ARPHA Proceedings

Proceedings ICTE-2025: Uzbekistan, 0737-0747
doi:10.3897/ap.11.e0737

International Conference on Teacher Education (ICTE-2025: Uzbekistan)

Formation of Spatial and Temporal Representations in Bilingual Children with General Speech Underdevelopment Using Neuropsychological Techniques

Davronbek D. Tilavov* (a), Zahro Sh. Islomova (b), Aisylu T. Khamitova (c)

(a), (b) Shakhrisabz State Pedagogical Institute, 181301, Shakhrisabz (Uzbekistan), 10 Shakhrisabz street, dtilavov14@gmail.com (a), zahroislomova2484@gmail.com (b)
(c) Kazan Federal University, 420008, Kazan (Russia), 18 Kremlyovskaya street, aysylu.khamitova.1999@mail.ru

Abstract

This article presents the results of an empirical study on the peculiarities of spatial and temporal representations in bilingual preschool children with general speech underdevelopment. The purpose of the study was to evaluate the effectiveness of a neuropsychological corrective program for the development of spatial and temporal representations in bilingual preschool children with general speech underdevelopment. The study involved 28 bilingual children aged 5–6 years with general speech underdevelopment, divided into experimental and control groups. Neuropsychological diagnostic tools were used, including methods for spatial representations, the Denman test for visual-spatial gnosis, and the technique for assessing temporal concepts. The results showed that children in the experimental group demonstrated statistically significant improvements in the understanding and verbalization of spatial and temporal categories, compared to the control group. The findings support the effectiveness of using neuropsychological techniques in speech therapy practice for bilingual children with speech delays. The novelty of the research lies in the integration of neuropsychological diagnostics and corrective approaches for the development of spatial and temporal representations in bilingual preschoolers, a field that remains insufficiently explored. The results can be applied in the practical work of speech therapists and special educators working with bilingual children in preschool educational settings.

Keywords: bilingualism, preschoolers, spatial representations, temporal representations, speech underdevelopment, neuropsychological techniques.

© 2025 Davronbek D. Tilavov, Zahro Sh. Islomova, Aisylu T. Khamitova
This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
Published by Samarkand State University and peer-reviewed under responsibility of ICTE-2025: Uzbekistan (International Conference on Teacher Education)

* Corresponding author. E-mail: dtilavov14@gmail.com

Introduction

The development of spatial and temporal representations in childhood plays a crucial role in shaping regulatory and cognitive functions. The ability to navigate time and space is fundamental for organizing behavior, planning activities, and forming socially significant personal traits such as accuracy, discipline, and goal-directedness (Melekhin, 2013). Spatial representations also serve as a foundation for orientation in the environment, enabling a child to interact effectively with objects and people in space (Denisova, 2018).

Children with general speech underdevelopment, especially those raised in bilingual environments, often face specific difficulties in mastering spatial and temporal categories. These difficulties may include confusion of spatial prepositions, limited use of adverbs of place and time, and a reduced ability to describe sequences of events (Khashimov, 2018; Kislitsyna, 2021). In bilingual children, the situation is complicated by the simultaneous development of two linguistic systems, which often results in language interference and delayed acquisition of both languages (Kharenkova, 2013; Wiesel & Konstantinova, 2016).

Despite the active development of bilingualism research, relatively few studies have focused on the neuropsychological foundations of spatial and temporal cognition in bilingual preschoolers with speech delays. The existing gap in empirical data on the corrective potential of neuropsychological methods in this target group confirms the relevance of the present study.

The aim of this research was to evaluate the effectiveness of a neuropsychological corrective program for the development of spatial and temporal representations in bilingual preschool children with general speech underdevelopment.

The structure of this article includes a literature review of bilingualism and cognitive development, a description of the methodology and diagnostic tools, a presentation of the research results, and a discussion of their implications for speech therapy and preschool education.

Purpose and objectives of the study

The purpose of the study was to evaluate the effectiveness of a neuropsychological corrective program for the development of spatial and temporal representations in bilingual preschool children with general speech underdevelopment.

The objectives of the study were:

1) to investigate the peculiarities of spatial and temporal representations in bilingual children with general underdevelopment of speech;

2) to develop a programme for the formation of spatial and temporal representations in bilingual children with general underdevelopment of speech using neuropsychological techniques;

3) to reveal the effectiveness of the programme for the formation of spatial and temporal representations in bilingual children with general underdevelopment of speech using neuropsychological techniques.

Literature review

Scientists are particularly interested in bilingualism because it often acts as a cause of speech pathology, which often affects the development of the cognitive sphere and hinders the social adaptation of a bilingual child (Kharenkova, 2013).

U. Weinreich defines bilingualism as the practice of alternately using two languages. Individuals engaging in this practice are referred to as bilinguals (Weinreich, 1953). F. Grosjean describes bilingualism as the use of two or more languages and considers individuals who regularly employ at least two languages in their daily lives to be bilinguals (Grosjean & Byers-Heinlein, 2018).

Vereshchagin (2014), Wiesel and Konstantinova (2016), Khashimov (2018), Chirsheva and Korovushkin (2019) and Scheglova (2019) have studied the problem of bilingualism.

E.M. Vereshchagin considers bilingualism as a mental mechanism (knowledge, skills, abilities) that allows a person to reproduce speech works that consistently belong to two language systems (Vereshchagin, 2014). In her study, I.V. Scheglova adheres to the sociolinguistic approach and under bilingualism she understands the achieved result of an individual who allows using two language systems in the process of communication to the extent that is sufficient to achieve certain communicative tasks (Scheglova, 2019).

Bilingualism with a second Russian language is the most common type of bilingualism in modern Russia. R.I. Khashimov proposes the term ‘foreign-Russian bilingualism’ to denote bilingualism with a second Russian language (Khashimov, 2018).

G.N. Chirsheva uses the concept of ‘children’s bilingualism’, which is a child’s mastery of two languages to such an extent that ensures successful communication in accordance with his/her age characteristics

(Chirsheva & Korovushkin, 2019). Y.R. Efremova shares a similar view and believes that a bilingual can be defined as an individual who has acquired the second language naturally through communication and is capable of expressing themselves freely in it and understanding other native speakers (Efremova, 2020).

The work of T.G. Wiesel and A.V. Konstantinova is based on the results of studying the neuropsychological status of bilingual children, the inferiority of which complicates the acquisition of the Russian language. The authors believe that children with delayed speech development are a risk group for school learning problems, and this risk increases with bilingual education (Wiesel & Konstantinova, 2016).

Despite the large amount of literature on the problem of bilingualism research, there are few studies of the peculiarities of spatial and temporal representations in bilingual children with general underdevelopment of speech and ways of forming spatial and temporal representations in bilingual children with general underdevelopment of speech. Insufficient development of the problem on this topic determines the relevance of the research topic.

Methodology

The study was conducted to evaluate the effectiveness of a neuropsychological corrective program aimed at developing spatial and temporal representations in bilingual preschool children with general speech underdevelopment.

The sample consisted of 28 bilingual children aged 5–6 years with general speech underdevelopment (speech development level III according to standard logopedic classification). All participants attended preschool institutions in which Russian was not the only language of communication. Based on preliminary diagnostic testing, children were divided into two groups:

1. Experimental group – 14 children who participated in the specially designed neuropsychological corrective program;
2. Control group – 14 children who continued education according to the standard kindergarten curriculum without additional corrective intervention.

The groups were matched for baseline levels of speech development.

Three diagnostic methods were applied:

1. Methodology for the Study of Spatial Representations (Semago & Semago, 2000) – to assess:

– representation of body space along vertical and horizontal axes;

– spatial relations between external objects and body;

– level of verbalization of spatial relations;

– right / left orientation at the level of the own body;

– linguistic representations (ability to construct spatial-temporal and causal sentences).

2. Denman Test (Glozman et al., 2020) – to assess visual-spatial gnosis via copying simple geometric figures. The test identifies dysmetric, topological, and coordinate errors.

3. Survey of Temporal Representations (Inshakova & Kolesnikova, 2006) – to assess understanding of temporal concepts, including:

– parts of the day;

– categories ‘yesterday’, ‘today’, ‘tomorrow’;

– seasons and their sequence;

– months and their order;

– days of the week.

The research was carried out in three stages:

1. Baseline diagnosis – all participants underwent assessment using the above methods.

2. Intervention – the experimental group attended a 26-session corrective program based on neuropsychological principles. The program included: exercises for development of visual-spatial gnosis; activities for body scheme orientation; speech tasks to enhance spatial and temporal verbalization; games for sequencing and categorizing temporal events.

Each session lasted 25 minutes and was conducted twice a week by a speech therapist with neuropsychological training. The control group continued standard educational activities without additional corrective sessions.

3. Post-intervention diagnosis – repeated assessment of both groups using the same diagnostic tools to compare pre- and post-test results.

The collected quantitative data were processed using the paired-samples t-test to determine statistically significant differences between pre- and post-intervention scores within each group. The significance level was set at $p < 0.05$ for two-tailed tests.

Results

Before using the correction program, the following results were revealed:

1. Body space orientation (vertical axis) – 54 % of bilingual children with general speech underdevelopment correctly identified facial parts on the vertical axis; 46 % could not name the relative position of facial parts on the horizontal axis. Spatial relations between external objects and body – 57 % used prepositions ‘over’, ‘under’, ‘in’, ‘behind’, ‘before’ in speech; difficulties were observed with ‘between’ and adverbs ‘left’, ‘right’. Verbalization of spatial relations – 54 % understood horizontal spatial prepositions; 32 % used them in speech. Right/left orientation – 61 % confused ‘left’ and ‘right’ when naming body parts. Linguistic representations – 53 % had difficulties forming comparative degrees of adjectives and spatial-temporal constructions; 36 % could not name what occurs before Wednesday and after Friday.

2. Visual-spatial gnosis – 7 % made one dysmetric error; 61 % made several dysmetric errors; 29 % made 1–2 topological or coordinate errors; 3 % made multiple topological and coordinate errors.

3. Temporal representations: parts of the day – 64 % correctly identified and sequenced images; difficulties naming neighbors of ‘morning’ and filling missing words. Yesterday-today-tomorrow – 18 % named without prompts; 43 % named with prompts; the rest failed to use them correctly. Seasons – 86 % correctly identified images; difficulties sequencing and naming seasons starting from a given point; errors in identifying preceding/following seasons. Months – 78 % could not name months in each season or identify the second month of spring, the last month of autumn, or neighbors of September. Days of the week – 89 % could not name all days in order; difficulties with identifying ‘today’, ‘yesterday’, ‘tomorrow’, and neighbors of Wednesday.

After the corrective program, statistically significant improvements ($p < 0.05$) were recorded in the experimental group ($n = 14$) across most parameters (Table 1).

Table 1. Comparison of the results of the examination of spatial and temporal representations in bilingual children with general underdevelopment of speech in the experimental group before and after correctional work.

Methods	Indicators	Average value before	Average value after	P values	
				One-tail	Two-tail
The Denmann test	Visual spatial gnosis (copying figures)	1,39	1,68	<,001	,001
N.Y.Semago and M.M.Semago's methodology for studying spatial perceptions	Representation of the space of one's own body along the vertical and horizontal axis	6,92	7,42	,002	,003
	Spatial representations in the relationship of external objects of the body and in relation to one's own body	5,5	6,42	,001	,002
	Level of verbalization of spatial representations	5,78	6,64	<,001	<,001
	Spatial representations at the level of one's own body in the right/left direction	2	2,35	,027	,055
	Linguistic representations (language space)	4,92	5,71	<,001	<,001
Examination of temporal representations (O.B.Inshakova)	Representations of the parts of the day	6,64	7,35	<,001	<,001
	Concepts of 'yesterday', 'today', 'tomorrow'	7,28	7,85	<,001	,001
	Representations of the seasons	6,85	7,57	<,001	<,001
	Representations of the months	4,07	4,78	<,001	<,001
	Representations of the days of the week	3,78	4,71	<,001	<,001

Significant differences in the results of the examination of visual-spatial gnosis were revealed. When copying simple Denmann geometric figures, there was either only one dysmetric error with general preservation of the proposed shape, or several dysmetric errors with general preservation of the shape.

Marked distinctions were observed in the results of the examination of the level of verbalization of spatial representations and linguistic representations. The results of independent use of prepositions by bilingual children with general underdevelopment of speech and their composition of spatial speech constructions became higher. In addition, preschoolers began to better understand speech constructions, including spatial-temporal and causal ones.

Notable divergences were revealed between the results of the examination of temporal representations: representations of the parts of the day, the concepts of 'yesterday', 'today', 'tomorrow', the seasons, months, and days of the week before and after remedial work.

In the control group (n = 14), smaller and fewer statistically significant changes were observed (Table 2).

Table 2. Comparison of the results of the examination of spatial and temporal representations in bilingual children with general underdevelopment of speech in the control group before and after correctional work.

Methods	Indicators	Average value before	Average value after	P values	
				One-tail	Two-tail
The Denmann test	Visual spatial gnosis (copying figures)	1,32	1,46	,020	,040
N.Y. Semago and M.M. Semago's methodology for studying spatial perceptions	Representation of the space of one's own body along the vertical and horizontal axis	6,85	7,14	,020	,040
	Spatial representations in the relationship of external objects of the body and in relation to one's own body	5,42	5,85	,004	,008
	Level of verbalization of spatial representations	5,64	6	,009	,019
	Spatial representations at the level of one's own body in the right/left direction	2,21	2,28	,168	,336
	Linguistic representations (language space)	4,92	5,28	,009	,019
Examination of temporal representations (O.B. Inshakova)	Representations of the parts of the day	6,14	6,5	,009	,019
	Concepts of 'yesterday', 'today', 'tomorrow'	6,64	6,92	,020	,040
	Representations of the seasons	6,28	6,57	,020	,040
	Representations of the months	3,64	4,21	<,001	,001
	Representations of the days of the week	3,85	4,5	<,001	<,001

Statistically meaningful were found between the results of the survey of ideas about months and days of the week before and after the correction work.

Discussion

The findings of this study confirm that bilingual preschool children with general speech underdevelopment demonstrate pronounced deficits in spatial and temporal representations, which is consistent with earlier research on the cognitive and linguistic difficulties of bilingual children (Kharenkova, 2013; Wiesel &

Konstantinova, 2016). The most common issues identified in our study – confusion of spatial prepositions, limited use of adverbs of place and time, and difficulties with sequencing temporal events – align with the results reported by Kislitsyna (2021) and Khashimov (2018), who emphasized the delayed acquisition of grammatical categories in bilingual children with speech impairments.

The statistically significant improvements observed in the experimental group after the neuropsychological corrective program support the effectiveness of integrating neuropsychological methods into speech therapy practice. Similar conclusions were drawn by Glozman et al. (2020), who demonstrated that neuropsychological interventions enhance both cognitive and speech development in preschool children with developmental delays. The observed gains in verbalization of spatial relations and improved sequencing of temporal categories are consistent with findings by Denisova (2018), highlighting the role of spatial cognition as a foundation for multiple domains of child development.

However, certain areas, such as right / left orientation, showed less pronounced improvement. This partial progress mirrors the results obtained by Inshakova and Kolesnikova (2006), who noted that spatial orientation at the body level is one of the most resistant skills to correction and may require longer intervention periods.

The present study has several limitations. First, the sample size was relatively small (28 children), which restricts the generalizability of the findings. Second, the intervention period was limited to 26 sessions, which may not be sufficient to achieve stable improvements in all parameters. Third, the study focused exclusively on bilingual children with Russian as one of their languages; results may differ for other language combinations.

Despite these limitations, the study contributes to the existing body of knowledge by demonstrating that targeted neuropsychological interventions can effectively improve spatial and temporal representations in bilingual children with general speech underdevelopment. These findings expand the understanding of bilingual cognitive development and provide practical implications for speech therapy in multicultural and multilingual preschool settings.

Future research should explore the long-term retention of these improvements, the effects of extending the intervention period, and the applicability of the program to other linguistic and cultural groups. Moreover, comparative studies with monolingual children with general speech underdevelopment could offer further insights into the role of bilingualism in shaping spatial and temporal cognition.

Conclusion

The analysis of Russian and international scientific literature has shown that modern approaches to the problem of bilingualism are not uniform. On the one hand, researchers point to additional cognitive resources formed under conditions of bilingualism; on the other hand, they emphasize the risk of specific speech and cognitive difficulties, especially when bilingualism is combined with general speech underdevelopment.

The empirical part of the study revealed distinctive features of spatial and temporal representations in bilingual preschoolers with general speech underdevelopment. The most pronounced difficulties were observed in differentiating the concepts of ‘left–right’, in the use of spatial prepositions and adverbs, as well as in understanding temporal sequences (days of the week, seasons, the categories ‘yesterday–today–tomorrow’). These deficits negatively affect not only speech development but also the formation of higher mental functions.

The neuropsychological corrective program developed within the framework of this study, which included exercises for the development of visual-spatial gnosis, body schema, and temporal categories, proved to be effective. Children in the experimental group demonstrated statistically significant improvements in most diagnostic indicators, which confirms the feasibility of applying neuropsychological techniques in speech therapy practice for bilingual children with general speech underdevelopment.

Thus, the aim of the study has been achieved: the effectiveness of the developed program has been confirmed, and its application can be considered a promising direction of corrective and developmental work in multicultural and multilingual educational settings. Future research should focus on expanding the sample, studying the long-term effect of the program, and comparing the results with groups of monolingual children with speech disorders.

References

Chirsheva, G. N., & Korovushkin, P. B. (2019). *Children’s bilingual speech.* Cherepovets: Cherepovets State University, 217.

Denisova, V. A. (2018). Formation of spatial representations in preschool children in ontogenesis. *Student Bulletin, 5*(25), 10–13.

Efremova, Y. R. (2020). Features of child bilingualism formation. *Bulletin of Social and Humanitarian Education and Science, 1,* 55–61.

Glozman, J. M., Potanina, A. Y., & Soboleva, A. E. (2020). *Neuropsychological diagnostics in preschool age*. SPb.: Piter, 80.

Grosjean, F., & Byers-Heinlein, K. (2018). *The listening bilingual: Speech perception, comprehension, and bilingualism.* Wiley-Blackwell, 264.

Inshakova, O. B., & Kolesnikova, A. M. (2006). *Spatial-temporal representations: examination and formation in schoolchildren with expressive alalia.* M.: B. Sekachev, 80.

Kharenkova, A. V. (2013). Analysis of the peculiarities of speech development of bilingual children. *Problems of modern education, 2,* 160–167.

Khashimov, R. I. (2018). *Bilingualism and interference: essence, typology and functioning*. M.: FLINT, 318.

Kislitsyna, O. N. (2021). Formation of spatial representations in preschool children in ontogenesis. *Science and innovations – modern concepts: collection of scientific articles of the International Scientific Forum.* Moscow: Infinity, 47–52.

Melekhin, A. I. (2013). Age-related psychological features of time cognition by preschoolers. *Sociosphere, 1,* 68–74.

Scheglova, I. V. (2019). *National-Russian bilingualism in the communicative behaviour of natural bilinguals:* dissertation for the degree of Candidate of Philological Sciences. Astrakhan: Astrakhan State Technical University, 313.

Semago, N. Y., & Semago, M. M. (2000). Spatial representations of the child. *School psychologist, 34,* 15–20.

Vereshchagin, E. M. (2014). *Psychological and methodological characteristics of bilingualism (Bilingualism).* M.: Direct Media, 162.

Weinreich, U. (1953). *Languages in Contact: Findings and Problems.* New York, 212.

Wiesel, T. G., & Konstantinova, A. V. (2016). *Literacy learning in bilingual settings.* M.: B. Sekachev, 90.