



Studying spatial orientation and constructive praxis disorders in normally developing and mentally retarded children aged 8-11 years

Tereza Yu. Azatyan ¹, Olga Yu. Piskun²

¹ Armenian State Institute of Physical Culture and Sport, Yerevan, Republic of Armenia

² Novosibirsk State Pedagogical University, Novosibirsk, Russian Federation

Abstract

Introduction.

The ability to orientate oneself in space is one of the basic requirements for the harmonious development of a person. The problem of human orientation in space is very complex. It includes both ideas about the size and shape of objects and the ability to distinguish the location of objects in space, and understanding different spatial relationships. The concept of spatial orientation includes the evaluation of distances, sizes, shapes, mutual position of objects and their position relative to the orienting object. Spatial orientation is significantly impaired in mentally handicapped children, since the impairment of mental development not only limits their motor activity, but also negatively affects the development of time representations, musculoskeletal functions and leads to a decrease in compensatory processes.

The purpose of this study is to identify spatial orientation and constructive praxis disorders in normally developing and mentally retarded children aged 8-11 years.

Materials and Methods.

The methodological basis of this research investigation was scholarly literature devoted to studying nervous functions in children with mental development disorders and interhemispheric asymmetry of the brain, regulation of these functions, identifying difficulties, modeling the system of work with these children and constructive praxis disorders in normally developing and mentally retarded children aged 8-11 years (Boguslavskaya, Miroshnichenko, 2019, Maryutina, Yermolaev 2001, Reuter-Lorenz and others, 2000, Azatyan2022).

The study was conducted in the research laboratory of the Faculty of Special and Inclusive Education at the Armenian State Pedagogical University after Kh. Abovyan and research laboratory in Armenian state institute of physical culture and sport.

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 Corresponding Author: Tereza Yu. Azatyan, atereza222@gmail.com

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A total of 131 children aged between 8 and 11 years participated in the study, including 73 healthy schoolchildren and 58 children with mild mental retardation. The degree of intellectual disability was assessed based on medical indications, degree of social adjustment, level of intellectual functioning, and learning outcomes in special education classes. Each category of participants was divided into 2 age groups: 8-9 years old and 10-11 years old.

Results. The article discusses the main issues of studies of spatial orientation and constructive praxis in normally developing and mentally retarded children aged between 8 and 11 years, provides a scientific rationale for the problem, taking into account previous research investigations. However, the problem of mentally retarded and normally developing children in this age group remains virtually unexplored.

Analysis of research findings allows the authors to identify and summarize the following important points:

- mentally handicapped primary school children lag behind their healthy peers in all indicators examined;
- 8- and 9-year-olds have less developed practical spatial orientation skills than their older peers;
- Intellectually disabled peers have underdeveloped spatial orientation skills and constructive practice, making it difficult to understand spatial relationships between objects.

The experimental study of task performance revealed interesting data, which will serve as a basis for developing the necessary means, methods and conditions for the development of elementary practical orientation in mentally disabled primary schoolchildren.

The authors have uncovered violations of spatial orientation and constructive praxis in normally developing and intellectually disabled children aged 8-11 years that highlight the limited and incomplete verbalization of spatial relationships of objects in intellectually disabled children. The listed errors in general are reduced to the use by mentally retarded schoolchildren of imprecise, vague spatial characteristics instead of more differentiated ones.

Conclusions. Thus, the results of the conducted experimental research testify to the insufficient development of the elementary practical orientation and understanding of the spatial relationships of objects in mentally retarded children of primary school age.

Keywords

Interhemispheric interaction; Brain functions; Spatial orientation disorders; Intellectual disabilities; Constructive praxis; Mental development of children; Primary school.

Introduction

The ability to orientate in space is one of the basic conditions for the harmonious development of a person¹ [1].

The problem of human orientation in space is quite multifaceted. It includes both ideas about the size and shape of objects and the ability to

distinguish the location of objects in space, understanding of different spatial relationships [2–10]. The notion of spatial orientation includes the assessment of distances, sizes, shapes, mutual position of objects and their position relative to the orientator [11; 12].

¹ Ermakov P. N., Boguslavskaya V. F. Interhemispheric functional asymmetry of preschool children with different readiness to study at school. *Psychological Bulletin of the Russian State University*, 1999, pp. 70–73.

Ermakov P. N., Shumakova E. R. Interhemispheric functional asymmetry and bimanual activity. *Psychological Bulletin of the Russian State University*, 1999, Issue 4, pp. 14–32.

The simplest forms of spatial orientation, associated with the transition to the upright position and the development of object actions, are formed as early as infancy. By the age of three a child develops a systematic mechanism of spatial orientation in which vision, kinesthesia, and static-dynamic sensations are interconnected [13].

By entering all areas of a child's interaction with reality, spatial orientation influences the development of self-awareness and personality and is an integral part of the socialisation process [14; 15].

Spatial orientation refers to “a person's understanding and determination of his or her position in relation to some material bodies that he or she has chosen”, or, similarly, their position in relation to himself or herself [16; 17].

For mentally retarded children, spatial orientation is significantly hampered [18; 19] because the impairment of mental development not only limits their motor activity, but also negatively affects the development of temporal representations, musculoskeletal function and leads to a decrease in compensatory processes².

The scientific and methodological literature [20–25] indicates the importance of developing spatial representations and practical orientation of mentally retarded children, but does not reveal the potential of their content. Therefore, the problem of correction of spatial representations and orientation disorders, as well as the development of orienting skills in the conditions of special school education are of extreme importance³.

In connection with the above, we set the goal of identifying spatial orientation and constructive praxis disorders in normally

developing and mentally retarded children aged 8-11.

Methods

The methodological basis of this research investigation was scholarly works by a number of authors devoted to the study of nervous functions in children with mental development disorders and interhemispheric asymmetry of the brain, regulation of these functions, identifying difficulties, modeling the system of work with these children and constructive praxis disorders in normally developing and mentally retarded children aged 8-11 (Boguslavskaya, Miroshnichenko, 2019 [1], Maryutina, Yermolaev 2001⁴, Reuter-Lorenz and others, 2000 [10], Azatyan, 2022 [12]).

The research was performed in the research laboratory of the Faculty of Special and Inclusive Education at the Armenian State Pedagogical University after Kh. Abovyan.

A total of 131 children aged between 8 and 11 years participated in the study, including 73 healthy schoolchildren and 58 children with mild mental retardation.

The degree of mental retardation was assessed on the basis of medical indications, degree of social adaptation, level of intellectual functioning and mastery of the school programme during training in a special educational institution.

Each category of examinees was divided into 2 age groups: 8–9 years old and 10–11 years old.

Control group of healthy schoolchildren:

– 8–9 years old 38 children, including 20 girls and 18 boys;

² Semenovich A. V. *Neuropsychological diagnostics and correction in childhood*. M.: Academy, 2002. 232 p.

³ Barkov V. A., Poleshchuk A. M. Formation of spatial orientation in schoolchildren with mental retardation. *Special Education*, 2010, no. 2, pp. 46–55.

⁴ Maryutina M. T., Ermolaev O. Yu. *Introduction to psychophysiology: textbook*. Moscow, Psychological and Social Institute Publishing House “Flint” 2001, 400 p.

– 10–11 years old 35 children including 17 girls and 18 boys;

Experimental group of children with mental retardation:

– 8–9 years – 28 children, including 11 girls and 17 boys;

– 10–11 years old 25 children, including 12 girls and 13 boys;

Children in the experimental group were selected on the basis of supporting documents with an approved diagnosis of mild mental retardation. After reviewing the results of clinical, laboratory, pedagogical and psychological examinations, a voluntary agreement was signed with family members and carers to allow the child to participate in the research.

In order to determine the level of development of elementary practical orientation: the subjects were offered the following tasks:

- show their right (left) hand;
- show the right (left) hand to the other person standing opposite;
- indicate what is on your right (left) side.

All studies were conducted separately for children with a leading right hand and a leading left hand, as it is reasonable to assume that children will be more successful in tests aimed at their leading hand.

We first sought to find out whether children with intellectual disabilities can correctly identify their right and left hand and the person facing them, how well they can orient in space and determine what is on their right or left side, identify the right or left-hand drawer of a table, put objects into the right or left-hand pocket of a jacket, etc. Because such elementary practical orientation skills often determine a mentally

retarded child's readiness to perform the more complex social, occupational and other activities needed in everyday life.

In these experiments we widely used both the verbal designation of objects and actions, and drawings, pictures of the same objects and actions contained in the proposed task. These are first of all household items and their pictures, well known to children: a key, a table, a glass, a pencil, etc. As pupils of special (auxiliary) school often, deal not only with natural objects, but also with their images.

In addition, the graphic representation of objects and actions with them will help correctly and more quickly identify difficulties in completing the proposed tasks, as in the works of T. I. Golovina and others⁵ there is data indicating a lack of understanding by mentally retarded younger pupils of the spatial relationships of the depicted objects. Taking this into account, we tried to use certain groups of words and word combinations reflecting spatial relations of objects.

Before subjects started each subsequent task we inquired whether they understood the meaning of the task, and until they had a clear idea of the meaning of the task and what was required of them, they did not proceed with it.

Results

Experimental results for children with a leading right hand and a leading left hand

The first task. (“Show your right (left) hand”) was aimed at determining the subjects' right and left hand orientation skills. Of the 29 normally developing right-handed children 8–9 years of age, 69 % of the students correctly

⁵ Makoedova G. V. *Formation of personal qualities in children with severe speech disorders in the light of the Federal State Educational Standard*. Petrozavodsk, Publishing House. PetrGU, 2016. pp. 128–130.

Melikyan Z. A., Sokorokhodova T. A. Individual features of the functional organization of the brain of children 7–8 years old with mental retardation in the process of processing visual-spatial information. *Human Physiology*, 2002, no. 2, pp. 31–34.

oriented themselves, while only 47.3 % of the 19 mentally retarded right-handed children managed to do this task (Table 1).

Table 1

Results of 'right-handed' test takers on the task to show right (left) hand

Age	Test takers									
	Normally developing children					Mentally retarded children				
	Number Of test takers	Correct		Mistake		Number Of test takers	Correct		Mistake	
		num	%	num	%		num	%	num	%
8-9	29	20	69	9	41	19	9	47,3	10	52,7
10-11	28	21	75	7	25	18	10	55,5	8	44,5
Total	57	41	72	16	28	37	19	51,3	18	48,7

In the group of 10–11 year olds with no intellectual disability, there were 28 right-handed children, of whom 75 % (21 children) showed correct orientation, (25 %) 7 children made a consistent error.

The ambidextrous were counted in the right-handed groups because their sensory asymmetry of the praxis test revealed a right-handed preference.

Out of a total of 73 children with normal mental development, 13 left-handed children were identified, distributed roughly equally across age groups: 7 children aged 8–9 years and 6 children aged 10–11 years. The test showed that 57 % of 8–9 year olds and 83.3 % of 10–11 year olds showed correct side preference (see Table 2).

Table 2

Results of "left-handed" subjects in the task show the right (left) hand

Age	Test takers									
	Normally developing children					Mentally retarded children				
	Number Of test takers	Correct		Mistake		Number Of test takers	Correct		Mistake	
		num	%	num	%		num	%	num	%
8–9	7	4	57	3	43	7	3	43	4	57
10-11	6	5	83,3	1	17,7	7	4	57	3	43
Total	13	9	68,5	4	31,5	14	26	44,8	34	58,6

In the experimental group of children with mental retardation, there were seven left-handed children in each age group (14 in total). Among 8–9 year olds, 43 % and among 10–11 year olds 57 % correctly coped with the task, while orientation disorders were found in 57 % and 43 %, respectively, by age group.

As seen from these results, children in the older age group (ages 10–11) did better than children in the younger age group (ages 8–9). This trend was also observed in the group of mentally retarded children, although it was not as pronounced as in the normal group.

So, we can state that mentally retarded “right-handed” and “left-handed” children are poorly oriented in identifying right and left-handedness and lag behind compared to normally developing peers in these measures.

The second, more difficult task “Show the right (left) hand to the other person standing in front of you” caused great difficulties for mentally retarded students. Only 31.0 % of 8–11 year old pupils in special (auxiliary) schools were able to cope with this task. Many normally developing children also had some difficulty with this activity, but to a much lesser extent.

Table 3

Results of the correct performance of the task “Show the right (left) hand of the other person standing in front of you (left) hand of the other person standing opposite”

Age	Trial subjects					
	Normally developing children			Mentally retarded children		
	Number of test takers	Correct answers	%	Number of test takers	Correct answers	%
8 years	19	13	68,4	16	3	18,6
9 years	21	15	71,4	17	4	23,6
10 years	16	11	68,8	12	6	30,0
11 years	17	14	82,3	13	5	38,5
Total	73	43	58,9	58	18	31,0

The table shows that 8- and 9-year-olds were most likely to confuse the right and left hands of the person standing in front of them. Thus, about 81.3 % of mentally retarded 8-year-olds could not cope with this task, 9-year-olds 76.5 %, and 10–11-year-olds, although they improved slightly, still remain at a low level. Compared to normally developing peers, the performance of mentally retarded children is significantly lower (Table 3). For example, while

normally developing examinees correctly identified the right and left hand of the person standing in front of them by age 10–11, the mentally retarded peers improved in the performance of this task from 18.6 % to 38.5 %, respectively, by age 8–11.

Thus, the data presented indicate a significant difficulty for mentally retarded students to mentally turn 180 degrees. This confirms the evidence in the literature about the

lack of maturation of the system of backward orienting actions in children of this age.

In the following task, when asked, “What is on your left (right) side?”, retarded children mostly noted large objects, although not all of them. For example, they named a cupboard, a table, chairs, a window, but they did not notice small objects such as books, a pen, pencils, a vase, etc. (although they were nearby).

Among mentally retarded children of age 8, only two children (23.5 %) handled this task satisfactorily, while among 9-year-olds only 4 (23.5 %) out of 17 children handled the task. By the age of 10–11 these figures increased slightly, but still remained low (Table 4).

Table 4

Results of the correct performance of the task "Point out what is on your right (left) on your right (left) side"

Age	Trial subjects					
	Normally developing children			Mentally retarded children		
	Number of test takers	Correct answers	%	Number of test takers	Correct answers	%
8 years	19	15	78,9	16	2	12,5
9 years	21	18	85,7	17	4	23,5
10 years	16	12	75,0	12	5	41,7
11 years	17	13	76,5	13	5	38,5
Total	73	58	79,5	58	16	27,6

Thus, more than half of the 10–11 year olds were able to list objects on their right (or left) side. These indicators are significantly lower as compared to normally developing examinees (Table 4). This lag is observed at all ages under study, but is most pronounced at the age of 8–9.

So, the results of the research indicate that mentally retarded students at the age of 8–11 retarded students aged 8–11 have poor right-hand and left-hand orientation, and even worse for the other person standing in front of them, and have difficulty correctly and completely enumerating objects on their right or left-hand side. Although these indicators improve somewhat with age, they are still low by the fourth grade.

Mentally retarded children have been found to be significantly inferior to their normally developing peers. This generally indicates that they have insufficient understanding of spatial relationships of objects and poor orientation.

In view of the above, it is most important to study the features of development of practical orientation of mentally retarded schoolchildren, connected, first of all, with domestic, educational, labour and other types of activity. In this connection, the subjects were offered the following practical tasks:

- how the right and left drawers of the table;
- o put a key in the right (left) pocket of a jacket;

– determine whether a pencil was on the right or left side of a notebook lying on the table.

These tasks, in comparison with those presented earlier, are of a more abstract nature, they are less equal in degree of habituality for children and are aimed at determining the abilities and skills of mentally retarded children to correctly orient to the sides of the study table, to the location of this or that object in relation to others, etc.

The results of the experimental study of task performance show that interesting data have been obtained which will serve as a basis for the development of necessary means, methods and conditions for the development of elementary practical orientation in mentally retarded elementary school children.

The analysis of the results of the study allows us to highlight the following important points:

- mentally retarded younger pupils lag behind their healthy peers in all the studied indicators;
- 9 year old have less developed practical spatial orientation skills than their older counterparts.

The listed errors are generally reduced to the use by mentally retarded pupils of imprecise, vague spatial characteristics instead of more differentiated ones. This vividly illustrates the limited and incomplete verbalization of spatial relations of objects in mentally retarded children.

Conclusions

We have identified disorders of spatial orientation and constructive praxis in normally developing and mentally retarded children aged 8-11, which clearly illustrate the limited and incomplete verbalization of spatial object relations in mentally retarded children. The listed errors as a whole are reduced to the use by mentally retarded schoolchildren of imprecise, vague spatial characteristics instead of more differentiated ones.

Thus, the results of the conducted experimental research testify to insufficient development of elementary practical orientation and understanding of spatial relations of objects at mentally retarded children of primary school age.

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The authors' stated contribution:

Tereza Yurevna Azatyan

Contribution of the co-author: collection of materials and initiation of research; definition of research methodology; analysis of research data.

Olga Yuryevna Piskun

Contribution of the co-author: formulation of a scientific problem research; structuring and literature review.

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Information about the Authors

Tereza Yurevna Azatyan

Candidate of Pedagogical Sciences, Associate Professor,
Armenian State Institute of Physical Culture and Sport;
Associate Professor, Head,
Department of Special Pedagogy and Psychology,
Armenian State Pedagogical University after Khachatur Abovyan,
Tigran Mets ave. Yerevan, Armenia.
ORCID ID: <https://orcid.org/0000-0002-7634-7727>
E-mail: atereza222@gmail.com (Corresponding Author)

Olga Yuryevna Piskun

Candidate of Pedagogical Sciences, Associate Professor,
Department of Correctional Pedagogy and Psychology,
Head,
Resource Center for Support of Students with Disabilities,
Novosibirsk State Pedagogical University,
630126, 28 Vilyuiskaya Str., Novosibirsk, Russian Federation.
ORCID ID: <https://orcid.org/0000-0002-4953-6733>
E-mail: o-piskun@yandex.ru



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Исследование нарушений пространственной ориентации и конструктивного праксиса у нормально развивающихся и умственно отсталых детей 8–11 лет

Т. Ю. Азатян¹, О. Ю. Пискун²¹ Армянский государственный институт физической культуры и спорта, Ереван, Армения² Новосибирский государственный педагогический университет, Новосибирск, Россия

Проблема и цель. Способность ориентироваться в пространстве является одним из основных условий гармоничного развития человека.

Проблема ориентации человека в пространстве достаточно многогранна. Она включает в себя как представления о величине и форме предметов, так и умение различать расположение объектов в пространстве, понимание различных пространственных отношений. Понятие пространственной ориентации включает в себя оценку расстояний, размеров, формы, взаимного расположения объектов и их положения относительно ориентирующегося.

У умственно отсталых детей пространственная ориентировка существенно затруднена, так как нарушение психического развития не только ограничивает их двигательную активность, но и отрицательно влияет на развитие временных представлений, функции опорно-двигательного аппарата и приводит к снижению компенсаторных процессов.

В связи с вышеизложенным, мы поставили цель выявить и научно обосновать нарушения пространственной ориентации и конструктивного праксиса у нормально развивающихся и умственно отсталых детей 8–11 лет.

Методология.

Методологической основой исследования послужили научные работы ряда авторов, посвященные изучению нервных функций у детей с нарушениями психического развития и межполушарной асимметрии мозга, регуляции этих функций, выявлению трудностей, моделированию системы работы с этими детьми и нарушений конструктивного праксиса у нормально развивающихся и умственно отсталых детей 8-11 лет (Богуславская, Мирошниченко, 2019, Марютина, Ермолаев 2001, Ройтер-Лоренц и другие, 2000, Азатян, 2022).

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 Автор для корреспонденции: Тереза Юрьевна Азатян, atereza222@gmail.com

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Исследование проводилось в научно-исследовательской лаборатории факультета специального и инклюзивного образования Армянского государственного педагогического университета им. Абовяна и научно-исследовательской лаборатории Армянского государственного института физической культуры и спорта.

В исследовании принял участие 131 ребенок в возрасте от 8 до 11 лет, из них 73 здоровых школьника и 58 детей с легкой умственной отсталостью.

Степень умственной отсталости оценивалась на основании медицинских показаний, степени социальной адаптации, уровня интеллектуального функционирования и освоения школьной программы в процессе обучения в специальном учебном заведении.

Результаты. *В статье рассматриваются основные вопросы исследования пространственной ориентации и конструктивного праксиса у нормально развивающихся и умственно отсталых детей 8–11 лет, дается научное обоснование проблемы с учетом ранних исследований, однако проблема умственно отсталых и нормально развивающихся детей данной возрастной категории остается практически неизученной.*

Анализ результатов исследования позволяет авторам выделить и обобщить следующие важные моменты:

– умственно отсталые дети начальной школы отстают от своих здоровых сверстников по всем изучаемым показателям;

– у 8- и 9-летних детей практические навыки пространственной ориентации развиты хуже, чем у их старших сверстников;

– у умственно отсталых сверстников недостаточно развиты навыки пространственной ориентировки и конструктивный праксис, что затрудняет понимание пространственных отношений между объектами.

По результатам экспериментального исследования выполнения заданий получены важные данные, которые послужат основой для разработки необходимых средств, методов и условий для развития элементарной практической ориентировки у умственно отсталых младших школьников.

Нами выявлены нарушения пространственной ориентировки и конструктивного праксиса у нормально развивающихся и умственно отсталых детей 8–11 лет, которые наглядно иллюстрируют ограниченность и неполноту вербализации пространственных отношений объектов у умственно отсталых детей. Перечисленные ошибки в целом сводятся к использованию умственно отсталыми школьниками неточных, расплывчатых пространственных характеристик вместо более дифференцированных.

Заключение. *Таким образом, результаты проведенного экспериментального исследования свидетельствуют о недостаточном развитии элементарной практической ориентировки и понимания пространственных отношений объектов у умственно отсталых детей младшего школьного возраста.*

Ключевые слова: *межполушарное взаимодействие; функции мозга; нарушения пространственной ориентации; умственная отсталость; конструктивный праксис; психическое развитие детей; начальная школа.*

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Информация об авторах

Азатян Тереза Юрьевна

кандидат педагогических наук, доцент,
Армянский государственный институт физической культуры и спорта,
Ереван, Армения;
доцент, заведующий,
кафедра специальной педагогики и психологии,
Армянский государственный педагогический университет им. Х. Абовяна,
Проспект Тиграна Меца, 17, Ереван, Армения.
ORCID ID: <https://orcid.org/0000-0002-3218-257X>
E-mail: atereza222@gmail.com

Пискун Ольга Юрьевна

кандидат педагогических наук, доцент,
кафедра коррекционной педагогики и психологии,
руководитель,
ресурсный центр сопровождения обучающихся с ограниченными возможностями здоровья,
Новосибирский государственный педагогический университет,
Виллойская ул., 28, Новосибирск, 630126, Россия.
ORCID ID: <https://orcid.org/0000-0002-4953-6733>
E-mail: o-piskun@yandex.ru