VIOLATION OF THE COGNITIVE ACTIVITY OF JUNIOR SCHOOLCHILDREN WITH SYSTEMIC SPEECH DISORDERS

Natalia Havrylova, Oksana Tkach, Oleksiy Havrylov

Kamianets-Podilskyi National Ivan Ohienko University (UKRAINE)

Abstract

The relevance of the research. Today, there is a sharp question of giving up writing diagnoses to identify existing violations of mental development in children. Instead, scientists are working at the formation of characteristics based on the neuropsychological aspect of the vision of the problem. On the basis of the analysis of the specificity of psychological tests implementation, the research in the field of neuropsychology gives information about the location of the defeat of the cerebral cortex; allows to define and describe the structure of the violation of the mental sphere and the impact of its underdevelopment on the state of assimilation of various kinds of educational information.

The purpose of the research was to identify and characterize the structural types of violation of the cognitive sphere in children with systemic speech disorders and determine their difficulties in learning educational information.

The study covered 386 junior pupils aged 6-10 years with typical development, systemic speech disorders, normal hearing, vision, and intelligence.

Two methods have been developed for the research: one for studying the peculiarities of the cognitive sphere in children aged 6-10 years, and second for studying the specifics of the learning of the educational material of basic disciplines in elementary school.

The methodology for studying the cognitive sphere was based on the neuropsychological approach. It included 38 tests and tasks from the neuropsychological method of O.R. Luria [15], the album of Y.Z. Gilbukh [19], the methods of N.M. Stadnenko [20] and R. Atmhauer.

To study the condition and peculiarities of mastering math knowledge by junior schoolchildren, we used the methods of N.S. Havrylova, V.V. Tarasun [21]. To study the same in writing and reading, we used the methods of M.V. Shevchenko and V.V. Tarasun [22].

To verify the results of the study, we applied Pearson's consistency criterion.

The analysis of the materials of the study showed that all the children with systemic speech disorders and normal intelligence demonstrated selective underdevelopment of processes and functions of the cognitive activity. The level of underdevelopment in their cognitive activity was not directly correlated with the severity of their speech disorder.

As a result, we identified 3 structural types of violation of the cognitive sphere that are most commonly encountered in junior pupils studying in a comprehensive school: kinetic, which arises in case of violation in the area of frontal lobe of the cerebral cortex; kinesthetic - with a defeat of the anterior part of the parietal lobe of the cerebral cortex; mnestic - with the defeat of the posterior border parietal-occipital parts of the brain. We also formed cross-sectional characteristics of these types of violation from the gnostic-praxis level to the mnestic and intellectual ones.

In the comparative analysis, we determined that every group of children has distinct types of difficulties in mastering educational information. The conducted multi-level analysis has allowed stating that the presence of specific difficulties of mastering educational information in children is caused by selective violations of the cognitive sphere.

Our study does not solve all aspects of the problem and may be the basis for further creation of individually directed correction and teaching methods to increase the efficiency of children’s mastering educational information.

Keywords: violation of the cognitive activity, systemic speech disorders, neuropsychological approach, junior schoolchildren.
1 INTRODUCTION

At the present stage of the development of special education, there is a sharp question of giving up writing diagnoses for identification of existing violations of mental development in children, and the formation of characteristics based on the neuropsychological aspect of the vision of the problem. In this regard, the scientific community gives strong support to all research in the field of neuropsychology. It has significant advantages: on the basis of the analysis of the specifics of the implementation of psychological tests it gives information about the location of lesions in the cerebral cortex; allows to define and describe the structure of the violation of the mental sphere and the effect of its underdevelopment on the state of assimilation of various kinds of educational information. On these grounds, it becomes possible to predict the types of difficulties when learning the educational material. In addition, this research is the basis for the creation, in the long run, of new individual methods aimed at eliminating the difficulties of learning the educational information by children at school.

The analysis of scientific research has shown that the causes of difficulties that schoolchildren meet learning the disciplines at school are diverse and complex. These include: 1) local lesions of the cerebral cortex; 2) general and selective disruption of mental operations; 3) underdevelopment of special educational abilities; 4) lack of speech readiness.

The nature of cognitive activity in children with speech disorders (motor alalia) was also actively studied by E. Sobotovich [1]. She revealed selective underdevelopment of certain mental processes of the gnostic-praxis (kinetic praxis, phonemic perception) and intellectual level of the development of the cognitive sphere in case of damage to the frontal area of the cerebral cortex that caused a significant delay in the development of all sides of speech in these children.

V.V. Tarasun [2] found that in a significant proportion of children with speech impairment, difficulties in learning were caused by selective lack of maturity of basic psychic structures (successional and synoptic syntheses). The consequence of their violation is the underdevelopment of special educational abilities, which affects the level of their mastering teaching material in mathematics and language as educational subjects.

N.Y. Semago, M.M. Semago [3] distinguish three interdependent and complementary elements that are part of the system of basic components of development and determine the potential opportunities for assimilation of educational information by the child: arbitrary mental activity, spatial and spatial-temporal representations, basic affective regulation. If there is a violation of the development in each of these components in children, there arise difficulties in learning.

A. Semenovich [4], A. Syrotyuk [5] identified 4 syndromes of partially unformed development as the causes of children’s difficulties in learning: functional immaturity of the frontal lobes of the brain, the left temporal fate, intercostal interaction of the transcortical level (corpus callosum) and the right hemisphere.

In the studies of American and European scientists, the most common causes of learning difficulties are noted.

Violations of the motor organization of general and small movements (apraxia) in the works of J.L. Wambaugh, C. Nessler, R. Cameron, and S.C. Mauszycki [6] is also defined as the predominant defeat of frontal formations in the cerebral cortex and is manifested through the difficulty of planning and controlling the implementation of motor activities.

Linguistic impairments as the causes of difficulties in learning of children were studied by M. Rosselli, A. Ardila [7]; W. Nasa, V. Hall, N. Oyer [8]. Their research suggests the emergence of specific difficulties in learning of this category of children through the selective defeat of specific speech areas or their lack of functionality due to the difficulty of processing their speech information.

In foreign theory and practice, the causes and symptoms of acalculia and dyscalculia are studied well (H.Levin, F. Goldstein, P. Spiers [9]). In particular, there are four main clinical forms - the central, leading, caused by problems of correlation of the word with its numerical correlation and by the underdevelopment of intellectual skills. Scanning of the processes of excitation and inhibition during the processing of numeric and verbal information, conducted by P. Rosenberger [10], made it possible to investigate the peculiarities of these processes in the cerebral cortex and to create interactive and computer simulators to overcome individual problems.

Despite the multifaceted approach to solving this problem, it is not yet exhausted.
The purpose of our study was to identify and characterize the structural types of violations of the cognitive sphere in children with systemic speech disorders (hereinafter referred to as SSD) due to local lesions of the cerebral cortex, and to determine their influence on the state of assimilation of educational information.

2 METHODOLOGY JUSTIFICATION

In the basis of the study of difficulties in learning of the children with systemic speech impairments, we put sign-and-symbol approach (O. Losev [11], L. Vygotsky [12] and others). According to it, a sign and a symbol perform the corresponding role, in particular, a stimulatory and inductive function, in the mental sphere of a person. They are born in the process of activity, then provide its organization and regulation. Comparison and synthesis of the results of scientific researches (Salmina N. [13], Davydov V. [14]) allowed to establish that in the process of studying the disciplines in school students master different types of knowledge that were divided into four groups: 1) verbal material of different levels of complexity (words (terms), phrases, texts); 2) symbols and schemes (geometric figures, numbers, letters, signs of arithmetic operations, schemes of computing, etc.); 3) concepts (composition of the number, bit number, sound, part of speech, etc.); 4) programs of execution of operations and actions (algorithms of execution of calculations, methods of analysis of texts, etc.).

We considered the peculiarities of the violation of the cognitive sphere as a cause of the difficulties of assimilating junior schoolchildren with systemic speech disorders of this educational knowledge and skills at school and chose the neuropsychological approach as the basis of our study. It is based on the idea of a "function" as a complex and plastic system aimed at realization of a psychological purpose (O.R. Luria [15]). Scientists (E.D. Khomskaia [16], O.R. Luria [15] and others) indicate that the psychic process and function cannot be related to one of the centers in the cerebral cortex; to a greater extent they are simultaneously or subconsciously localized. Their elements, at the same time, maintain strict differentiation and play a highly specialized role in a single activity.

In particular, the precise localization of the primary projection zones of analyzer systems in the cerebral cortex was determined: auditory and olfactory - in the temporal fate, visual - in the occipital lobe, tactile-kinesthetic and taste - in the parietal lobe. It was also found that secondary and tertiary fields (simultaneous synthesis) appear and expand gradually as the child develops as derivatives from the primary sensory zones. They also intersect forming the intergenerational links providing for the perception, retention, and processing of information.

The frontal fate is considered as the place of the formation of human activity programs and has a three-layer, similar to the back of the brain, structure. In the region of primary motor zones, the centrifugal motorways are started, and secondary and tertiary zones (succession synthesis) are formed around them.

3 METHODOLOGY

Thus, based on the idea of a function as a dynamic system, the elements of which retain their strict differentiation and play a highly specialized role in a single activity, based on the generalization of materials of researchers in the field of neuropsychology (E. Simernitskaya [17], L. Tsvetkova [18] and others), the main processes, functions and operations of the cognitive sphere that are involved in the process of acquiring the educational knowledge and skills are defined and grouped together at levels. Each of them develops under the predominant participation of differentiated cortical cortex units.

In particular, such processes as kinesthetic (propioreceptive), spatial and dynamic (kinetic) praxis, auditory coordination, visual gnosis and sensory-motor function of speech were attributed to the gnostic-praxis (perceptual) level. Hearing, speech, visual-spatial and visual-verbal memory - to the mnestic level. Mental operations of analysis, synthesis, comparison, grouping, generalization, reasoning, establishment of cause-effect relationships - to the intellectual level.

Special mental processes of function and mental operations were the basis of the methodology for the study of the cognitive sphere. It included the main tests and tasks from the neuropsychological methodology of E. Simernitskaya [17], the album by Y. Hilbukh (1993) and the methods of N. Stadnenko [20]. Thus, our diagnostic technique included 3 tests with 38 tasks: 18 tasks - for the examination of gnosis and praxis (combined, in accordance with the investigated function, in 7 groups); 10 tasks - to examine memory; 10 - for the examination of thinking.
Scales were developed to assess the level of formation of certain types of processes, functions, and operations of cognitive activity. The peculiarity of our methodology is that the unit of measure is not a mental process or a function of the psychic sphere, but some of its properties, which are part of the structure. Thanks to this, diagnostics by means of this technique allows not only to reveal the level of lagging behind the norm for certain parameters but also to study the peculiarities of the development of the cognitive sphere.

The results of the study of gnosis and praxis were evaluated on 6 scales, memory - on 12, and thinking - on 10 scales. Each scale had a clear quantitative expression and determined the level of underdevelopment of each mental function, process or only one of their properties, a separate thinking operation, for example: the volume of auditory and visual memory, inhibition of visual and auditory observations, the re-establishment of a sequence of visual and auditory stimuli, regulation and control of visual and auditory memory; operations of comparison, generalization, establishment of cause-effect relationships and others.

Analysis of performance indicators of individual tasks allowed to identify and characterize the area not only of current but also of the proximal development of the studied children.

The study covered 386 junior schoolchildren aged 6-10 years with typical development (205 persons) and systemic speech impairment with stored hearing, vision, and intelligence (181 persons). The results of the neuropsychological study were correlated with the peculiarities of the schoolchildren’s learning basic school disciplines (mathematics, writing, and reading).

To study the condition and features of the junior schoolchildren's mastering of educational knowledge in maths, we used the method of Havrylova N.S., Tarasun V.V. [21]; in grammar and spelling - Shevchenko M.V., Tarasun V.V. [22].

To verify the results of the study, Pearson's consistency criterion was applied.

4 RESULTS OF THE STUDY OF THE COGNITIVE SPHERE IN CHILDREN WITH SYSTEMIC SPEECH DISORDER

As a result of the analysis of the peculiarities of the performance of tasks for the study of the state of gnosis, praxis, memory and thinking formation in children with SSD, we identified 3 groups with different levels of underdevelopment of the cognitive sphere: 1 group (14%) - insignificant (22-54 points); 2 (45%) - with an average (55-89 points), and 3 (41%) - with significant underdevelopment of processes and functions of cognitive activity (90-118 points). Also, in children with SSD of each group, we determined the correlation coefficient between processes and functions of the cognitive sphere, which allowed us to confirm the presence of different structural types of their violations (see Table 1).

<table>
<thead>
<tr>
<th>Processes and functions of the cognitive activity used to determine the correlation coefficient</th>
<th>Groups of children with SSD (quantity of students in a group (in %))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 (14%)</td>
</tr>
<tr>
<td>Kinesthetic praxis and spatial praxis</td>
<td>-</td>
</tr>
<tr>
<td>Kinesthetic praxis and sensory-motor function of speech</td>
<td>-</td>
</tr>
<tr>
<td>Kinetic praxis and sensory-motor function of speech</td>
<td>0,7</td>
</tr>
<tr>
<td>Kinesthetic praxis and auditory-verbal memory</td>
<td>-</td>
</tr>
<tr>
<td>Kinesthetic praxis and visual memory</td>
<td>-</td>
</tr>
<tr>
<td>Kinetic praxis and spatial praxis</td>
<td>-</td>
</tr>
<tr>
<td>Kinetic praxis and auditory-verbal memory</td>
<td>0,9</td>
</tr>
<tr>
<td>Spatial praxis and auditory-verbal memory</td>
<td>-</td>
</tr>
<tr>
<td>Spatial praxis and visual memory</td>
<td>-</td>
</tr>
</tbody>
</table>
Sensory-motor function of speech and auditory-verbal memory 0.2 0.9 0.8 0.8 0.6
Sensory-motor function of speech and visual memory 0.1 0.9 0.6 0.8 0.7
Auditory-verbal memory and visual memory 0.7 0.9 0.9 0.8 0.9
Regulation and control over the process of remembering and causal relationships - - 0.8 - 0.9
Regulation and control over the process of remembering and reasonings 0.8 0.4 0.9 0.6 0.6
Visual memory and reasoning - 0.7 - 0.8 -
Visual memory and comparisons 0.3 0.8 0.7 0.7 0.9
Auditory-verbal memory and verbal-logical thinking 0.4 0.9 0.8 0.7 0.9
Auditory-verbal memory and visual-figurative thinking - 0.4 0.6 0.8 0.6 0.9
Visual memory and visual-figurative thinking 0.5 0.5 0.6 0.7 0.9
Visual memory and verbal-logical thinking 0.5 0.7 0.8 0.9 0.8

The analysis of experimental materials made it possible to determine that schoolchildren of groups 2 and 3 have qualitatively different peculiarities of the cognitive sphere. In view of this, each of them was divided into two subgroups. Subgroup 2A included children (23%) with more severe difficulties in the formation of internal circuits. Underdevelopment of kinesthetic praxis was the basis of this type of violation, so we called it kinesthetic. Subgroup 2B included ones (22%) with difficulties due to the weakness of kinetic organization of mental operations and actions. This type of violation, albeit less expressed, we observed in children of group 1 (14%). Also, the subgroup of 3D included schoolchildren (7%) with the same features of underdevelopment of the cognitive sphere, although the level of their violation was deeper. As underdevelopment of kinetic praxis was the basis of this type of violation, we called it kinetic. Subgroup 3C (34%) included students with significant underdevelopment of auditory-verbal and visual-spatial memory. This level was called mnestic.

5 THE FINAL CHARACTERISTICS OF STRUCTURAL TYPES OF VIOLATION OF THE COGNITIVE SPHERE IN JUNIOR SCHOOLCHILDREN WITH SYSTEMIC SPEECH DISORDERS

The final analysis of the results of the study made it possible to find that for all the schoolchildren with SSD, the underdevelopment of the sensory-motor function of speech and the durability of memorizing the auditory-verbal tracks was common. The most underdeveloped one was the operation of reasoning. It has been established that in students with SSD, visual perception and visual-verbal memory, in relation to other mental processes, are the most preserved.

We also identified three structural types of cognitive impairment in children with systemic speech disorders that could have varying levels of difficulty. In the structure of cognitive activity in each individual case, a number of differences were identified.

Students with a kinetic type of violation (with a defeat of the frontal lobe of the cerebral cortex), with a slight lack of development of the kinetic basis of activity, had significant underdevelopment of regulation and control of auditory-verbal memory. With a more significant violation of kinetic praxis, there was a significant underdevelopment of the regulation and control of auditory-verbal and visual memory, as well as the establishment of cause-effect relationships.

In schoolchildren with a kinesthetic type of violation (with damage to the anterior parts of the parietal lobe), along with significant underdevelopment of kinesthetic praxis, there was a considerable lag in development, the speed of memorizing the visual-spatial and auditory-verbal stimuli, the regulation, and control of visual-spatial memory. We found that they had more significant difficulties in applying the comparison operation with the relative consistency of other mental activities. In the case of a higher
level of underdevelopment of the psychic sphere of this type, the underdevelopment of such thinking operations as grouping and generalization was also revealed. First of all, these difficulties were due to the inaccuracy of perception of information, inability to concentrate on small details. However, in all cases, in this type of violation, the mental operation of establishing cause-effect relationships corresponded to typical features of development.

In schoolchildren with mnestic type of violation of the cognitive sphere, significant underdevelopment of the volume, speed of memorizing of visual-spatial and auditory-verbal stimuli was revealed. In this case, the direct dependence of the volume of auditory-verbal memory from spatial is determined: the narrower the spatial, the less the volume of auditory-verbal memory. There was also a violation of the regulation and control of the auditory-verbal and visual-spatial memory. Along with it, we have found significant underdevelopment of grouping and generalization operations with relative preservation of the ability to establish causal relationships and compare. Memory impairment in this group caused more difficulties for the children in the process of manipulating the information in the abstract-logical plan at the verbal level. However, when describing the material, the ability to operate the proposed material substantially improved.

6 INFLUENCE OF VIOLATIONS OF THE COGNITIVE SPHERE ON THE STATE OF ASSIMILATION OF EDUCATIONAL INFORMATION IN CHILDREN WITH SYSTEMIC SPEECH DISORDERS

When correlating the peculiarities of mastering the educational information from the main subjects at school (mathematics, writing, reading) with violations of the cognitive sphere, a number of dependencies among junior schoolchildren with SSD were identified.

In particular, there is no direct correlation between the level of these children’s mastering educational knowledge and skills and the level of violation of their cognitive sphere. At the same time, we revealed its connection with the structure of the violation of processes and functions of the cognitive activity.

It was determined that the causes of the difficulties in mastering educational material by the children with SSD of different groups have common and distinctive features.

In most children with SSD (86%), the common cause of the difficulty in verbal information assimilation (perception and reproduction of terms, phrases and texts; their memorization, recollection and understanding, and the choice and definition of the logical sequence of specific verbal units during the analysis of texts) is the underdevelopment of sensory-motor function of speech, auditory-verbal memory and verbal-logical thinking. Along with this, their occurrence in students with a kinesthetic type of violation is affected by the underdevelopment of kinesthetic and spatial praxis, and in children with the kinesthetic type of violation - of kinetic praxis and mental operations of reasoning and establishment of cause-effect relationships.

It is determined that the lack of formation of spatial praxis and visual-spatial memory causes difficulty of perception and reproduction of texts. At the same time, we did not find any significant influence of underdevelopment of these mental processes on the quality of their mastering terms and phrases. The results obtained suggest that the level of development of these mental operations determines the volume of our internal field of consciousness, within which the thought moves. However, this assumption still requires further research.

All children with SSD experienced difficulties in learning the concepts: understanding their essence, formation of the corresponding level of abstraction. Every time, the reason for their occurrence was the underdevelopment of auditory-verbal and visual memory. In students with kinesthetic and mnestic types of violations (57%), such difficulties were due to the lack of formation of spatial praxis, sensory-motor function of speech and visual-figurative thinking. In schoolchildren with a mnestic type of violation, we have found the influence of underdevelopment of verbal-logical thinking on the emergence of this type of difficulty.

In 86% of children with SSD, the general reason for the difficulty of mastering signs - letters, numbers, divisive and arithmetic signs (perception, reproduction, memorization, specification and selection of signs for the formation of circuits) - was the underdevelopment of auditory-verbal memory. In schoolchildren with kinesthetic and mnestic types of violation (57%), their occurrence was conditioned by the inadequate formation of spatial praxis and visual-figurative thinking. Along with this, with a kinesthetic type of violation, such difficulties are due to the underdevelopment of kinesthetic praxis, and with a mnestic type - of the sensory-motor function of speech and verbal-logical thinking.
Children with SSD experienced difficulties in assimilating operations and actions: specifying and selecting verbal and non-verbal units in an abstract-logical plan for the formation of programs of mathematical and verbal activity; remembering programs of execution of operations and actions; formation of educational programs; control over the process of forming programs. The biggest difficulties in the formation of this knowledge we saw in children with a violation of the kinetic type. The common reasons for the difficulties of this type were the lack of development of regulation and control of auditory-verbal memory and the establishment of cause-effect relationships. With stronger underdevelopment of this type, the quality of the formation of programs was affected by the underdevelopment of visual memory and visual-figurative thinking. Analysis of the research data shows that children with a kinesthetic type of violation have difficulties in performing operations and actions as a result of their lack of understanding and the corresponding level of abstraction of complex concepts (instead of underdevelopment of individual mental processes and mental operations).

It is revealed that the causes of difficulties, as well as the difficulties in acquiring algorithms of action in writing, in 86% of children with SSD are somewhat different than in the case of oral execution of actions. In particular, children with SSD of a kinesthetic type meet these difficulties when perceiving, memorizing and forming schemes for writing algorithms for actions. They are caused by underdevelopment of kinesthetic and spatial types of praxis, visual memory and verbal-logical thinking. Mistakes that arise when performing mathematical calculations are more due to the inadequate assimilation of complex mathematical concepts.

In students with a kinetic type of violation, more significant difficulties arise during the memorization, the formation of a program of the algorithm of execution of actions in writing, and control over the process of its implementation. They are manifested both in mathematics and writing in the form of spaces of letters in the words of permutation of their places. These errors are caused by underdevelopment of auditory-verbal memory and verbal-logical thinking. With more severe violations of this type, their development is also affected by the underdevelopment of visual-figurative thinking.

In children with the mnestic type of violation, difficulties are observed at all stages of the learning of this educational material. They are caused by the inadequate formation of spatial praxis, sensory-motor function of speech, auditory-verbal and visual-spatial memory, and verbal-logical thinking. It is determined that these children can master the phased implementation of the programs of activities. What they really lack is basic knowledge of educational subjects, and the ability to easily keep the scheme of action in mind. When rendering information, when writing, their potential capabilities and quality of execution of tasks significantly improve.

7 CONCLUSIONS

The analysis of the materials of the study showed that in all children with SSD with intelligence primarily saved, there is selective underdevelopment of processes and functions of cognitive activity. The level of underdevelopment of their cognitive activity does not directly correlate with the complexity of speech impairment and the level of knowledge acquisition in basic school disciplines.

It was determined that the level and characteristics of underdevelopment of processes and functions of cognitive activity in children with SSD had both common and distinctive features.

In general, we defined 3 structural types of violations of the cognitive sphere of junior schoolchildren with SSD that study in junior grades: kinetic that appears when a violation occurs in the area of the frontal lobe of the cerebral cortex; kinesthetic – when a violation covers the anterior part of the parietal lobe of the cerebral cortex, and mnestic - with the defeat of the posterior border parietal-occipital parts of the brain. We also formed a cross-sectional characteristic of these types of violation from the gnostic-praxis level to the mnestic and intellectual ones.

When applying Pearson's consistency criterion, it was determined that each group of children had differentiated types of difficulties in the mastering educational information. We saw that the causes of their occurrence were selective violations of the cognitive sphere, different in structure.

Our research does not exhaust all aspects of the problem and may be the basis for the further creation of individually directed correction and teaching techniques, which will increase the effectiveness of the learning of educational information by children with SSD.
REFERENCES