01; *** - p<0.001*

At the same time, the amplitude of progressive saccades, when reading all texts, was less in children of dyslexics (Figure 6).

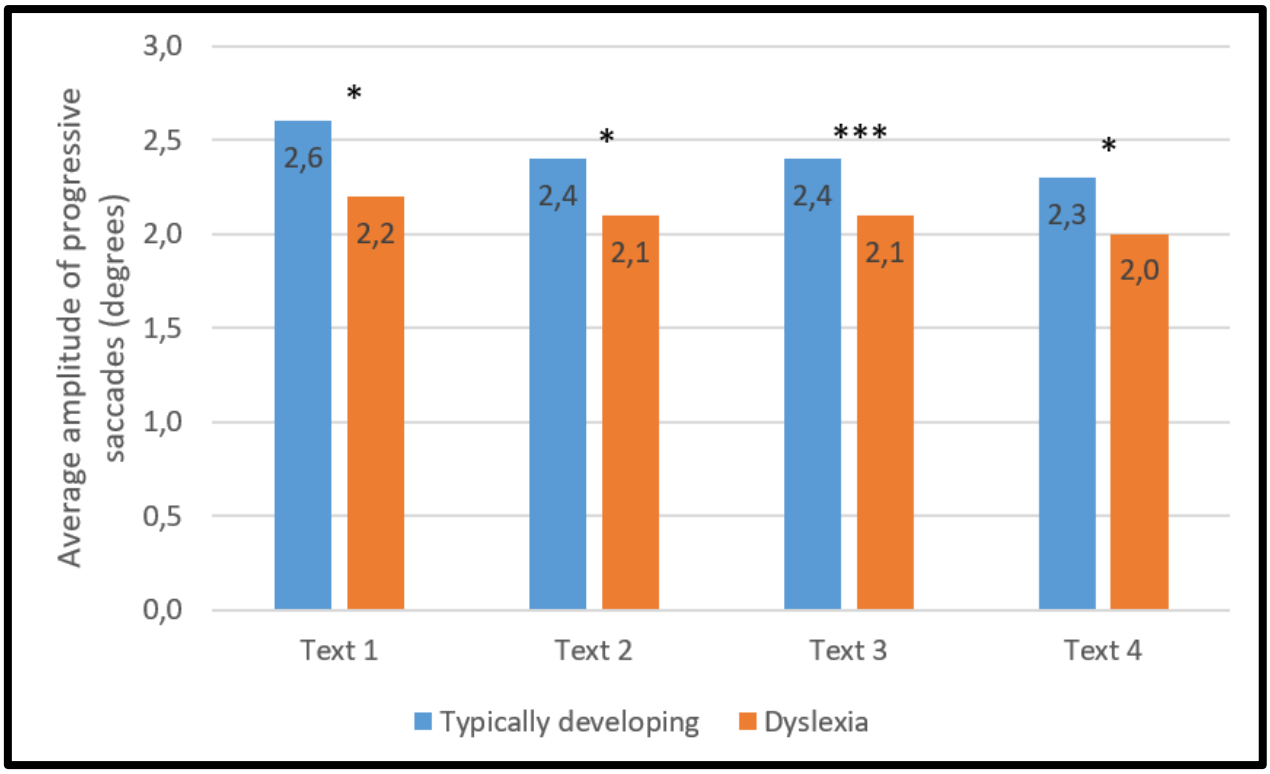

Figure 6 – Average amplitude of progressive saccades during reading

*Note: * - p<0.05; ** - p<0.01; *** - p<0.001*

The findings indicate significant differences in the characteristics of decoding actions in dyslexic children from their healthy peers [50; 79; 81]. According to the literature, fixations can be considered as oculomotor referents of the recoding operation [173; 309; 387; 396, etc.], which is one of the components of the decoding action.

The relevance of oculomotor operations as referents of re- and decoding is also evidenced by the results of correlation analysis of oculomotor parameters and indicators of the reading technique of the Standardized Assessment of Reading Skills technique, reflecting the quality and speed of decoding actions (the number of words read in the first minute and the coefficient of the reading technique). In the normal group (Table 28), significant correlations were found between fixation and progressive saccades and Standardized Assessment of Reading Skills parameters.

Table 28 - Relationship of fixation and progressive saccades parameters with reading fluency in the control group

	Average count of fixations	Average duration of fixations	Average count of progressive saccades	Average amplitude of progressive saccades
Reading fluency (words per minute). Text 1 ("How I caught crayfish")	r= -0.589***	r= -0.586***	r= -0.555***	r= 0.554***
Reading fluency (words per minute). Text 2 ("Ungrateful Spruce")	r= -0.670***	r= -0.471***	r= -0.636***	r= 0.531***
Coefficient of reading fluency. Text 1 ("How I caught crayfish")	r= -0.422***	r= -0.502***	r= -0.475***	r= 0.556***
Coefficient of reading fluency. Text 2 ("Ungrateful Spruce")	r= -0.502***	r= -0.339***	r= -0.543***	r= 0.502***

*Note: r-correlation coefficient, *** - p<0.001*

The results of correlation analysis reveal a strong relationship between oculomotor parameters of fixations and progressive saccades with parameters reflecting the state of the art of reading. There is a negative relationship between read speed and the number of latches and progressive saccades a child needs to perform to perform a decoding action. A similar relationship is found between read speed and latch duration. In addition, a positive correlation was revealed between the parameters of the Standardized Assessment of Reading Skills method with the amplitude of progressive saccades: the speed of reading the text is positively associated with the average amplitude of progressive movements of the eye during reading.

In a group of children with dyslexia (Table 29) revealed similar correlations between reading techniques and the average number of fixations and progressive saccades. The average duration of fixations was negatively correlated with the reading technique coefficient and the number of words read per minute in text №2.

Table 29 - Relationship of fixation and progressive saccades parameters with reading fluency in the experimental group

	Average count of fixations	Average duration of fixations	Average count of progressive saccades	Average amplitude of progressive saccades
Reading fluency (words per minute). Text 1 ("How I caught crayfish")	r= -0.387***	r= -0.185	r= -0.330**	r= 0.058
Reading fluency (words per minute). Text 2 ("Ungrateful Spruce")	r= -0.462***	r= -0.316**	r= -0.276*	r= 0.096
Coefficient of reading fluency. Text 1 ("How I caught crayfish")	r= -0.420***	r= -0.128	r= -0.398***	r= 0.131
Coefficient of reading fluency. Text 2 ("Ungrateful Spruce")	r= -0.460***	r= -0.250*	r= -0.276*	r= 0.090

*Note: r-correlation coefficient, *-p<0.05, **-p<0.01, *** - p<0.001*

Therefore, the obtained results of the analysis of the average number of fixations allow us to say that in order to successfully complete decoding, children with dyslexia need to undertake more recoding operations, which is reflected in more fixations made. In addition, the comparison of the duration of fixations suggests that, on average, it takes longer to perform one recoding operation in children with dyslexia compared to children of the normal group.

Differences in the characteristics of progressive saccades are also related to the number of recoding operations required to perform decoding. Each transition to subsequent fixation requires moving the gaze to an unread fragment of a word (the number of progressive saccades). In addition, the amplitude of progressive saccades is presumably associated with the amount of information processed in one fixation: the fewer characters are processed simultaneously, the smaller the amplitude of movement will follow the fixation [383; 384; 390]. In particular, readers with a high level of reading skill have been found to analyze a larger amount of information (3-4 characters to the left of the center of fixation and 5-6 characters to the right)

compared to readers with a low reading skill, which allows them to more often move the gaze forward of a higher amplitude. In addition, in an earlier study by Taylor [451], it was found that the size of the perceptual region grows as children grow older and learn the reading skill: for children 7 years old, it corresponds to a length of 0.57 words, 9 years old - 0.72 words, 11 years old - 0.83 words.

Our results are consistent with data from other studies conducted in other languages when reading individual words and sentences, which also found similar differences in the number of fixations and saccades between normal-reading children and dyslexics [178; 267; 270; 317; 504]. Long duration of reading fixations in dyslexic children was also found by researchers [267; 270; 357; 375; 395; 458]. However, most of the research data are dominated by a descriptive approach aimed only at determining the characteristics of oculomotor behavior as such, outside the focus of researchers' attention, the phenomenology of reading as aimed at comprehension activity remained.

The difference in the nature of the relationships between the reading technique and the amplitude of progressive saccades in the control and experimental groups deserves attention. In the group of children with normal reading skills, strong correlations between reading speed and amplitude of progressive saccades are found, and in the group of children with dyslexia, there are no relationships. Such differences may be explained by the disorganized type of saccade planning in dyslexic children, which may lead to a mismatch between the measures associated with reading speed and the amplitude of progressive saccades. In studies by MacKeben et al. [317], similar results were obtained that found a weak ability of children with dyslexia to program saccades and a weak correlation between reading speed and amplitude of progressive saccades. A disorganized type of saccade planning, manifested in the inability of a dyslexic child to predict the necessary displacement amplitude for successful implementation of decoding, is associated with the aforementioned lower volume of character perception in dyslexic children [128; 328; 397, etc.]. A smaller range of perceptions limits children's ability to

choose the distance by which the gaze can be moved (possessing a wider range of perceptions of symbols, children with normal reading skills can "choose" the distance by which the gaze will be moved). However, the key is the consequences of these difficulties: the inability to program the displacement amplitude increases the operational decoding load on the one hand, and on the other, it creates difficulties for establishing communication between words [317, p.397]. The results of our study are also consistent with other works that found a "weak" level of control of oculomotor behavior [127; 128; 204, etc.].

In such a way, the results of our study demonstrate pronounced violations of the mental actions of decoding (translation of the written word into oral) in children with dyslexia, which are manifested in the need to perform more recoding operations and their longer duration on the one hand, and on the other - in a smaller amount of simultaneously recoded information and poor ability to program oculomotor operations related to the implementation of decoding.

3.4.2 Regressive saccades, as indicators of the success of performing mental actions to create a logical connected model of text and process its macro-propositional structure

Comparative analyses of regressive saccade scores revealed significant differences between the groups. Children with dyslexia were characterized by the completion of more regressive saccades when reading all texts (Figure 7).

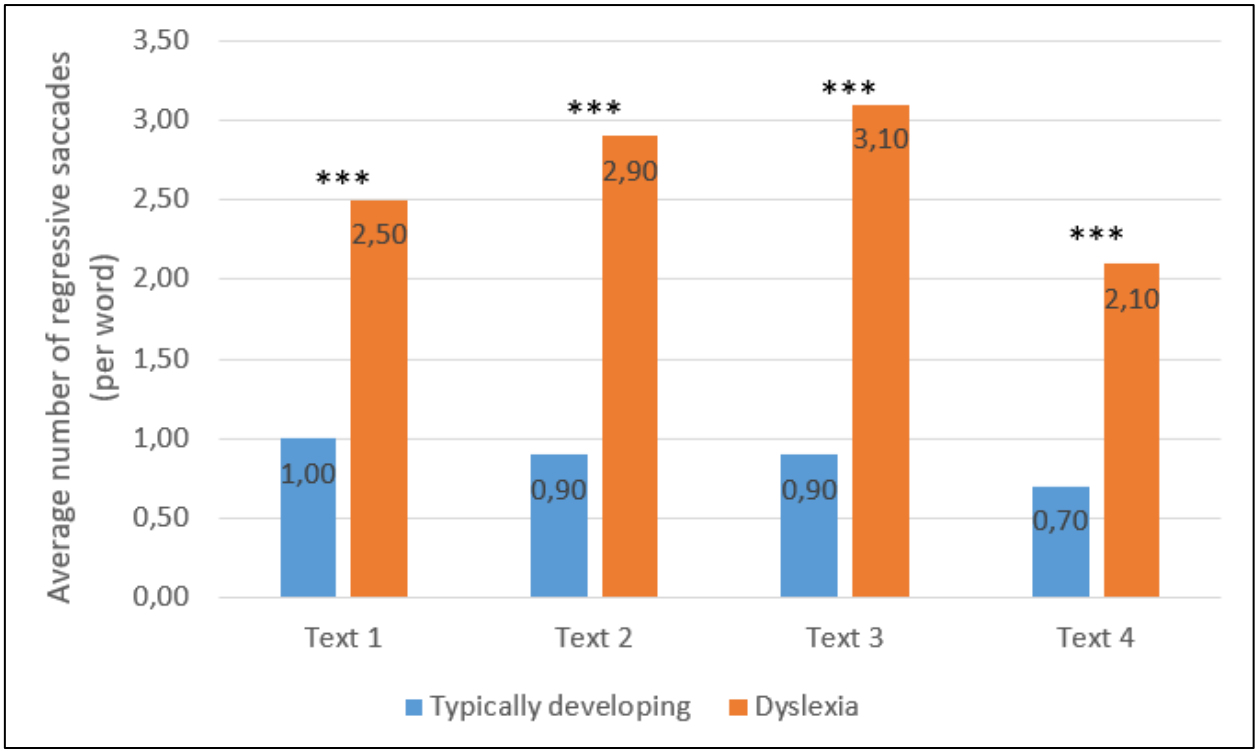

Figure 7 – Average count of regressive saccades during reading

*Note: * - p<0.05; ** - p<0.01; *** - p<0.001*

However, for three texts out of four, it was found that the amplitude of regressive saccades in dyslexic children is significantly smaller than in normally reading children (Figure 8).

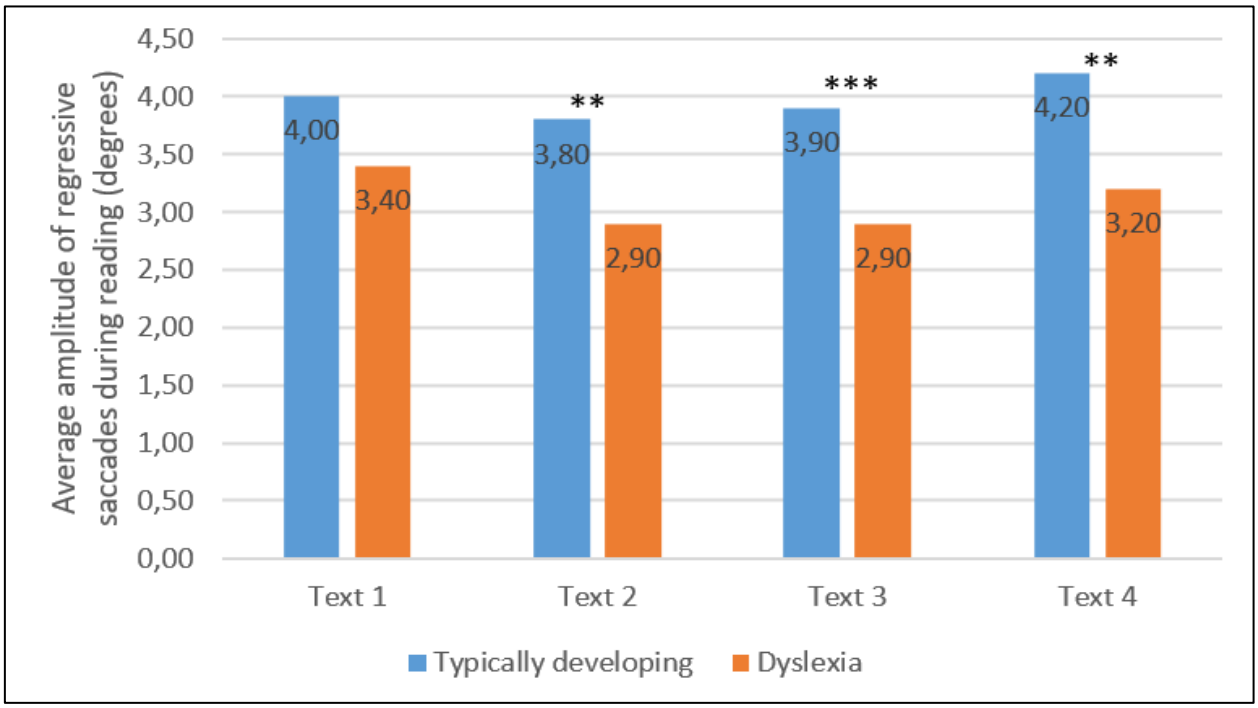

Figure 8 - Average amplitude of regressive saccades during reading

*Note: * - p<0.05; ** - p<0.01; *** - p<0.001*

The resulting differences in the number and average amplitude of regressive saccades can be explained by different reasons: a large number of errors made by children with dyslexia during recoding operations, which create the need for a short return to a certain part of the word for adjustment [270; 387; 389]; difficulties in establishing a link between sentence fragments and checking its logical correctness in dyslexic children performed through longer length regressions [299].

In order to clarify the reasons for the described differences, we made a comparative analysis of the average number of micro-corrections made (amplitude approximately equal to the length of half a word), short (ranging from syllable to word), medium (ranging from word to three words) and long (more than three words) regressive saccades in terms of one word. In the first two amplitude ranges, subgroup comparisons supported the assumption of a large number of regressions associated with recoding and decoding in dyslexic children. In all texts, children with dyslexia made 3-4 times more microregresses and short regressive saccades (Table 30).

Table 30 - Comparative analysis of the number of regressive saccades of all types

Parameter	Text	Control group	Experimental group	Significance of differences (p=)
		(M±m)	(M±m)	
Number of microregresses (per word)	Text 1	0.23±0.17	0.69±0.59	0.001
	Text 2	0.22±0.15	0.82±0.64	0.001
	Text 3	0.19±0.14	0.80±0.50	0.001
	Text 4	0.18±0.13	0.53±0.40	0.001
Number of short regressive saccades (per word)	Text 1	0.37±0.24	1.1±0.84	0.001
	Text 2	0.34±0.25	1.29±0.89	0.001
	Text 3	0.36±0.24	1.26±0.86	0.001
	Text 4	0.30±0.18	0.89±0.67	0.001
Number of medium regressive saccades (per word)	Text 1	0.26±0.15	0.67±0.47	0.001
	Text 2	0.25±0.16	0.70±0.48	0.001
	Text 3	0.28±0.15	0.72±0.51	0.001
	Text 4	0.21±0.12	0.49±0.33	0.001

Table 30 continuation

Number of long regressive saccades (per word)	Text 1	0.13±0.07	0.33±0.28	0.001
	Text 2	0.12±0.07	0.31±0.29	0.001
	Text 3	0.12±0.07	0.30±0.23	0.001
	Text 4	0.11±0.05	0.25±0.18	0.001

Note: M - group mean, m - standard deviation; p - significance coefficient

However, the assumption of fewer mean and long regressive saccades in dyslexic children has not been directly confirmed. The number of saccades in these ranges also exceeds the indicators of the normal group. The indicators of standard deviation of the number of medium and long regressive saccades deserve special attention. So in the group of children with dyslexia, the indicators of intragroup variability according to these parameters significantly exceed the indicators of the control group. This may indicate the heterogeneity of the group in this indicator.

In this regard, we undertook a comparative distribution analysis of the percentage distribution of regressive saccades of different species in relation to the total number of regressive saccades (Table 31) when reading texts in children of the experimental and control groups.

Table 31 - Comparative analysis of the relative number of microregressions, short, medium and long regressive saccades in relation to the total number of regressive saccades

Parameter	Text	Control group	Experimental group	Significance of differences (p=)
		(M±m)	(M±m)	
Percentage of the number of microregressions to the total number of regressive saccades (%)	Text 1	21±6	24±6	0.135
	Text 2	22±6	26±5	0.008
	Text 3	19±5	26±5	0.001
	Text 4	16±5	13±4	0.020
Percentage of the number of short regressive saccades to the total number of regressive saccades (%)	Text 1	37±7	37±5	0.658
	Text 2	35±6	40±6	0.002
	Text 3	36±6	40±4	0.003
	Text 4	35±6	39±5	0.023

Table 31 continuation

Percentage of the number of medium regressive saccades to the total number of regressive saccades (%)	Text 1	28±7	25±5	0.100
	Text 2	29±7	23±4	0.002
	Text 3	30±6	23±4	0.001
	Text 4	27±7	23±5	0.032
Percentage of the number of long regressive saccades to the total number of regressive saccades (%)	Text 1	13±6	13±6	0.840
	Text 2	15±5	10±4	0.003
	Text 3	14±5	10±3	0.002
	Text 4	16±5	13±5	0.015

Note: M - group mean, m - standard deviation; p - significance coefficient

In texts No. 2, No. 3, No. 4, children with dyslexia were significantly less likely to have medium and long regressive saccades, and more often to have microregressive and short regressive saccades. As previously described, medium (within a sentence) and long regressive saccades (beyond the average sentence length) can be considered as oculomotor referents of the actions associated with checking inferences and assessing the logical connectivity of the constructed text model. From this point of view, the findings demonstrate the complex nature of text reading and comprehension disorders in dyslexic children - children experience difficulties not only in actions and operations related to word processing, but also in those aimed at building a macro-propositional text structure and monitoring this process.

According to the results of a large number of studies, the comprehension of the written text depends on the presence of certain prerequisites related to: decoding ability [293; 420; 427, etc.]; the ability to establish semantic relations between different propositional units of the text and assess the adequacy of the conclusions made [288]; the ability to implement self-monitoring of comprehension, in other words, self-assessment of the quality of comprehension of the text [80; 83; 143; 376].

According to van den Broek's theory [469], which largely develops the approach of Kintsch and van Dijk [18], successful comprehension of what is read depends on the effective integration of processed fragments of text. By analyzing sentences, the reader sequentially decodes words, and then constructs the meaning of the read sentence and its meaning in accordance with the rules of syntax [366; 474]. After that, the set of sentences by means of conclusions is integrated into macro positions, and then the reader creates a connected propositional model (in van den Broeck's term "mental representation") of the text as a whole [237; 293; 456].

At the same time, it is important to say about the cyclical nature of the process of building an information model of text. The integrated elements become the background for the synthesis of the next (new) macro-position, this cyclic process continues until a connected propositional model of the entire text is built. In the process of integrating new semantic units, the reader, relying on context, returns to previous fragments (regressive saccades that go beyond the word), correlates new elements with those already stored in short-term memory, makes conclusions, checks the connectivity of the model being built, corrects (reintegrates) uncoordinated elements (which is also done through return movements of gaze to these elements) [231; 465; 466; 470].

Therefore, the results of our study demonstrate the deficits of both the decoding action [50; 81; 85] and the actions associated with controlling the adequacy of the inferences made and controlling the connectivity of the constructed text model in children with dyslexia [82; 84; 85; 87; 295; 296]. The description of the peculiarities of mental actions related to the control of comprehension read in children with dyslexia seems fundamentally new on the one hand, and on the other - requiring special attention. This is due to the fact that according to the work of a number of researchers, the deficit in the ability to control the comprehension of what is read turns out to be associated with the ability of the subject to assess the quality of his training in the broad sense of the word - "meta- comprehension" [190; 206; 207; 320].

3.5 Factor analysis of operational and activity components of reading and quality of text comprehension

The general purpose of reading activity is to understand what has been read. The provision of A.N. Leontiev on the systemic nature of the purpose of the activity allows us to assume the existence of a relationship between the success of actions and operations and the degree of achievement of the purpose of the activity. To identify the factors involved in the implementation of reading activities, we undertook a factor analysis of the set of variables that are oculomotor referents of mental actions and operations, as well as the text comprehension index.

The obtained data were processed by the method of main components (construction of a correlation matrix) with varimax rotation, the number of extracted factors is three. Parameters with absolute correlation coefficient less than 0.4 are excluded from the tables. Three factors were found in the normal group, controlling 71% of the intragroup variance in total (Table 32).

Table 32 - Results of factual analysis in the control group: the relative number of saccades, number of fixations, the number of correct answers

	Factor		
	1	2	3
Number of fixations (per word)	0.953		
Number of progressive saccades (per word)	0.952		
Number of microregressions relative to the total number of regressive saccades		-0.874	
Number of short regressions related to the total number of regressive saccades		-0.484	-0.701
Number of medium regressive saccades related to the total number of regressive saccades		0.914	0.541
Number of long regressive saccades related to the total number of regressive saccades			0.719
Number of correct answers			0.748

Note: relationship coefficients with an absolute value of less than 0.4 have been deleted from the table

The loads of the first factor (absolute values > 0.4 included) are represented by the average number of fixations and progressive saccades. The relationship of the variables included in this factor is presumably explained by the oculomotor patterns described earlier - the more fixations are made by the reader, the more movements (from fixation to fixation) he needs to make. In other words, the first factor reflects decoding actions that are performed through oculomotor latching operations and progressive saccades. This factor controls 30% of the intragroup variance.

The second factor is represented by the number of mean regressive saccades and the number of micro- and short regressive saccades. This factor describes the negative relationship between oculomotor referents associated with operations to control the correctness of decoding and actions, presumably one of which is to verify or clarify the correctness of the conclusions made. It can be assumed that the identified relationship between the variables included in the factor may reflect the limited resources of readers' activities. In other words, it is possible that the operational load of decoding actions is associated with the possibility of successfully generating macro positions (the more resources are spent on decoding, the less resources are available for generating macro positions). This factor controls 22% of the intragroup variance.

The loads of the third factor in the control group reflect a hidden variable reflecting the inclusion of actions related to the generation of macro positions and checking the connectivity of the text model in the process of comprehension. Thus, an association was found between the number of correct answers and the number of medium and long regressive saccades. In addition, the analysis of intra-factor relationships allows us to talk about a negative relationship between the quality of comprehension and the number of short regressive saccades taken to eliminate decoding errors. It can be assumed that errors arising during decoding prevent actions related to the generation of macro positions and checking the connectivity of the text model. The third factor controls 19% of the intragroup variance.

Factor analysis in the dyslexic pediatric group revealed three factors controlling for 74% of intragroup variance (Table 33).

Table 33 - Results of factual analysis in the experimental group: the relative number of saccades, number of fixations, the number of correct answers

	Factor		
	1	2	3
Number of fixations (per word)	0.956		
Number of progressive saccades (per word)	0.957		
Number of microregressions relative to the total number of regressive saccades		-0.907	
Number of short regressions related to the total number of regressive saccades			
Number of medium regressive saccades related to the total number of regressive saccades		0.835	
Number of long regressive saccades related to the total number of regressive saccades			-0.721
Number of correct answers			0.515

Note: relationship coefficients with an absolute value of less than 0.4 have been deleted from the table

The first factor in the group of children with dyslexia, as in the normal group, is represented by the average number of fixations and progressive saccades and presumably reflects the variable associated with the number of decoding actions performed during the course of reading activities. This factor controls 32% of the variance.

The second factor in the dyslexic group of children is represented by a negative relationship between the number of microregressive saccades and the number of mean regressive saccades. It can be assumed that this factor describes the relationship between the number of decoding errors and the number of actions associated with the generation of macro positions. As in the group of children of the norm, this connection can be explained by the competition of actions for resources

in reading: the need to return to fragments of a word (microregress) for the successful completion of decoding requires the involvement of a certain number of resources, which in turn can adversely affect the implementation of actions related to the generation of macro positions. This factor controls 23% of the variance in the dyslexic group of children.

The third factor is represented by the negative relationship between the number of correct answers and the number of long regressive saccades presumably taken to test the connectivity of the constructed text model. This factor describes the uniqueness of the difficulties of children with dyslexia in creating and checking the connectivity of a text model. It can be assumed that the more attempts to check the quality of comprehension the text, the more returns to poorly understood fragments of text a child with dyslexia makes, the worse the result of comprehension turns out to be. In other words, attempts to return to poorly understood text fragments and check the connectivity of the constructed text model only exacerbate its comprehension. This factor controls 19% of the variance and it is important to note that this is the only factor in which a significant relationship of mental actions referents with the quality of comprehension was found in a group of children with dyslexia.

Comparison of the results of factor analysis in the group of children with dyslexia and the control group reveals on the one hand similar mechanisms for the implementation of reading activities, and on the other hand, key differences in the relationships between actions taken and operations with the main purpose of reading activities - comprehension. The first and second factors turned out to be similar in the internal structure of relationships in both groups and, apparently, describe the mechanisms for implementing decoding actions (the first factor), as well as the "competition" between decoding actions and generating macro positions for resources (the second factor). Competition for resources is facilitated by the lack of formation of decoding actions in children with dyslexia, which leads to significant resource costs when they are performed [400]. These results are consistent with

studies in which a similar relationship was found: readers with a low reading technique turned out to be less capable of qualitative comprehension of the text and the use of effective analysis strategies, because they spent a large amount of cognitive resources on decoding [136; 424; 437, etc.].

A key to the analysis of the specifics of reading activities and comprehension in children with dyslexia is the comparison of factors No. 3. If in the control group the third factor is represented by a variable reflecting the inclusion of mental actions in the process of comprehension the text, then the results of the analysis in the group of children with dyslexia allow us to talk about the negative role of actions related to checking the connectivity of the text model as its comprehension. In addition, the analysis of intra-factor relationships allows us to say that understanding how the result of achieving the goal of reading activity in children with dyslexia turns out to be practically unrelated to the operations included in its structure.

The results of the study are consistent with a number of works that described the difficulties of children with reading disorders and, in particular, dyslexia in making conclusions and creating a logical connection between sentences in the reading process [129; 352; 494]. Indirectly, the lack of ability to construct and test connectivity is also indicated by the results of studies devoted to the generation of narratives, in which it was found that in children with dyslexia, the structure of the narrative is much less often characterized by the connectivity of events and linguistic consistency (using language units denoting connection) [57; 144; 416]. Thus, it can be assumed that the lack of connection between comprehension and actions to generate macro-positions, check the conclusions made during reading, as well as actions to check the connectivity of the constructed text model are explained by their non-formation in children with dyslexia.

3.6 Cognitive mechanisms for the implementation of readers' activities

Reading activity is a number of interrelated mechanisms aimed on the one hand at achieving the common goal of activity - comprehension, and on the other - serving to implement more private goals. To study the structure of violations of

reading activity, it is necessary to study the relationships between the "foundation" of its implementation - "cognitive prerequisites" and the indicators of actions and operations taken with their involvement. We undertook a correlation analysis of oculomotor referents of mental actions and operations and the results of cognitive tests. For the convenience of presenting the results in the figures, the following are given: 1) only the relationships between oculomotor and cognitive parameters; 2) the relationship with the absolute value of the correlation coefficient is not less than 0.3.

In the control group, the following were found: 1) negative relationships between the parameters of the "repetition of unweeds" test with the number of progressive saccades and fixations, as well as the duration of fixations; 2) negative relationship between the results of the subtest "Digit span in backward order" with the duration of fixations; 3) negative correlations between the indicators of performing the subtest " Digit span in forward order" with the number of fixations and microregressive saccades, as well as positive correlation with the number of medium regressive saccades; 4) negative correlation of non-verbal intelligence test results with the number of fixations (Figure 9).

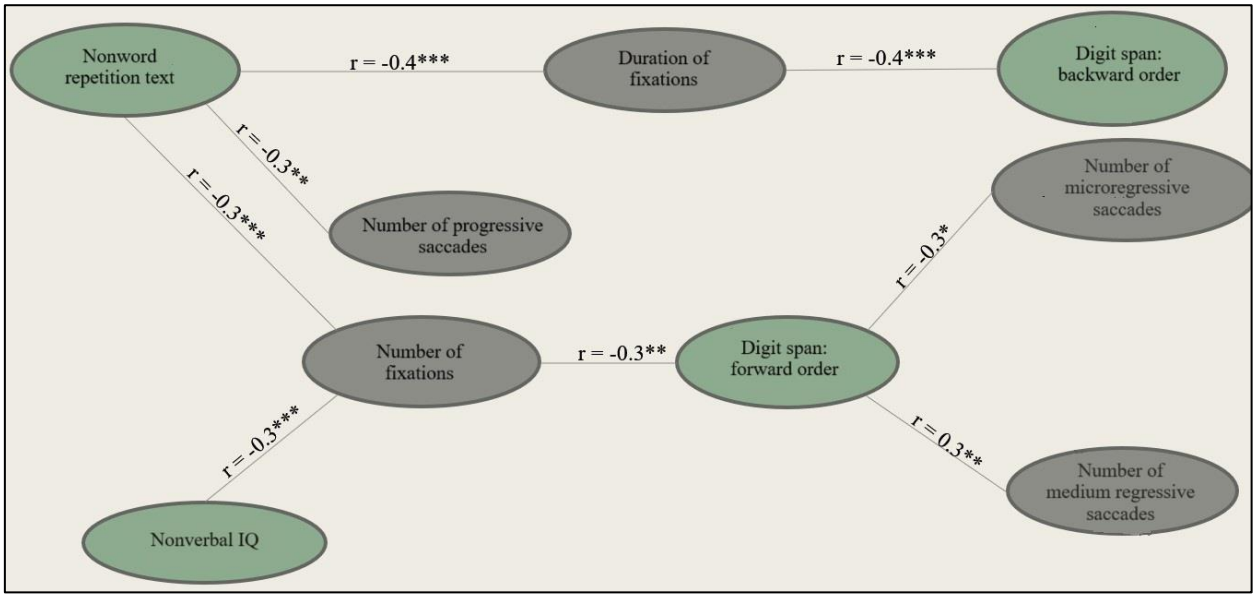

Figure 9 - Correlation analysis of the relationship between cognitive predispositions and oculomotor references of mental activity in children in the control group

*Note: r-correlation coefficient; *- p<0.05; ** - p<0.01; ***-p<0.001*

The nature of the discovered relationships suggests that in children who do not have dyslexia, the number of committed fixations and progressive saccades, which are oculomotor referents of the number of recoding operations, is negatively associated with the level of phonological working memory, and to some extent with the level of non-verbal intelligence. In addition, the latching duration reflecting the processing duration of the information fragment (oculomotor referent decoding duration) is negatively associated with the short-term memory indicators.

Short-term memory for serially organized verbal material revealed a negative relationship with oculomotor referents of the number of recoding operations and a positive relationship with referents of operations for checking conclusions.

In the experimental group, in comparison with the normal group, a greater number of relationships were identified between oculomotor referents of mental actions and operations with the indicators of cognitive tests No. (Figure 10).

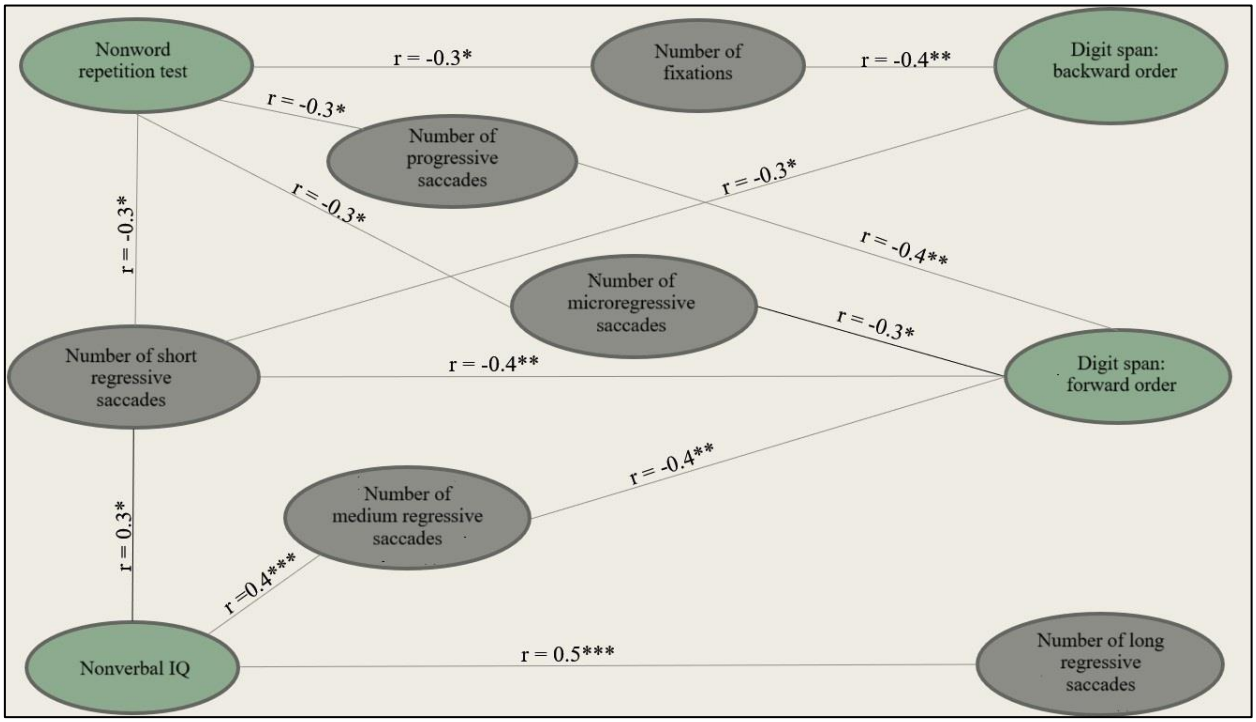

Figure 10 - Correlation analysis of the relationship between cognitive predispositions and oculomotor references of mental activity in children in the experimental group

*Note: r-correlation coefficient; *- p<0.05; ** - p<0.01; ***-p<0.001*

The following were identified: 1) negative relationships between the parameters of the "repetition of weeds" test with the number of fixations, the number

of progressive, as well as micro- and short regressive saccades; 2) negative relationship between the results of the subtest " Digit span in backward order" with the duration of fixations and the number of short regressive saccades; 3) negative correlations between the subtest " Digit span in forward order" and the number of progressive, as well as micro-, short and medium regressive saccades; 4) positive correlations between the nonverbal intelligence score and the number of short, medium and long regressive saccades.

A similar pattern of relationships allows us to argue that in children with dyslexia, as well as in children of the normal group, the number of oculomotor referents of recoding operations is negatively associated with the level of phonological working memory. It is important to note that in the group of children with dyslexia, no association of the duration of fixation with the indicators of cognitive prerequisites of reading activity was found. Short-term memory for serially organized material in children with dyslexia turned out to be negatively associated with the number of oculomotor referents of recoding operations, as well as operations to check the conclusions made (in contrast to the normal group). Different results from the control group were found in the presence of relationships between non-verbal intelligence and oculomotor parameters: in the group of children with dyslexia, non-verbal intelligence turned out to be directly related to the number of oculomotor referents not only of recoding operations, but also of actions to generate macro positions and check the logical connectivity of the text model.

Regression analysis was undertaken to assess the effect of cognitive premises on actions and operations. Independent variables were the studied cognitive parameters, and dependent - oculomotor referents of mental actions and operations. Also, to test the direct effect of cognitive prerequisites on the quality of text comprehension, the parameter "number of correct answers" (percentage of correct answers) was included in the list of dependent variables.

In the control group, regression analysis of the indicators revealed a determination: the number of fixations, microregressive and short regressive

saccades by the level of non-verbal intelligence; all variables except the number of progressive and long regressive saccades by the phonological working memory level; duration of fixations by the level of modal-nonspecific short-term memory. Short-term memory did not affect any oculomotor parameter (Table 34).

Table 34 - Analysis of the influence of the cognitive parameters studied on the quality of comprehension and oculomotor correlates of mental actions and operations: control group

Dependent variable	Independent variable											
	Nonverbal IQ			Nonword repetition test			Digit span: forward order			Digit span: backward order		
	F	R^2	p	F	R^2	p	F	R^2	p	F	R^2	p
Percentage of right answers (%)	0.180	0.002	0.672	2.824	0.023	0.095	0.031	0.000	0.861	0.736	0.009	0.394
Number of fixations	8.029	0.065	0.005	5.103	0.040	0.026	0.901	0.011	0.345	0.237	0.003	0.628
Duration of fixations	1.976	0.017	0.162	11.726	0.079	0.001	0.958	0.012	0.331	9.844	0.108	0.002
Number of progressive saccades	2.497	0.021	0.117	2.933	0.023	0.089	0.382	0.005	0.538	0.011	0.000	0.915
Number of microregressive saccades	6.945	0.056	0.010	5.490	0.042	0.021	1.477	0.018	0.228	1.060	0.013	0.306
Number of short regressive saccades	5.657	0.047	0.019	5.714	0.210	0.018	0.776	0.009	0.381	0.154	0.002	0.696
Number of medium regressive saccades	3.234	0.027	0.075	6.569	0.050	0.012	0.692	0.008	0.408	0.862	0.011	0.356
Number of long regressive saccades	0.368	0.003	0.545	3.567	0.028	0.061	0.050	0.001	0.823	2.773	0.033	0.100

Note: F – Fisher criterion, R^2 – coefficient of determination, p - significance coefficient

The results of regression analysis in the group of children with dyslexia found a completely different picture of the determination of oculomotor referents of reader activity by cognitive parameters. It was found that the level of nonverbal intelligence and short-term memory per serially organized material determine almost all oculomotor parameters except for the duration of fixations; the level of phonological working memory, on the contrary, does not determine any of the oculomotor referents of reading activities; the level of modally nonspecific short-term memory influenced all oculomotor parameters examined, except for the duration of fixations and the number of long regressive saccades (Table 35).

Table 35 - Analysis of the influence of the cognitive parameters studied on the quality of comprehension and oculomotor correlates of mental actions and operations: experimental group

Dependent variable	Independent variable											
	Nonverbal IQ			Nonword repetition test			Digit span: forward order			Digit span: backward order		
	F	R^2	p	F	R^2	p	F	R^2	p	F	R^2	p
Percentage of right answers (%)	0.044	0.001	0.835	0.048	0.001	0.827	0.485	0.008	0.489	3.603	0.058	0.063
Number of fixations	6.117	0.089	0.016	0.784	0.014	0.380	5.173	0.083	0.027	11.450	0.167	0.001
Duration of fixations	1.821	0.028	0.182	3.823	0.064	0.056	0.042	0.001	0.838	0.055	0.001	0.815
Number of progressive saccades	7.249	0.103	0.009	1.982	0.034	0.165	12.025	0.174	0.001	5.462	0.087	0.023
Number of microregressive saccades	5.105	0.075	0.027	2.098	0.036	0.153	11.271	0.165	0.001	8.123	0.125	0.006
Number of short regressive saccades	5.161	0.076	0.027	2.717	0.046	0.105	16.020	0.219	0.001	8.050	0.124	0.006
Number of medium regressive saccades	12.782	0.169	0.001	1.848	0.032	0.180	13.311	0.189	0.001	7.141	0.111	0.010
Number of long regressive saccades	33.367	0.346	0.001	1.750	0.030	0.191	6.433	0.101	0.014	3.048	0.051	0.086

Note: F – Fisher criterion, R^2 – coefficient of determination, p - significance coefficient

The results of regression analysis allow us to talk about significant differences in the cognitive mechanisms of the implementation of reading activities between children with dyslexia and their healthy peers.

In particular, the most striking differences are characterized by the results of an analysis of the influence of mnestic indicators: if in the norm group the only significant determinant was phonological working memory, then in the group of children with dyslexia the picture turned out to be significantly different. It can be assumed that the implementation of reading activities in a group of children with dyslexia proceeds according to the principle of "reliance on a safe link." Valid differences in mnestic functions between groups were found only in the level of phonological working memory, which turned out to be worse in children with dyslexia, which, presumably, determines the lack of its influence in the implementation of mental actions and operations related to decoding, generation of macro positions and checking the connectivity of the constructed text model. Not having the full opportunity to use the phonological working, a child with dyslexia, a child is faced with the impossibility of constructing conclusions and limitations in checking the logical connectivity of the text. According to a large number of works, the implementation of these actions is primarily based on phonological working memory [171; 177; 346; 348; 457; 490, etc.], which is a key element of the "cognitive resources" of the reading and comprehension process.

Speaking of "cognitive resources," we rely on the concept of cognitive resource and resource deficit, as one of the causes of disorders of generation/ comprehension of both oral and written speech [117; 118; 409; 483]. Accordingly, the presence of restrictions in the volume of phonological working memory will affect the number and quality of operations performed with its help.

However, the results of our study allow us to talk about dyslexic deficiency only in the indicators of phonological working memory, while the results of regression analysis demonstrate a serious contribution of the level of modal non-specific short-term memory (not related to ideas about the word) and short-term memory, in which differences between the groups were not found. This fact allows

us to argue that the key is not only a shortage of cognitive resources, but also mechanisms for the "use" of preserved functions.

Another conclusion arising from the results of the study and fully consistent with the previous one - the quality of comprehension the text does not directly depend on the level of cognitive resources, but turns out to be the deterministic effectiveness of the actions taken and operations aimed at comprehension the text. The results of our study are consistent with the results of Oakhill, Yuill, Parkin [353], which, based on the results of two experiments with children with a low and high level of reading and comprehension skills, came to similar conclusions, namely: there is no evidence of a direct connection between the level of comprehension of the text and mnestic abilities; key to comprehension of text are strategies for "constructing" a text model, i.e. how a child uses the resources available to him to create a text model and what text analysis strategies he uses.

The above conclusions update the question of the strategies used in the process of carrying out readers' activities as a set of certain actions aimed at comprehension of the text.

3.7 Strategies for the implementation of reading activities in children with dyslexia and their healthy peers: flexibility and variability in the organization of activities

It is known that in various situations, depending on the purpose of reading activity, a normally reading person uses different methods of analyzing the text, "in each specific case, different perception strategies are optimal" [67, p. 96]. The concept of "strategy" always implies a focus on achieving the goal. By strategies, we mean "a set of targeted actions of the reader aimed at full perception, mastering the content of the text, including attempts to change and control them for more successful comprehension" [110, p.5].

In addition, it is important to note that a strategy for the implementation of an activity includes actions that can be carried out to fulfill a specific task, but their combination is always aimed at achieving a common goal of the activity. Strategies

are almost always potentially conscious (a good reader can stop and realize the strategy he is using) and manageable (also good readers can resort to re-reading text or fragments of it for a better comprehension) [379, p. 89-90].

This paragraph contains the results of the study:

1) repeated readings of the text by children as an element of a strategic approach to the implementation of reading activities;

2) the influence of the task set for the child on the features of reading activities (assessment of the flexibility and variability of strategies for the implementation of reading activities);

3) the influence of the genre of text on the features of readers' activities and the strategies used (assessment of the flexibility and variability of strategies for the implementation of readers' activities).

3.7.1 Repeated readings as a strategic element of reader activity in children with dyslexia and their healthy peers

By re-reads, we mean the reading activity carried out after the first complete decoding of the text space (from the first word to the last). The primary analysis revealed a significant difference in the frequency of repeated text reads in dyslexic children and normal reading children. When reading all texts, children with dyslexia resorted to repeated readings less often than children of the control group (Table 36).

Table 36 - Percentage of children using re-reading in control and experimental groups

Text	Percentage of children using re-reading in control group (%)	Percentage of children using re-reading in experimental group (%)
All texts	46	15
Text 1	53	20
Text 2	52	23
Text 3	42	4
Text 4	38	12

Such a comparative analysis of the frequency of repeated readings is of independent interest. Taking into account the results of a number of works that

demonstrated the role of re-reads in improving the comprehension of the text as a whole [269], as well as their functional significance in the control of conclusions made in the process of reading [149; 213] and in checking the connectivity of the constructed text model [329; 502], it can be assumed that such differences in the frequency of repeated readings are associated with the peculiarities of text processing and comprehension in children with dyslexia.

Regression analysis of the effect of the number of reads on the percentage of correct responses was performed to determine the role of re-reads in comprehension of the text by dyslexic children and normally reading children.

In the group of normally reading children, the average number of re-reads in all texts, as well as separately for texts No. 1 and No. 2, significantly influenced the number of correct answers. The more often the children of the control group resorted to repeated readings, the better they understood what they read (Table 37).

Table 37 - The influence of re-readings on the quality of text comprehension: control group

Independent variable	Dependent variable	Text	R^2	F	p=
Number of rereadings	Percentage of right answers (%)	All texts	0.041	6.927	0.009
		Text 1	0.125	5.706	0.022
		Text 2	0.133	5.984	0.019
		Text 3	0.068	2.905	0.096
		Text 4	0.002	0.093	0.763

Note: F – Fisher criterion, R^2 – coefficient of determination, p - significance coefficient

In a group of children with dyslexia, the effect of the number of reads in text №4 on the number of correct answers was found. At the same time, no influence on the quality of comprehension of other texts was found (Table 38).

Table 38 - The influence of re-readings on the quality of text comprehension: experimental group

Independent variable	Dependent variable	Text	R^2	F	p=
Number of rereadings	Percentage of right answers (%)	All texts	0.011	0.849	0.360
		Text 1	0.017	0.293	0.596
		Text 2	0.003	0.054	0.819
		Text 3	0.011	0.192	0.667
		Text 4	0.205	4.641	0.045

Note: F – Fisher criterion, R^2 – coefficient of determination, p - significance coefficient

The analysis of the frequency of repeated readings, as well as the results of regression analysis, suggest that repeated readings of the text in children with dyslexia are not an important element of reading activity in comparison with children of the control group. This fact is explained by the previously described shortage of actions and operations related to the processing of the macro-propositional structure of the text and checking the connectivity of the constructed text model, which led to the impossibility of using re-reads. Experiencing difficulties in monitoring the correctness of the conclusions made and establishing a connection between macro-propositional elements of the text, a child with dyslexia does not find the need to re-read the fragments. In other words, we can talk about the difficulty of children with dyslexia in using re-reading to improve the quality of comprehension of the text due to the lack of formation of actions and operations related to self-control of comprehension [354]. The results of our study are consistent with the results of work that found a connection between assessing the coherence of the text, making conclusions and repeated readings [158; 473].

However, as found (Table 36), a small number of children with dyslexia resorted to re-reading, this fact requires a deeper study of reading activities in the process of re-reading in these children. We conducted a comparative analysis of oculomotor correlates performed during the first and repeated readings of mental actions in each of the groups. Such analysis makes it possible to assess the flexibility

of reading activity, because it reflects the degree of change in reading activity during the transition from the first reading to the second. A similar type of analysis was undertaken in a number of English-language studies with adult readers [269; 281] and demonstrated serious potential in describing the phenomenology of reading activity.

The results of comparison of oculomotor parameters in the first and repeated readings in the control group are presented in Table 39.

Table 39 - Comparison of first reading and re-readings: control group

Parameter	Text	First reading (M±m)	Re-reading (M±m)	Significance of differences (p=)
Number of fixations (per word)	Text 1	2.4±1.0	1.7±1.3	0.012
	Text 2	2.1±0.7	2.0±1.8	0.038
	Text 3	2.3±0.7	1.3±1.1	0.001
	Text 4	1.9±0.6	1.0±0.8	0.001
Duration of fixations (msec)	Text 1	234.1±55.6	219.5±48.5	0.413
	Text 2	237.6±64.1	220.3±50.9	0.285
	Text 3	247.2±62.5	207.8±37.3	0.007
	Text 4	245.7±64.5	194.1±27.3	0.001
Number of progressive saccades (per word)	Text 1	1.5±0.6	1.4±1.0	0.307
	Text 2	1.4±0.5	1.8±1.6	0.879
	Text 3	1.4±0.5	1.0±0.8	0.004
	Text 4	1.3±0.4	0.7±0.6	0.001
Percentage of the number of microregressions to the total number of regressive saccades (%)	Text 1	21±7	18±6	0.044
	Text 2	22±8	17±7	0.024
	Text 3	19±6	16±8	0.105
	Text 4	21±7	18±8	0.217
Percentage of the number of short regressive saccades to the total number of regressive saccades (%)	Text 1	37±8	32±9	0.027
	Text 2	35±7	34±7	0.434
	Text 3	36±6	32±8	0.030
	Text 4	36±6	33±7	0.125

Table 39 continuation

Percentage of the number of medium regressive saccades to the total number of regressive saccades (%)	Text 1	28±7	34±9	0.002
	Text 2	28±7	32±6	0.025
	Text 3	30±7	31±7	0.572
	Text 4	27±8	28±9	0.550
Percentage of the number of long regressive saccades to the total number of regressive saccades (%)	Text 1	13±6	16±7	0.116
	Text 2	15±6	16±7	0.298
	Text 3	14±5	20±10	0.006
	Text 4	16±6	20±5	0.023

Note: M - group mean, m - standard deviation; p - significance coefficient

In the control group, the change in reading activity during the transition from first reading to repeated reading was global in nature. To one degree or another, a change in the characteristics of oculomotor referents of mental actions and operations was found when reading all incentive texts. Children who read normally during re-readings were less likely to commit in all texts, and the duration of fixations in the 3rd and 4th texts was shorter than in the first readings. In addition, a comparative analysis of the frequency of occurrence of regressive saccades of different lengths demonstrated that when reading texts No. 1 and No. 2, normally reading children perform fewer microregressive saccades associated with the elimination of recoding errors and medium regressive saccades, which are the oculomotor referent for inference operations. It was also found that in texts No. 3 and No. 4, when moving from the first reading to the repeated reading, the number of long regressive saccades associated with checking the connectivity of the constructed text model decreases.

The results of the comparative analysis in the experimental group revealed a less global change in oculomotor parameters compared to the control group during the transition from the first reading to the second reading (Table 40).

Table 40 – Comparison of first reading and re-readings: experimental group

Parameter	Text	First reading (M±m)	Re-reading (M±m)	Significance of differences (p=)
Number of fixations (per word)	Text 1	5.2±2.6	2.0±1.4	0.003
	Text 2	4.5±1.9	1.6±1.6	0.002
	Text 3	4.4±1.7	3.7±1.5	0.960
	Text 4	3.7±1.6	2.4±2.4	0.627
Duration of fixations (msec)	Text 1	331.3±106.6	313.2±61.4	0.845
	Text 2	341.6±138.3	286.0±55.1	0.408
	Text 3	325.9±117.5	233.4±40.2	0.320
	Text 4	345.6±161.2	250.5±38.7	0.219
Number of progressive saccades (per word)	Text 1	3.2±1.5	1.3±1.0	0.003
	Text 2	3.0±1.5	1.0±1.0	0.003
	Text 3	3.1±1.6	2.7±1.6	1.000
	Text 4	2.2±1.0	1.0±1.2	0.219
Percentage of the number of microregressions to the total number of regressive saccades (%)	Text 1	23±5	20±3	0.222
	Text 2	24±6	29±13	0.181
	Text 3	25±6	24±6	0.873
	Text 4	24±6	21±6	0.432
Percentage of the number of short regressive saccades to the total number of regressive saccades (%)	Text 1	38±5	41±7	0.277
	Text 2	40±6	37±10	0.407
	Text 3	40±5	38±6	0.763
	Text 4	39±5	31±7	0.027
Percentage of the number of medium regressive saccades to the total number of regressive saccades (%)	Text 1	26±6	26±3	0.926
	Text 2	24±6	31±9	0.031
	Text 3	24±5	24±5	0.995
	Text 4	23±6	31±7	0.068
Percentage of the number of long regressive saccades to the total number of regressive saccades (%)	Text 1	13±6	13±5	0.973
	Text 2	11±5	12±6	0.785
	Text 3	11±4	13±4	0.579
	Text 4	13±5	16±6	0.323

Note: M – group mean, m – standard deviation; p – significance coefficient

Repeated readings of children with dyslexia significantly differed from the first readings in the number of fixations and progressive saccades in texts No. 1 and No. 2, as well as in the relative number of short regressive saccades in text No. 4 and medium regressive saccades in text No. 2. When re-reading the text, children with dyslexia performed on average fewer fixations and progressive saccades, as well as short regressive saccades. In other words, it can be assumed that repeated readings of scientific texts were characterized by a smaller number of performed recoding operations and correction of accompanying errors.

Changes in the nature of mental actions associated with the skills of semantic analysis were reflected in the significant differences in the relative number of mean regressive saccades. It can be assumed that in the process of repeated readings of text No. 2, children with dyslexia more often resorted to actions related to checking the conclusions made in comparison with the first readings.

The results we obtained are partly consistent with the data of Hyona & Niemi [269], in which a study of reading texts by students with a normal reading skill found a decrease in the number of fixations, saccades, as well as a decrease in the duration of fixations and an increase in the average amplitude of saccades when moving from the first reading to the subsequent one.

There are three main points of view on the causes and role of re-reads in comprehension of the text. According to the first point of view, during the first reading of the text, the reader forms an intermediate image of the text, and during repeated reads, a more strategic, selective reading is used to refine the built model and extract the necessary information [333; 334; 441]. The second point of view implies the use by readers of a selective reading strategy already in the process of first reading, which leads to the loss of information from the “field of view” necessary for comprehension, this information can be extracted during repeated readings [311; 312; 385]. The third point of view, formulated on the basis of the results of the study by Hyona and Niemi [269], implies the importance of re-reading both to extract the necessary information and to build a common text model.

In addition, the results of a study by Schad, Nuthmann, & Engbert [410] conducted on the material of readers with a high and low level of skill in comprehension of the text, demonstrated that subjects with a high level of comprehension spend more time processing text and searching for logical inconsistencies, which is also associated with the appearance of re-reads.

The results of our study demonstrate major differences in the functional significance and targeting of re-reads between children with dyslexia and their conditionally healthy peers. The lack of influence of the "read again" factor on the quality of comprehension of the text in children with dyslexia reveals a low level of focus of this element of reader activity. In other words, it is legitimate for children with dyslexia to conclude that both the presence and absence of re-readings do not in any way affect the quality of comprehension of the text, while normal-reading children demonstrate more frequent re-readings and find their impact on the quality of comprehension of the text.

According to the results of a number of studies, re-readings are carried out primarily based on working memory resources [230; 446; 503], which seems natural. During the first reading, a certain amount of text information is placed in the short-term memory unit, and the second readings are made due to the detection of logical errors, "incoherence" or the awareness of the need to read the text fragment that has been missed again during reading. From this point of view, children with dyslexia who have discovered a shortage of phonological working memory are limited in the resources necessary for repeated readings, while normal reading children, on the contrary, use repeated readings as an additional opportunity to clarify the information, check the correctness of the conclusions made during the first readings, and assess the connectivity of the constructed text model.

3.7.2 Impact of task type on the nature of mental actions and operations in children with dyslexia

A comparative analysis of oculomotor parameters in both groups was carried out to compare the peculiarities of reading activity in the performance of tasks of type 1 and 2.

In the group of normally reading children, differences were found in the number of fixations (text No. 3), the average duration of fixations (text No. 2 and No. 4) and the average amplitude of progressive saccades (text No. 2) during the first and second tasks (Table 41).

Table 41 – Comparative analysis of oculomotor references of mental actions and operations in task №1 and task №2: control group

Parameter	Text	Task 1	Task 2	Significance of differences (p=)
		(M±m)	(M±m)	
Number of fixations (per word)	Text 1	3.3±1.2	3.4±1.5	0.864
	Text 2	2.8±1.0	3.6±2.2	0.689
	Text 3	2.4±0.7	2.0±0.6	0.036
	Text 4	1.7±0.6	2.0±0.5	0.086
Duration of fixations (msec)	Text 1	247.4±48.1	222.0±58.5	0.068
	Text 2	222.2±60.5	253.8±59.6	0.037
	Text 3	256.2±67.1	226.7±45.9	0.071
	Text 4	217.5±59.7	258.1±61.0	0.020
Number of progressive saccades (per word)	Text 1	2.1±0.9	2.5±1.0	0.230
	Text 2	2.1±1.0	2.7±1.8	0.786
	Text 3	1.8±0.9	1.9±0.8	0.531
	Text 4	1.6±0.5	1.6±0.6	0.760
Average amplitude of progressive saccades (degrees)	Text 1	2.6±0.5	2.8±0.6	0.181
	Text 2	2.8±0.6	2.4±0.5	0.043
	Text 3	2.4±0.6	2.5±0.5	0.268
	Text 4	2.6±0.6	2.3±0.5	0.076
Percentage of the number of microregressions to the total number of regressive saccades (%)	Text 1	20±5	21±7	0.864
	Text 2	20±8	21±5	0.665
	Text 3	19±6	19±6	0.834
	Text 4	20±6	20±7	0.832
Percentage of the number of short regressive saccades to the total number of regressive saccades (%)	Text 1	35±7	37±7	0.405
	Text 2	35±6	35±6	0.939
	Text 3	36±4	36±9	0.816
	Text 4	35±6	36±6	0.561

Table 41 continuation

Percentage of the number of medium regressive saccades to the total number of regressive saccades (%)	Text 1	30±7	28±8	0.386
	Text 2	30±9	29±4	0.726
	Text 3	31±6	31±7	0.948
	Text 4	29±8	26±8	0.312
Percentage of the number of long regressive saccades to the total number of regressive saccades (%)	Text 1	14±5	14±7	0.894
	Text 2	15±5	15±5	0.980
	Text 3	15±5	14±6	0.958
	Text 4	16±6	17±5	0.655

Note: M - group mean, m - standard deviation; p - significance coefficient

Therefore, depending on the type of task set, oculomotor referents associated with the recoding duration changed in children of the control group (a greater value of the duration of fixations when performing the second type of task). Moreover, taking into account the previously described relationship between the amplitude of progressive saccades and the volume of symbols processed simultaneously, the results suggest that when performing a first type of task, this volume was larger than when performing a second type of task. This fact, in turn, can be explained by the fact that the children of the control group could use the "hint" in the form of the questions presented on the content before reading the text (according to the condition of the first type of task), which, in turn, allowed them to process the text in large fragments (large amplitude of progressive saccades), skipping information irrelevant to answers to questions and focusing on fragments containing answers to questions. Our results are indirectly consistent with the results of studies in which it was demonstrated that when reading the text, readers focus more on the text fragments of interest to them (corresponding to their purpose), to a certain extent ignoring other information blocks of the text [229; 282].

In the group of children with dyslexia, none of the oculomotor referents performed by children with dyslexia of mental actions differed when performing tasks of the first and second types. The absence of reliable differences was found when comparing all texts (Table 42).

Table 42 - Comparative analysis of oculomotor references of mental actions and operations in task №1 and task №2: experimental group

Parameter	Text	Task №1	Task №2	Significance of differences (p=)
		(M±m)	(M±m)	
Number of fixations (per word)	Text 1	6.0±3.2	5.3±1.8	0.865
	Text 2	4.6±2.1	5.1±2.1	0.781
	Text 3	4.7±2.0	4.3±2.3	0.155
	Text 4	3.7±1.6	4.0±1.9	0.677
Duration of fixations (msec)	Text 1	312.9±110.7	347.2±96.9	0.361
	Text 2	346.3±104.3	332.4±164.1	0.560
	Text 3	327.1±142.8	323.1±64.1	0.953
	Text 4	316.0±65.9	360.6±196.8	0.890
Number of progressive saccades (per word)	Text 1	3.6±1.8	3.3±1.5	0.910
	Text 2	3.0±1.6	3.3±1.6	0.631
	Text 3	3.5±1.8	2.6±1.3	0.174
	Text 4	2.2±1.0	2.4±1.2	0.718
Average amplitude of progressive saccades (degrees)	Text 1	2.2±0.3	2.5±1.1	0.608
	Text 2	2.3±0.5	2.0±0.3	0.176
	Text 3	2.1±0.3	1.9±0.2	0.263
	Text 4	2.0±0.4	2.1±0.5	0.718
Percentage of the number of microregressions to the total number of regressive saccades (%)	Text 1	23±5	22±5	0.682
	Text 2	22±6	26±6	0.097
	Text 3	25±3	26±8	0.488
	Text 4	26±7	23±5	0.230
Percentage of the number of short regressive saccades to the total number of regressive saccades (%)	Text 1	39±5	37±5	0.296
	Text 2	39±6	40±6	0.694
	Text 3	40±5	39±6	0.619
	Text 4	38±4	39±6	0.732
Percentage of the number of medium regressive saccades to the total number of regressive saccades (%)	Text 1	26±5	26±5	0.696
	Text 2	25±6	24±6	0.397
	Text 3	24±4	23±6	0.691
	Text 4	22±6	25±6	0.234

Table 42 continuation

Percentage of the number of long regressive saccades to the total number of regressive saccades (%)	Text 1	11±4	15±7	0.086
	Text 2	12±5	10±4	0.119
	Text 3	11±4	11±5	0.881
	Text 4	14±5	13±5	0.607

Note: M - group mean, m - standard deviation; p - significance coefficient

In other words, the nature of the course of mental actions and operations in children with dyslexia does not differ in the performance of both types of tasks. There is reason to believe that such inflexibility in the performance of mental actions and operations is due to the low level of variability in reading skills and the arsenal of strategies that children with dyslexia can use. This assumption is supported by studies that evaluated the effectiveness of the use and formation of various strategies in readers with dyslexia [183; 218; 443].

3.7.3 Influence of the text genre and its individual features on the nature of mental actions and operations in children with dyslexia

The results of a comparative analysis of oculomotor referents of mental actions and operations when reading scientific and narrative texts in a group of children with normal reading skills demonstrated pronounced inter-genre differences (Table 43).

Table 43 - Comparative analysis of oculomotor references of mental actions and operations in reading scientific and narrative texts: control group

Parameter	Text genre		Significance of differences (p=)
	Scientific texts	Narratives	
	(M±m)	(M±m)	
Number of fixations (per word)	3.3±1.5	2.5±1.0	0.001
Duration of fixations (msec)	234.9±58.0	245.2±62.1	0.235
Number of progressive saccades (per word)	2.3±1.2	1.7±0.8	0.001
Number of microregressive saccades (per word)	0.3±0.2	0.2±0.1	0.004

Table 43 continuation

Number of short regressive saccades (per word)	0.6±0.3	0.4±0.3	0.004
Number of medium regressive saccades (per word)	0.5±0.3	0.3±0.1	0.004
Number of long regressive saccades (per word)	0.2±0.1	0.1±0.1	0.022

Note: M - group mean, m - standard deviation; p - significance coefficient

When reading narrative texts, children of the control were less likely to make fixations, progressive saccades, as well as micro-, short, medium and long regressive saccades. In other words, almost all oculomotor referents of the mental actions and operations performed by normally reading children differed depending on the genre of the text.

In the group of children with dyslexia, differences were found only in the number of fixations and progressive saccades. Children were less likely to resort to fixations and progressive saccades when reading narrative texts (Table 44).

Table 44 - Comparative analysis of oculomotor references of mental actions and operations in reading scientific and narrative texts: experimental group

Parameter	Text genre		Significance of differences (p=)
	Scientific texts	Narratives	
	(M±m)	(M±m)	
Number of fixations (per word)	5.2±2.4	4.2±1.9	**0.004**
Duration of fixations (msec)	333.9±121.3	335.3±140.7	0.900
Number of progressive saccades (per word)	3.3±1.6	2.7±1.5	**0.032**
Number of microregressive saccades (per word)	0.7±0.5	0.6±0.4	0.258
Number of short regressive saccades (per word)	1.2±0.8	0.9±0.7	0.222
Number of medium regressive saccades (per word)	0.7±0.5	0.6±0.4	0.089
Number of long regressive saccades (per word)	0.4±0.2	0.3±0.2	0.230

Note: M - group mean, m - standard deviation; p - significance coefficient

The results of comparative analysis in both groups suggest less sensitivity of children with dyslexia to the genre features of the text. If in children with dyslexia the parameters reflecting the course of all the main mental actions (decoding, generating macro positions, checking the connectivity of the constructed text model) changed, then in the group of children with dyslexia only the parameters associated with the recoding operation differed.

In order to assess the presence and degree of influence of the "genre of text" factor on the mental actions performed by children and the quality of comprehension, we undertook regression analysis in each of the groups.

In the group of children with normatively developed reading skills, a significant influence of the "text genre" factor on the number of fixations performed, the number of progressive, as well as micro-, short, medium and long regressive saccades was found (Table 45).

Table 45 - Influence of the genre on the quality of text comprehension and oculomotor references of mental actions and operations: control group

Dependent variable	Independent variable		
	Text genre		
	F	R^2	p
Number of fixations (per word)	15.055	0.079	0.001
Duration of fixations (msec)	1.296	0.007	0.257
Number of progressive saccades (per word)	15.352	0.081	0.001
Number of microregressive saccades (per word)	8.599	0.047	0.004
Number of short regressive saccades (per word)	8.343	0.046	0.004
Number of medium regressive saccades (per word)	8.611	0.047	0.004
Number of long regressive saccades (per word)	5.322	0.030	0.022

Note: F – Fisher criterion, R^2 – coefficient of determination, p - significance coefficient

In a group of children with dyslexia (Table 46), a significant influence of the text genre on the number of fixations and progressive saccades was found.

Table 46 - Influence of the genre on the quality of text comprehension and oculomotor references of mental actions and operations: experimental group

Dependent variable	Independent variable		
	Text genre		
	F	R^2	p
Number of fixations (per word)	5.590	0.054	0.020
Duration of fixations (msec)	0.003	0.000	0.959
Number of progressive saccades (per word)	5.822	0.057	0.018
Number of microregressive saccades (per word)	1.295	0.013	0.258
Number of short regressive saccades (per word)	1.508	0.015	0.222
Number of medium regressive saccades (per word)	2.946	0.029	0.089
Number of long regressive saccades (per word)	1.458	0.015	0.230

Note: F – Fisher criterion, R^2 – coefficient of determination, p - significance coefficient

The results obtained are to a certain extent consistent with the results of the Kraal & van den Broek [299] studies, in which in the research of reading children with high and low reading comprehension skills, significant differences in oculomotor parameters were described when reading scientific and narrative texts. In addition, the authors found that in the group of well- comprehending children, inter-genre differences in some oculomotor parameters are more pronounced than in the group of poorly comprehending children. The results of the study demonstrated a low ability of poorly comprehending children to change reading strategies by text genre [299, p.11].

The results of our comparative and regression analyses suggest that reading activity in dyslexic children compared to children with a normally developed reading skill is less flexible. So taken, mental actions in children with dyslexia turned out to be less sensitive to the factor "genre of text" than in their healthy peers.

When talking about the flexibility of reading activity, we imply the ability of the subject of activity to change it under the influence of certain conditions to increase efficiency in achieving the goal. In the translation to reading activity, such

an ability turns out to be synonymous with the ability of the reader to use different reading strategies to better understand the read, change them, depending on the task, genre, difficulties, etc.

In a certain number of studies, it has been found that strategies in the broad sense of the word are special actions (or sequences of actions) that a person uses to facilitate the process of implementing activities, in particular training [236; 277]. Reading strategies have been found to be a key influence on the quality of text comprehension [119; 189; 289]. Monitoring the implementation of activities, flexibility in using reading strategies allow the reader to more accurately assess the quality of reading comprehension, as well as improve the quality of text comprehension [119; 132; 170].

According to the theory of Wenstein & Mayer [486], two types of strategies can be distinguished to increase the efficiency of comprehension. The first type is the so-called "repetition strategies," which are reflected in the use of re-reads and turn out to be more related to surface text processing. They demonstrate a high level of efficiency in tasks related to storing text information. In other tasks, in particular, related to a full comprehension of the text, these strategies are characterized by a low level of performance. The second type of strategies is "depth processing strategies." The core of these strategies is the ability to generalize the information received, to build conclusions. Using these strategies, the reader returns to certain fragments of text (without resorting to continuous rereading), trying to discover and build connections between different semantic units of text [238]. "Deep processing strategies" turn out to be related to the ability of the reading child to plan his activities depending on the task, to use self-monitoring of comprehension to identify fragments in the comprehending of which difficulties arise [297]. In turn, to solve difficulties, the reader can go back or look ahead in search of information that could help in comprehension. Thus, the results of our study make it possible to talk about inaccessibility for children with dyslexia as surface processing strategies (almost complete absence of re-reads compared to children in the control group, in which a significant effect of re-reads on the quality of comprehension was found), as well as

"deep processing strategies" (the number of mental actions and operations established by us that are reliably less related to the control of conclusions and checking the connectivity of the constructed text model) [298; 354; 355].

A number of studies have clearly demonstrated that there are differences between strategies that well and poorly comprehending readers use when reading scientific and narrative texts [125; 188; 192; 361; 401]. These differences are primarily due to the peculiarities of genres. Narrative texts describe the events of real or imagined life [145; 448], they usually have a certain structure [245], most often such texts contain many famous and everyday words [191; 246]. Scientific texts, on the contrary, seem less structured [108], and the nature of the presentation of information in them differs significantly from narrative texts [245]. The links between macro-propositional structures in such texts are implicit, the "density of information" is significantly higher than in the narrative genre [125; 126; 290]. Scientific text is often a description of a set of facts that form a structure that is complex for building a coherent model of text.

The results of our study reveal the insignificant nature of changes in the structure of reader activity (mental actions and operations) in children with dyslexia depending on the genre of text and the task at hand. In addition, children with dyslexia show no use of either "surface processing strategies" or "depth processing strategies" of the text. This is evidenced by the results of the analysis of the frequency of actions related to the verification of conclusions and actions aimed at monitoring the connectivity of the text model, as well as the results of the analysis of repeated readings

Discussion and Conclusions

The dissertation research focused on investigating the structure of reading difficulties in children with dyslexia as well as their clinical-psychological characteristics, including cognitive prerequisites of reading activity and emotional-personal elements.

The analysis of the literature made it possible to operationalize reading activities using oculomotor referents of mental actions and operations. It was found that parameters such as the number of fixations and their duration, as well as the number of progressive saccades and their amplitude were associated with the mental action of decoding. The parameters of regressive saccades of different amplitudes are associated with mental actions, the task of which is to semantic processing of the text and self-control the quality of comprehension (generation of macro positions, processing of the macro-propositional structure of the text, checking the connectivity of the constructed text model). The results of the study made it possible to describe a model for studying readers' activities and their violations, which can be presented through the correlation of the stages of the text processing process, their tasks, as well as mental actions, operations and their oculomotor referents (Table 47).

Table 47 – The structure of reading activity: phases of text analysis, mental actions, operations and oculomotor referents

Stage	Aim	Action	Operation	Oculomotor referents
Processing the surface structure of the text	Generation of micropropositions	Decoding	-Recoding -Relating a phonetic word to the lexicon -Serial organization of operations	-number of fixations and progressive saccades -duration of fixations -number of micro- and short regressive saccades
Processing the macropropositional structure of the text	Generation of macropropositions	Creating a macroproposition	Inference-based synthesis of micropropositions	Number of medium regressive saccades
Creating a coherent, cohesive structure for a whole text (text base)	Integration of macropropositional structures and control of their coherence	Synthesis of macropropositions and verification of their contextual adequacy and logical coherence	Control of contextual adequacy and logical correctness of the inferences made	Number of long regressive saccades
Creating a holistic situational mental model of the text (situational model)	Creating a personalized version of the semantic content of a text	Producing heuristic hypotheses about the meaning of an entire text by integrating the text's information base and the reader's personal knowledge base	Extracting and synthesizing information from the information base of the text and the reader's personal knowledge base	No direct oculomotor references

The use of this model using aytracking technology made it possible to find that the structure of reading activities of children with dyslexia is characterized not only by violations of the technical side of the reading skill, but also by the non-formation of mental actions, the task of which is to create macro positions, check their contextual adequacy, as well as assess the connectivity of the constructed text model.

The results of the study are important in the context of falling out of view of the clinical and psychological theory and practice of questions related to a violation of the skills of analysis and comprehension of the written text in children with dyslexia. We can talk about the practical complete absence of comprehensive psychological programs for the correction of dyslexia in children. In addition, it is important to note that domestic methods of diagnosing dyslexia are also so far limited by the only methodology for studying the reading skill of Standardized Assessment of Reading Skills. The data obtained in the framework of this study can form the basis for the creation of psychodiagnostic and psychocorrection programs based on the complex nature of violations of the reading activities of children with dyslexia.

An analysis of the cognitive prerequisites of reader activity found a deficit in phonological working memory in children with dyslexia, identifying one of the actual targets of psychocorrection work. At the same time, it was found that the influence of cognitive parameters on the quality of comprehension of the written text is mediated, and the effectiveness of the mental actions taken is key.

Furthermore, research has found that children with dyslexia exhibit a significant level of personal anxiety, often accompanied by personality traits like insecurity, social reticence, anxiety, and tension. The manifestation of these characteristics, along with the associated stress and unease, pose a specific risk to the development of self-worth in a kid with dyslexia who consistently encounters the feeling of personal inadequacy. The study findings indicate the necessity of establishing psychological support networks for children with dyslexia, which have the potential to be effective in addressing their needs.

The results of the study allow us to formulate the following conclusions:

1. The structure of the reading activity is represented by the stages of text processing, completion of the tasks, and corresponding mental actions and operations. The reading activity is organized into four stages: analyzing the surface structure of the text, analyzing the macropropositional structure, constructing a cohesive structure of the entire text, and forming a comprehensive mental representation of the text. The stages are implemented through the following cognitive avtions: decoding, synthesizing macropropositions, monitoring contextual appropriateness and logical accuracy of inferred inferences, extracting and synthesizing information from the text's information base and the reader's personal knowledge base;

2. A psychodiagnostic study of reading and comprehension skill found impaired reading technique and lower reading comprehension in dyslexic children. At the same time, no direct relationship between the technical components of reading and the quality of comprehension of the text was revealed; children with dyslexia are characterized by a lower level of phonological working memory compared to children with a normal level of reading skill development

3. Children with dyslexia are characterized by a higher level of personal anxiety compared to children with a reading norm, as well as the severity of personality traits such as social timidity, self-doubt and tension;

4. Children with dyslexia are characterized by a violation of the mental actions of decoding, creating macro-positions, synthesizing macro-positions and checking their contextual adequacy and logical connectivity. These violations are reflected in: more recoding operations and their longer time duration in comparison with children with a normatively developed reading skill; a shortage of microproposition synthesis operations and control of the contextual and logical adequacy of the conclusions made;

5. The cognitive prerequisites for reading do not directly impact the quality of text comprehension. Instead, the efficiency of the mental actions and operations involved in processing the meaning of the text defines its quality;

6. Children with dyslexia are characterized by a low level of purposeful reader activity. Actions included in the structure of reading activities in children with dyslexia are largely unrelated to the quality of comprehension of the text;

7. Children with dyslexia demonstrate less flexibility in organizing reading activity, as evidenced by their lack of sensitivity to the genre-specific qualities of the text and the current task. They also struggle with employing strategic reading techniques and analyzing texts.

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ANNEXES

Annex 1.

SMINCH test: text 1

Как я ловил раков

В нашей деревне текут два ручейка. В них живет много раков. Мальчики ловят их руками под камнями, в дырах между корнями или под берегом. Потом они варят их и лакомятся ими. Одного рака я получил от моего друга, и он мне очень понравился,был очень вкусный.

Мне тоже захотелось ловить раков. Но легко сказать, а трудно сделать. У раков есть свое оружие — клешни, которыми они щиплются как следует. Кроме того, я боялся сунуть руку е дыру между корнями. Ведь можно прикоснуться к лягушке или даже к змее! Мой друг посоветовал мне, как можно ловить раков совсем по-другому...

Нужно привязать на длинную палку тухлое мясо. Рак крепко схватит мясо, и затем его легко вытащить из воды, как рыбу на удочке. Этот способ мне очень понравился, и поэтому я подготовил все нужные вещи. В пруду я нашел глубокое место и сунул палку в воду.

Сижу спокойно. Вода чистая, но раков я не Бидел нигде. Вдруг я заметил усы, потом глаза и клешни, наконец, весь рак медленно вылез к мясу. Потом схватил мясо клешнями и разорвал его челюстями. Я очень осторожно вытянул свою удочку из воды, и рак лежит на траве.

Но некоторые раки были более осторожными. Когда палка-удочка дрожала, рак сразу ее отпускал и задом плыл в нору.

Отгадайте, почему задом? Но все-таки я наловил много раков. Мама их сварила. Какими они были красными! И очень вкусными!

Annex 2.

SMINCH test: text 2

Неблагодарная ель

В отдаленной части леса, рядом с высокой рощей, росла ель. Маленькую елочку поражала красота белых цветков, которые распускались весной на терновнике.

Стали они с терновником друзьями еще с осени. Тогда ели понравились его синие плоды. Когда ель стала взрослой, птицы ей сказали, что другой такой красавицы в лесу нет. Тогда охватили ель гордость и самолюбие. Однажды она сказала: «Слушай, терновник, убери свои кривые ветки от меня! Ведь ты не позволяешь, чтобы прохожие восхищались моей красотой и моим прекрасным ростом». «И это ты мне за всю защиту от ветра и плохой погоды?» — жалобно спросил терновник. Ель молчала и только мрачно качала ветвями. Терновник рассердился и отодвинулся к солнцу. Через несколько дней к солнцу обратились все ветви терновника, но ни одна не прикоснулась к ели. И ель росла, росла...

Во время первых зимних метелей в лес пришли лесорубы. Они искали новогодние елки. От страха начала ель просить терновник, чтобы он ее спрятал. Но было уже поздно просить. Все ветки терновника летом повернулись к солнцу и зимой уже не могли приблизиться к ели. Она заплакала: «Ведь меня топором убьют!» «И это из-за того, что ты была гордой, самолюбивой и неблагодарной», — ответил терновник. «Да, неблагодарная гордость не принесет пользу», — заплакала ель.

Едва она сказала это, как перед ней уже стояли люди и восхищались ее красотой. Ее срубили. Ель упала в объятия терновника и навсегда распрощалась с лесом.

Annex 3.

SMINCH test: Assessment comprehension of text 1

Вопросы к тексту I для оценки понимания прочитанного:

1.Сколько ручейков текут в деревне?

2.Кто в них живет?

3.Где мальчики ловят раков?

4.Что мальчики с ними делают?

5.От кого мальчик получил рака?

6.Чего захотелось мальчику?

7.Что есть у раков?

8.Что боялся сделать мальчик?

9.Почему?

10.Что посоветовал ему друг?

Annex 4.

SMINCH test: Assessment of comprehension of text 2

Вопросы к тексту II:

1. Где росла ель?
2. Что поражало маленькую ель?
3. Какие отношения у нее были с терновником?
4. Что ели понравилось осенью?
5. Что сказали птицы?
6. Что сказала ель терновнику?
7. Что терновник ей ответил?
8. Что потом сделал терновник?
9. Что сделалось с ветвями терновника?
10. Что происходило с елью?

Annex 5.

Nonword repetition test

Номер слова	**Слово**	**Оценка +/-**
1	взун	
2	Руст	
3	Взонг	
4	Гран	
5	шикс	
6	пчифт	
7	**фкур**бак	
8	би**дузл**	
9	**бриждк**ус	
10	бул**штем**	
11	мунг**ляпс**	
12	ким**спект**	
13	извыр**лофт**	
14	му**практ**вил	
15	пу**флин**тир	
16	арба**дяск**	
17	доронА**уск**	
18	возиву**арт**	
19	поси**бард**	
20	кубан**кряст**	
21	сигути**напт**	
22	нирамик**стун**	
23	нарантИ**глинт**	
24	вишИ**мнуст**рин	

Annex 6.

Stimuli of an eye-racking study of reading activity: research text 1

«Падающие звезды» это метеоры. Греческое слово метеор по-русски означает «происходящее в воздухе». Метеоры появляются потому, что в земную атмосферу с огромной скоростью влетают мельчайшие твердые крупинки, весящие доли грамма. Эти крупинки в бесчисленном количестве движутся в межпланетном пространстве, и Земля непрерывно встречается с ними. Они движутся с огромной скоростью, во много раз большей, чем скорость пули или снаряда.

Влетая в атмосферу с такой скоростью, метеорная частица встречает чрезвычайно сильное сопротивление воздуха. Поэтому она быстро нагревается до очень высокой температуры, вскипает и испаряется, превращаясь в раскаленный газ, который быстро рассеивается в воздухе. Вот этот раскаленный и светящийся газ мы и замечаем в виде быстро пролетающего по небу метеора. После ярких метеоров на небе в течение нескольких секунд виден след - слабо светящаяся тонкая ниточка.

Annex 7.

Stimuli of an eye-racking study of reading activity: research text 2

Вторая по удаленности от Солнца планета - Венера. В противоположность Меркурию найти ее на небе очень легко. Каждому случалось видеть, как иной раз вечером на совсем еще светлом небе загорается «вечерняя звезда». По мере того как гаснет заря, Венера становится все ярче и ярче, а когда совсем стемнеет и появятся другие звезды, она резко выделяется среди них своим сильным светом. Но светит Венера недолго. Проходит час-другой, и она заходит. В середине ночи она не появляется никогда, но зато бывает время, когда ее можно видеть по утрам, перед рассветом, в роли «утренней звезды». Уже совсем рассветет, исчезнут все звезды, а Венера все еще светит и светит на ярком фоне утренней зари.

Annex 8.

Stimuli of an eye-racking study of reading activity: research text 3

У старухи были пятнистая корова и козёл. Корова и козёл вместе ходили в стадо. Корова всё время ворочалась, когда её доили. Старуха вынесла хлеба с солью, дала корове и потихоньку приговаривала: «Да стой же, матушка; на, на; ещё вынесу, только стой смирно».

На другой вечер козёл вперёд коровы вернулся с поля, расставил ноги и стал перед старухой. Старуха замахнулась на него полотенцем, но козёл стоял, не шевелился. Он помнил, что старуха обещала хлеба корове, чтобы стояла смирно. Старуха видит, что козёл совершенно не пронимается, взяла здоровую палку и прибила его.

Когда козёл отошёл, старуха опять стала кормить корову хлебом и уговаривать её.

«Нет в людях правды! - подумал козёл. - Я смирнее её стоял, а меня прибили».

Он отошёл в сторонку, разбежался, ударил в подойник и разлил молоко.

Annex 9.

Stimuli of an eye-racking study of reading activity: research text 4

Прилетела муха к Человеку и говорит:

—Ты хозяин над всеми земными зверями, ты всё можешь сделать, что захочешь. Сделай мне хвост.

—А зачем тебе хвост? — говорит Человек.А затем мне хвост, — говорит Муха, — что он у всех зверей, — для красоты.

Я таких зверей не знаю, у которых хвост для красоты. А ты и без хвоста хорошо живёшь.

Рассердилась муха и давай человеку надоедать: то на сладкое блюдо сядет, то на нос ему перелетит, то у одного уха изо всех сил жужжит, то у другого. Надоела, сил нет! Человек ей и говорит:

— Ну, ладно! Лети ты, Муха, в лес, на реку, в поле. Если ты найдёшь там зверя, птицу или гада, у которого хвост для красоты только привешен, можешь его хвост себе взять. Я разрешаю.

Обрадовалась муха и вылетела в окно. Но и по сей день она летает без хвоста.

Annex 10.

Types of analyzed regressive saccades