

ПСИХОЛОГИЯ РАЗВИТИЯ | DEVELOPMENTAL PSYCHOLOGY

Dynamics of the Development of Dialectical and Logical Thinking in the Senior Preschool and Primary School Age

Nikolai E. Veraksa

Lomonosov Moscow State University, Moscow, Russia

ORCID: <https://orcid.org/0000-0003-3752-7319>, e-mail: neveraksa@gmail.com

Zlata V. Airapetyan

Lomonosov Moscow State University, Moscow, Russia

ORCID: <https://orcid.org/0000-0002-4466-9799>, e-mail: zlata.a.v@yandex.ru

Olga V. Almazova

Lomonosov Moscow State University, Moscow, Russia

ORCID: <https://orcid.org/0000-0001-8852-4076>, e-mail: almaz.arg@gmail.com

Kristina S. Tarasova

Lomonosov Moscow State University, Moscow, Russia

ORCID: <https://orcid.org/0000-0002-9072-8761>, e-mail: christinap@bk

Earlier in our research we studied the differences between formal and dialectical thinking, so formal operations are aimed at the exclusion of contradiction, and dialectical ones at the active transformation of the relations of opposites. The clarification of the relationship between these two forms of thinking in dynamics continues to be a relevant task. The aim of the work was to investigate the performance in solving logical and dialectical tasks, as well as to identify age norms for 5-10-year-old children (n=756). To assess logical thinking, we used J. Piaget's tests, which are aimed at assessing the ability to coordinate two parameters simultaneously when analyzing proportions ("Probability"), balance ("Scales") and motion ("Mechanical curve"). Methods aimed at assessing children's ability to perform dialectical thought actions of transformation ("Drawing of an unusual tree"), mediation ("What can be both at the same time?"), and seriation ("Cycles") were applied. By 8-10 years of age, the majority of children successfully coped with the solution of all three logical tests, with boys performing better than girls on a spatial task aimed at coordinating multidirectional movements ("Mechanical curve"). Most children by the age of 9 successfully cope with building cyclical seriations. At the same time, dialectical tasks, as a result of which one object transforms into its opposite ("Drawing of an unusual tree") or both objects are combined into a single new one ("What can be both at the same time?") are relevant for children over 10 years old. It is probable that, as thinking is formed at each age stage, the ability to identify and operate with opposites retains its significance.

Keywords: dialectical actions, formal operations, age norms.

*Веракса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.*
Динамика развития диалектического и формально-
логического мышления в старшем дошкольном и
младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

*Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.*
Dynamics of the Development of Dialectical and
Logical Thinking in the Senior Preschool and Primary
School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

Funding. This research was funded by the Russian Science Foundation (RSF) grant №19-18-00521-П

For citation: Veraksa N.E., Airapetyan Z.V., Almazova O.V., Tarasova K.S. Dynamics of the Development of Dialectical and Logical Thinking in Senior Preschool and Primary School Age. *Psikhologo-pedagogicheskie issledovaniya = Psychological-Educational Studies*, 2023. Vol. 15, no. 4, pp. 111–127. DOI:10.17759/psyedu.2023150407

Динамика развития диалектического и формально- логического мышления в старшем дошкольном и младшем школьном возрасте

Веракса Н.Е.

ФГБОУ ВО «Московский государственный университет имени М.В. Ломоносова» (ФГБОУ ВО «МГУ имени М.В. Ломоносова»), г. Москва, Российская Федерация
ORCID: <https://orcid.org/0000-0003-3752-7319>, e-mail: neveraksa@gmail.com

Айрапетян З.В.

ФГБОУ ВО «Московский государственный университет имени М.В. Ломоносова» (ФГБОУ ВО «МГУ имени М.В. Ломоносова»), г. Москва, Российская Федерация
ORCID: <https://orcid.org/0000-0002-4466-9799>, e-mail: zlata.a.v@yandex.ru

Алмазова О.В.

ФГБОУ ВО «Московский государственный университет имени М.В. Ломоносова» (ФГБОУ ВО «МГУ имени М.В. Ломоносова»), г. Москва, Российская Федерация
ORCID: <https://orcid.org/0000-0001-8852-4076>, e-mail: almaz.arg@gmail.com

Тарасова К.С.

ФГБОУ ВО «Московский государственный университет имени М.В. Ломоносова» (ФГБОУ ВО «МГУ имени М.В. Ломоносова»), г. Москва, Российская Федерация
ORCID: <https://orcid.org/0000-0002-9072-8761>, e-mail: christinap@bk.ru

*Веракса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.*
Динамика развития диалектического и формально-логического мышления в старшем дошкольном и младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

*Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.*
Dynamics of the Development of Dialectical and Logical Thinking in the Senior Preschool and Primary School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

Ранее в наших исследованиях были изучены различия формального и диалектического мышления, так, формальные операции направлены на исключение противоречия, а диалектические – на активное преобразование отношений противоположностей. Уточнение связей этих двух форм мышления в динамике продолжает оставаться актуальной задачей. Цель работы заключалась в исследовании результативности решения формально-логических и диалектических задач, а также выявлении возрастных норм для детей 5-10-летнего возраста (n=756). Для оценки формально-логического мышления были применены пробы Ж. Пиаже, которые направлены на оценку способности координировать одновременно два параметра при анализе пропорций («Вероятность»), равновесия («Весы») и движения («Цилиндр»). Были применены методики, направленные на оценку способности детей совершать диалектические мыслительные действия превращения («Рисунок необычного дерева»), опосредствования («Что может быть одновременно?»), сериации («Циклы»). К 8-10 годам большинство детей успешно справлялись с решением всех трех формально-логических проб, при этом мальчики лучше, чем девочки выполняли пространственную задачу, направленную на координацию разнонаправленных движений («Цилиндр»). Большинство детей к 9 годам успешно справляются с выстраиванием циклических сериаций. При этом диалектические задачи, в результате которых один объект превращается в свою противоположность («Рисунок необычного дерева») или оба объекта объединяются в единый новый («Что может быть одновременно?»), являются актуальными для детей старше 10 лет. Вероятно, по мере формирования мышления на каждом возрастном этапе способности определять противоположности и оперировать ими сохраняют свою значимость.

Ключевые слова: диалектические действия; формально-логические операции; возрастные нормы.

Финансирование. Исследование выполнено при финансовой поддержке Российского научного фонда (РНФ), проект № 19-18-00521-П.

Для цитаты: *Веракса Н.Е., Айрапетян З.В., Алмазова О.В., Тарасова К.С.* Динамика развития диалектического и формально-логического мышления в старшем дошкольном и младшем школьном возрасте [Электронный ресурс] // Психолого-педагогические исследования. 2023. Том 15. № 4. С. 111–127. DOI:10.17759/psyedu.2023150407

Introduction: Features of Performing Tasks Related to the Application of Logical and Dialectical Thinking

According to the periodization of intellectual development proposed by J. Piaget, formal operations develop in stages. At preschool age, a child's thinking is egocentric, accompanied by insensitivity to contradictions and errors in solving problems on classification, seriation, the structuring of space, time, etc. These simple operations become available to the child at the age of 7-

*Веракса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.*
Динамика развития диалектического и формально-
логического мышления в старшем дошкольном и
младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

*Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.*
Dynamics of the Development of Dialectical and
Logical Thinking in the Senior Preschool and Primary
School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

11. The final formation of formal operations is in 11-12 - 14-15 years, when the child acquires the ability to understand and analyze proportions, dynamic and homeostatic balance, motion and probabilities [8]. To assess these abilities, J. Piaget et. al used tests in which the child was asked to coordinate two parameters simultaneously: proportions and probabilities ("Probability"), balance taking into account the weight of weights and their location ("Scales"), coordination of two differently directed movements ("Mechanical curve").

In subsequent studies carried out in line with the theory of J. Piaget, the results of children who did not fit into the rigid framework of the periodization of intellectual development were demonstrated. In the experiment by I. Rogozhina [17] the hypothesis that the formation of the principle of conservation in preschool children 5.5-6.9 years old is possible through the development of the composition and structure of logical operations of classification and seriation was confirmed. In the studies of N.E. Veraksa et al., results were obtained that indicated that children of 5-6 and 6-7 years of age have access to the action of seriation [4; 5; 20]. In the study by F. Pons et al. using the "Scales" test [18], children of 12-14 years old successfully coped with probability analysis (the "Scales" test), and a longitudinal study by N.E. Veraksa et al. [5] obtained data that children as early as 5-6 years old paid attention to two parameters, but relied on only one of them for prediction. In the study by F. Pons et al. [19] of formal operations using the "Mechanical curve" and "Probability" tests in children aged 8, 10, and 12, it was shown that at the age of 12, almost all children also successfully coped with the tests. In the studies of N.E. Veraksa et al. [5] it was revealed that children at the age of 7, performing the "Scales" test, are able to take into account two parameters (weight and location of weights). Thus, the results of comparative studies [5] showed that formal operations developed unevenly, but significant changes occurred already at the age of 7. Thus, the variability in the success rate of the three tasks aimed at assessing formal operations, in which children were asked to coordinate proportional, weight, and spatial measures, can be traced. At the same time, the tasks were previously offered only to children of primary school age and no age dynamics were traced.

J. Piaget [14] gave special importance to dialectical thinking as a "genetic aspect of equilibrium" that completes the formation of thinking in each age period. Within the framework of the structural dialectical approach (N.E. Veraksa, L.F. Bayanova, S.A. Zadadaev, E.E. Krashennikov, I.B. Shiyani, O.A. Shiyani, etc.) dialectical thinking is considered as a process of operating the relations of opposites at the formal and substantive level [3, 7, 10]. The formal side of dialectical thinking is represented by the structure of thinking actions, among which the following are accessible at a child's age: transformation and conversion, mediation, and seriation. Dialectical thinking is meaningfully connected with the solution of three types of tasks [4], aimed at: creating a creative product, understanding the processes of development; overcoming contradictions.

An earlier study found gender differences in the success rate of performing tasks of dialectical methods in children aged 5-7 [4]. In A.K. Belolutskaia's study, it was found that preschoolers and adults have a significantly higher rate of performing dialectical techniques than schoolchildren in general [1].

Earlier studies aimed at studying the differences and connections of formal and dialectical thinking have been conducted [4, 5], specifying the links of the development of these two forms of thinking continues to be a relevant task. The aims of this study were to identify the dynamics of the success rate of tasks aimed at assessing formal operations and dialectical thinking by children from 5 to 10 years old and to determine age norms.

Study Procedure and Research Methods

756 children participated in the study: 202 children of 5-6 years old (M month=62.6, SD=3.81), 186 children of 6-7 years old (M month=74.4, SD=3.65), 142 children of 7-8 years old (M month=89.0, SD=3.70), 140 children of 8-9 years old (M month=103.0, SD=3.62), 86 children of 9-10 years old (M month=115.6, SD=3.61). Of them, 47.5% were boys. Children attended preschool and schools in Moscow in 2019-2023.

Logical Thinking.

The "Scales" test [5] assessed the formal operation associated with understanding equilibrium with the presence of two variables: the weight of weights and their location. The child was presented with a visual task using lever scales with 12 holes on each side equidistant from the fulcrum and weights weighing 32 g each (Fig. 1). The shoulders of the scales were fixed in a horizontal position throughout the entire procedure. The child is asked: "What will happen to the weights if I unlock the bolt? Will they stay in the same position or will they tilt to this side or that side? Which way? How did you figure that out (a)?" . There was a total of 7 assignments. (The maximum score was 15).

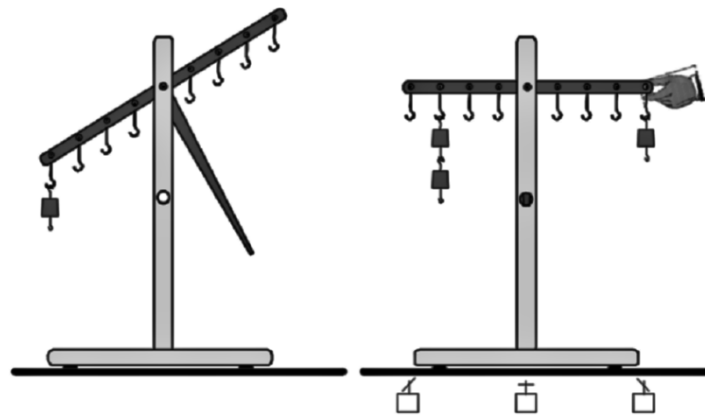


Figure 1. The device for conducting the "Scales" test

The "Probability" test [5] assessed a formal operation related to analyzing the proportions of white and black chips and probabilistic choice. The instructions were as follows: "There are two piles in front of you, each with white and black chips. Which side will have a higher chance of getting the white chip? How did you figure that out(s)?" . There are a total of 5 assignments. (Maximum score of 9).

The "Mechanical curve" test [5] assessed a formal operation aimed at coordinating two multidirectional movements. A cylinder was rotated in the vertical plane, and a pencil was moved above it in the horizontal plane in both directions. A piece of paper with a starting point was fixed on the cylinder (Fig. 2).

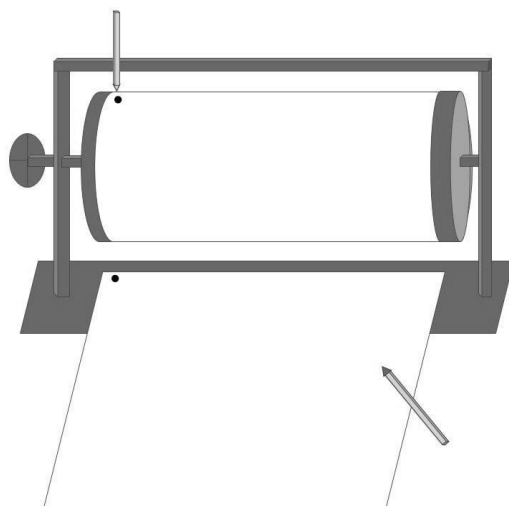


Fig. 2. "Mechanical curve" test device, frontal view from the child's side.

In the introductory tasks, the experimenter demonstrated the movements of the pencil and cylinder to the child, and in the test tasks the experimenter only voiced the conditions of the task. For each task, the child was presented with a piece of paper with a starting point. The instructions were as follows: "Draw what kind of trace you will get if...". There were 5 tasks in total. (Maximum score 9).

In all three tests there were 2 introductory tasks, and each child's answer was evaluated according to a 4-point system: if the child did not understand the task, he was given 0 points; if the child considered only one parameter in his answer, he was given 1 point; if the child mentioned both parameters in his answer, but relied only on one of them in his prediction, he was given 2 points; if the child tried to correlate two parameters, he was given 3 points.

Dialectical Thinking.

The method "Drawing of an unusual tree" [5] allows for the assessment of the child's ability to solve a creative problem using the action of transformation. Children used a form (A-4 sheet) and a simple pencil to make a drawing. The child was offered instruction: "Please draw an unusual tree" and then asked to give a description. Trees of 3 types were evaluated: 1) 0 points - normative (if there are changes, they practically do not differ from the usual image of a tree), 2) 1 point - symbolic (theme of desires, fantasies) and 3) 2 points - dialectical (a tree "vice versa", inverted, fractal). The type of transformation was also assessed from 0 to 7 points.

The "Cycles" method [5] assesses the child's ability to understand the simplest cyclical processes of development and apply dialectical thinking actions of seriation. The child was offered three sets of five pictures, which made up forward and reverse half-cycles. The child was given the task of arranging the pictures in such a way as to produce a sequential story.

The score for lining up one cycle ranged from 0 points to 5 points. The maximum score was 15.

The method "What can be both at the same time?" [5] is aimed at assessing the ability to overcome contradictions. Solving a problem of this type involves the use of the dialectic thinking action of mediation, as a result of which children combine two opposites in one object in such a way that the opposite qualities or properties make up a new indivisible whole. The method included five questions

*Веркса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.*
Динамика развития диалектического и формально-
логического мышления в старшем дошкольном и
младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

*Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.*
Dynamics of the Development of Dialectical and
Logical Thinking in the Senior Preschool and Primary
School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

containing a contradictory pair of attributes. For example, children were asked to answer the question: "What is both black and white at the same time?". The score received by the child while performing the method could vary from 0 to 20 points.

Results of the Study

The articles [4; 5] examined the relations between children's results for each type of thinking - logical and dialectic - both within each of these constructs and between them, which was a test of the convergent and construct validity of the instrument. In addition, for the "What can be both at the same time?" method it was found that the Cronbach's alpha coefficient for all tasks of the technique is 0.67, which is an acceptable result for internal consistency. The structure of other methods does not allow for us to check the internal consistency of the data in them.

Table 1 summarizes the main characteristics of the descriptive statistics of the sums of children's scores on each of the Piaget tests in different age groups.

Table 1

Main Characteristics of the Descriptive Statistics of Sum Scores on Piaget Tests in Children from Different Age Groups

Test/Age	Mean	Median	Stand.dev.	Minimum	Maximum
Probability, 5-6 years old	2,75	3,00	1,390	0	7
Probability, 6-7 years old	3,33	3,00	0,880	3	6
Probability, 7-8 years old	3,47	3,00	1,136	1	8
Probability, 8-9 years old	5,54	5,00	2,170	3	9
Probability, 9-10 years old	5,10	5,00	2,081	3	9
Scales, 5-6 years old	4,97	5,00	2,437	0	14
Scales, 6-7 years old	5,41	5,00	1,686	0	15
Scales, 7-8 years old	8,18	8,00	2,535	5	15
Scales, 8-9 years old	12,03	13,00	2,742	5	15
Scales, 9-10 years old	Not conducted				
Mechanical curve, 5-6 years old	4,11	4,00	2,281	0	7
Mechanical curve, 6-7 years old	3,19	3,00	1,245	0	6
Mechanical curve, 7-8 years old	5,76	6,00	1,865	3	9

Mechanical curve, 8-9 years old	6,99	7,00	1,956	3	9
Mechanical curve, 9-10 years old	7,21	8,00	1,995	3	9

Using a two-factor analysis of variance, taking gender and age group as factors, it was found that children's scores on the “Probability” ($F=69.795$, $p<0.001$) and “Scales” ($F=236.859$, $p<0.001$) tests differed across age groups. The “Mechanical curve” test differed between age groups ($F=94.570$, $p<0.001$) and between boys and girls ($F=9.139$, $p=0.003$). That is, the age group factor is significant for scores on all Piaget tests and gender is significant for the “Mechanical curve” test. The interaction of the gender and age group factors is not significant for the scores for all Piaget tests (Figure 3).

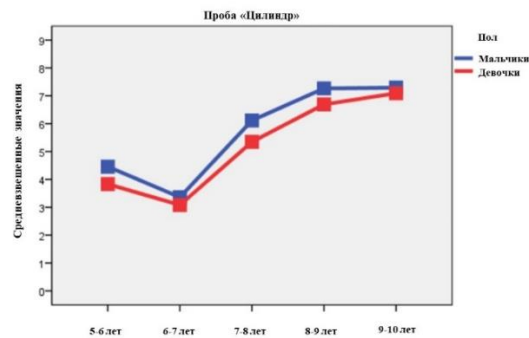


Figure 3. Weighted average values of the sums of scores for the Piaget's “Mechanical curve” test in boys and girls of different age groups

Table 2
Comparison of Results Obtained with J. Piaget's Samples for Children of 5-10 Years Old.

Age in Years	7-8	8-9	9-10	Differences
«Probability»				
Preschoolers	5-6	-0,715*	-2,791**	-2,353**
	6-7		-2,213**	-1,775**
Schoolchildren	7-8		-2,077**	-1,639**
«Scales»				

Preschoolers	5-6	-2,775**	-6,612**	No measurement was conducted	F=236,859**
	6-7	-6,612**	-1,775**		
Schoolchildren	7-8		-3,837**		
«Mechanical curve»					
Preschoolers	5-6	-1,646**	-2,875**	-3,098**	F=94,570**
	6-7	-2,563**	-3,791**	-4,015**	
Schoolchildren	7-8		-1,228**	-1,452**	

Note: * $p < 0.05$; ** $p < 0.01$.

Due to the results obtained with the Tukey test, when constructing norms for the results of Piaget's tests, we will combine 5-7 and 8-10-year-old children. For the “Mechanical curve” test, norms were calculated separately for boys and girls (Table 2).

Since the distribution not for all methods and not for all subsamples is normal (Shapiro-Wilk test), norms were calculated for all methods and for all age groups as follows: 15% of the lowest scores were considered low, 15% of the highest scores were considered high, and the remaining scores were considered average.

Table 3 summarizes the norms of Piaget's test results for children 5-10 years old.

Table 3

Norms of Piaget Test Scores for Children 5-10 Years Old

Age in Years /Result		Low	Average	High
«Probability»				
Preschoolers	5-7	0 – 2	3	4 - 9
Schoolchildren	7-8	0 – 2	3 - 4	5 - 9
	8-10	0 – 3	4 – 8	9
«Scales»				
Preschoolers	5-7	0 – 4	5	6 - 15
Schoolchildren	7-8	0 – 5	6 - 10	11 -15
	8-10	0 – 9	10 - 14	15
«Mechanical curve»				
Preschoolers, boys	5-7	0 – 2	3 - 5	6 - 9
Schoolchildren, boys	7-8	0 – 3	4 - 8	9
	8-10	0 – 6	7 – 9	
Preschoolers, girls	5-7	0 – 1	2 - 5	6 - 9

Веракса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.
Динамика развития диалектического и формально-
логического мышления в старшем дошкольном и
младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.
Dynamics of the Development of Dialectical and
Logical Thinking in the Senior Preschool and Primary
School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

Schoolchildren, girls	7-8	0 – 3	4 - 7	8 - 9
	8-10	0 - 4	5 - 8	9

Dialectical Thinking

Table 4 summarizes the distribution of the results of children 5-10 years old by type of Unusual Tree Drawing.

Table 4

Distribution of Children of 5-10 Years Old by Type of Tree

Age/Type of Drawing		Normative	Symbolic	Dialectical
Preschoolers	5-6	50%	42.%	8%
	6-7	25%	59%	16%
Schoolchildren	7-8	22%	69%	9%
	8-9	12%	73%	15%
	9-10	12%	80%	8%

Using Pearson's χ^2 criterion, it was found that the type of drawing and the age group of the children were related ($\chi^2=87.742$, $p<0.001$, Cramer's $V=0.241$).

The number of normative trees decreases with age (from 5 to 10 years). The percentage of symbolic drawings increases with each year (from 5 to 10 years), while the percentage of dialectical drawings changes in a wave-like manner from 8% to 16%. The result of performing the "Drawing of an unusual tree" method was also evaluated depending on the features of transformation of the image of an ordinary tree (Table 5).

Table 5

Main Characteristics of the Descriptive statistics of the Sums of Scores when Performing the Methods Aimed at Diagnosing Dialectical Thinking (5-10 years old)

Age in Years/Characteristic		M	Med	Sd	Min	Max
«Drawing of an unusual tree», by type of transformation						
Preschoolers	5-6	2,64	4,00	2,388	0	7
	6-7	4,03	4,00	2,075	0	7
Schoolchildren	7-8	3,97	4,00	1,818	0	7
	8-9	4,61	5,00	1,703	0	7
	9-10	4,38	4,00	1,296	1	7
«Cycles»						
Preschoolers	5-6	5,30	5,00	3,441	0	13
	6-7	9,34	9,00	2,546	3	15
Schoolchildren	7-8	11,75	12,00	2,246	0	15

	8-9	14,31	15,00	1,206	9	15
	9-10	13,60	14,00	1,185	11	15
«What can be both at the same time?»						
Preschoolers	5-6	3,66	2,00	3,433	0	14
	6-7	6,88	7,00	4,528	0	18
Schoolchildren	7-8	9,93	10,00	4,084	0	19
	8-9	13,12	14,00	4,142	1	20
	9-10	11,94	12,00	3,724	4	18

Using the Tukey test, it was revealed that children of 5-6 years old had significantly lower scores in performing the "Drawing of an unusual tree" method than children of 6-7 (MD=-1.389), 7-8 (MD=-1.328), 8-9 (MD=-1.971) and 9-10 years old (MD=-1.726) at $p < 0.001$. Due to these results, we will distinguish two groups - 5-6 and 6-10-year-old children when constructing the norms for the "Drawing of an unusual tree" method.

With the help of two-factor analysis of variance, taking gender and age group as factors, it was found that by the *type of transformation* the drawings of the children differ in different age groups ($F=26.020$, $p < 0.001$), but do not differ by gender. By means of two-factor analysis of variance, taking gender and age group as factors, it was found that the scores obtained by children when performing the "Cycles" method differed in different age groups ($F=302.400$, $p < 0.001$), but did not differ between boys and girls (Table 6). The scores obtained by children when performing the "Cycles" technique differed in different age groups ($F=302.400$, $p < 0.001$), but did not differ between boys and girls (Table 6). The scores obtained by children when performing the "What can be both at the same time?" method differ in different age groups ($F=129.649$, $p < 0,001$), but do not differ between boys and girls (Table 6). When constructing the norms for these methods, we will combine the results of children 8-10 years old, the other groups were assessed separately.

Table 6

**Comparison of Results Obtained when Performing the Methods Aimed at Diagnosing
Dialectical Thinking (5-10 years old)**

Age in Years		6-7	7-8	8-9	9-10	Differences
«Cycles»						
Preschoolers	5-6	-3,550*	-5,958*	-8,520*	-7,803*	F=302,400*
	6-7		-2,408*	-4,970*	-4,253*	
Schoolchildren	7-8			-2,563*	-1,846*	
«What can be both at the same time?»						
Preschoolers	5-6	-2,822*	-5,870*	-9,062*	-7,882*	F=129,649*
	6-7		-3,048*	-6,240*	-5,060*	
Schoolchildren	7-8			-3,192*	-2,012*	

Веракса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.
Динамика развития диалектического и формально-
логического мышления в старшем дошкольном и
младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.
Dynamics of the Development of Dialectical and
Logical Thinking in the Senior Preschool and Primary
School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

Note: * $p < 0.05$.

Table 7 summarizes the norms of performing the dialectical methods for children of different age groups.

Table 7

Norms of Performing the Methods Aimed at Diagnosing Dialectical Thinking (5-10 years old)

Age in Years/Result		Low	Average	High
«Drawing of an unusual tree», by type of transformation				
Preschoolers	5-6	0	1-4	5 - 7
Children	6-10	0 - 2	3-5	6 - 7
«Cycles»				
Preschoolers	5-6	0 – 2	3 - 10	11 - 15
	6-7	0 – 6	7 - 11	12 - 15
Schoolchildren	7-8	0 – 10	11 - 13	14 - 15
	8-10	0 – 13	14 – 15	
«What can be both at the same time?»				
Preschoolers	5-6	0	1 - 8	9 - 20
	6-7	0 – 2	3 - 11	12 - 20
Schoolchildren	7-8	0 – 5	6 - 14	15 - 20
	8-10	0 - 8	9 - 16	17 - 20

Discussion of results

Logical Thinking

The results of the study revealed age differences in the completion success rate of all J. Piaget's tests. This result agrees with the data in the works of F. Pons et al. [18] and substantiates the orientation of our study towards the consideration of formal operations from the point of view of L.S. Vygotsky's cultural-historical approach [6]. At the same time, as a result of performing the "Mechanical curve" test, gender differences were found.

The results of children in the performance of the "Probability", "Scales" and "Mechanical curve" tests are close to achieving the "ceiling" effect already at the age of 8-10 years. Thus, when increasing the sample size, the results of the studies conducted earlier by F. Pons et al. [18; 19] were not confirmed.

Dialectical Thinking

The results of the study complement the conclusions obtained earlier [4] about the heterochrony of the development of dialectical thinking. The two thinking acts, transformation and mediation, do

*Веракса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.*
Динамика развития диалектического и формально-
логического мышления в старшем дошкольном и
младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

*Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.*
Dynamics of the Development of Dialectical and
Logical Thinking in the Senior Preschool and Primary
School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

not develop linearly. With probability, such a wave-like manifestation of dialectical drawings depends on factors that we did not evaluate in this study [2; 11; 12; 13]. Tasks aimed at overcoming contradiction and transformation are relevant for children from 5 to over 10 years old. It is likely that these activities are related to the content aspect and in each age period children showed the ability to overcome contradictions with different degrees of success based on the relevant structure of thinking. Such a result is close to Piaget's thesis that dialectics is a "genetic aspect of equilibrium", as intelligence is "a flexible simultaneously stable structural equilibrium of behavior" [8, p.3].

The obtained results allow for us to conclude that the senior preschool age and the beginning of schooling are sensitive ages for the development of dialectical actions of seriation. This result is consistent with the conclusions of J. Piaget that "a child is not able to think in terms of relations until he has learned to conduct seriation.

Findings:

1. The senior preschool and primary school ages are sensitive to the development of the ability to perform formal operations of analyzing proportions, probabilities, balance and motion. These abilities strengthen with age, and we can trace their genesis: children's results in solving logical tasks aimed at coordinating the two parameters in the age periods of 5-7, 7-8 and 8-10 years differ significantly. At the same time, boys were more successful than girls in spatial tasks aimed at the coordination of multidirectional movements ("Mechanical curve").

2. Dialectical thinking develops unevenly. The age of 5-9 years old is relevant for the development of the thinking action of seriation and the use of tasks aimed at ordering and understanding processes in development, relying on the search for opposites and transitional states ("Cycles"). Tasks aimed at finding and transforming opposites ("What can be both at the same time?", "Drawing of an unusual tree") are relevant for diagnosing the development of dialectical thinking of children from 5 years old and over 10.

3. It was found that the improvement of the ability to perform the thinking action of transforming an object into its opposite coincides with the end of preschool age and the middle of the third age period (8-10 years old) emphasized when solving logical problems. It is probable that, as thinking is formed at each age stage, the ability to identify opposites and operate them continues to be a task that needs to be solved based on relevant thinking activity.

Conclusion

The conducted study allowed us to identify the age norms of the development of logical and dialectical thinking in children of 5-10 years old as a result of solving tasks aimed at diagnosing logical and dialectic thinking. The limitation of this study is that the sample is represented by children from one region. It is shown that it is reasonable to develop an understanding of developmental processes and the performance of formal operations aimed at assessing the success of the coordination of two parameters simultaneously in children of 5-10 years old. At the same time, the tasks, as a result of which one object turns into its opposite or both objects unite into a single new one, are relevant for children from 5 to over 10 years old. Thus, as logical operations develop, tasks aimed at searching for opposites and the active operation of relations of opposites continue to be relevant. The obtained results will help teachers to apply both logical (search for consistent solutions) and dialectical

Веракса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.
Динамика развития диалектического и формально-
логического мышления в старшем дошкольном и
младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.
Dynamics of the Development of Dialectical and
Logical Thinking in the Senior Preschool and Primary
School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

(transformation of the relations of opposites) tasks during the course of educational activities.

References

1. Belolutskaya A.K. Razvitie dialekticheskoi strategii myslitel'nogo operirovaniya protivopolozhnostyami u detei i vzroslykh [Development of a dialectical strategy of mental operation of opposites in children and adults]. *Pedagogicheskii zhurn. Bashkirii* [Bashkiria pedagogical journal], 2011. Vol. 2, pp. 50–58. (In Russ.).
2. Brofman V.V., Masterov B.M., Tekoeva Z.S. Terapiya razvitiem: oposredstvovanie i okno detskikh vozmozhnostei [Development therapy: mediation and windows of children's opportunities]. *Sovremennoe doshkol'noe obrazovanie* [Preschool Education Today], 2022. Vol. 4, pp. 32–49. DOI:10.24412/1997-9657-2022-4112-32-49 (In Russ.).
3. Veraksa N.E. Dialekticheskoe myshlenie [Dialectical thinking]. Ufa: Vagant, 2006. 212 p. (In Russ.).
4. Veraksa N., Almazova O., Airapetyan Z., Tarasova K. Geterokhronnost' razvitiya dialekticheskogo myshleniya u detei starshego doshkol'nogo vozrasta [Heterochronicity of dialectic thinking development in preschool 5-7-years-old children]. *Psikhologicheskii zhurnal* [Psychological journal], 2021. Vol. 42, no. 4, pp. 59–73. DOI:10.31857/S020595920015202-8 (In Russ.).
5. Veraksa N.E., Airapetyan Z.V., Almazova O.V., Tarasova K.S. Razvitie formal'no-logicheskogo i dialekticheskogo myshleniya u detej 5-8 let [Development of Formal-logical and Dialectical Thinking in Children of 5-8 Years Old]. *Kul'turno-istoricheskaya psikhologiya = Cultural-Historical Psychology*, 2022. Vol. 18, no. 4, pp. 4–14. DOI:10.17759/chp.2022180401 (In Russ.).
6. Vygotsky L.S. Sbranie sochinenii v 6 t. [Collected works in 6 volumes]. Vol. 6. Moscow: Nauchnoe nasledstvo, 1984. (In Russ.).
7. Piaget J., Inhelder B. Psikhologiya rebenka [Psychology of the child]. Moscow: Piter, 2003. 159 p. (In Russ.).
8. Piaget J. Psikhologiya intellekta [Psychology of intelligence]. Saint-Petersburg: Piter, 2004. 192 p. (In Russ.).
9. Rzhanova I.E., Alekseeva O.S., Fominykh A.Ya. Gender differences in cognitive indicators in preschool and primary school age children [Gender differences in cognitive indicators in preschool and primary school age children]. *Vestnik Moskovskogo Universiteta. Seriya 14. Psikhologiya* [Moscow University Psychology Bulletin], 2020. Vol. 2, pp. 141–157. DOI:10.11621/vsp.2020.02.07 (In Russ.).
10. Chichinina E.A., Bukhalenkova D.A., Chursina A.V., Boldyreva (Fominykh) A.Y. Sex Differences in Media Use in 6–7-year-old Children. *Psikhologo-pedagogicheskie issledovaniya = Psychological-Educational Studies*, 2023. Vol. 15, no. 3, pp. 38–51. DOI:10.17759/psyedu.2023150303 (In Russ.).
11. Shiyan O.A., Belolutskaya A.K., Le-Van T.N., Zadadaev S.A. Kognitivnoe razvitie doshkol'nikov: vzaimosvyaz' normativnykh, preobrazuyushchikh i simvolicheskikh sposobnostei [Cognitive development of preschoolers: the relationship of normative, transformative and symbolic abilities]. *Sovremennoe doshkol'noe obrazovanie* [Preschool Education Today], 2021. Vol. 6, no. 108, pp. 14–25. DOI:10.24412/1997-9657-2021-6108-14-25 (In Russ.).
12. Joukova E.S., Artemenkov S.L., Bogoyavlenskaya D.B. The Formation of Giftedness and

Веракса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.
Динамика развития диалектического и формально-
логического мышления в старшем дошкольном и
младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.
Dynamics of the Development of Dialectical and
Logical Thinking in the Senior Preschool and Primary
School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

Intelligence at School Age. *New Ideas in Child and Educational Psychology*, 2022. Vol. 2, no. 1-2, pp. 80–92. DOI:10.11621/nicper.2022.0205

13. Leybina A.V., Kashapov M.M. Understanding Kindness in the Russian Context. *Psychology in Russia: State of the Art*, 2022. Vol. 15, no. 1, pp. 66–82. DOI:10.11621/pir.2022.0105

14. Piaget J. *Les Formes Élémentaires de la Dialectique*. Gallimard, 1980. 249 p.

15. Piaget J., Inhelder B. *La genèse de l'idée de hasard chez l'enfant*. Paris: PFU, 1951.

16. Piaget J., Inhelder B., Sieminska A. *La géométrie spontanée de l'enfant*. Paris: PFU, 1948.

17. Pogozhina I. Development of the logical operations in preschool children. *Procedia, Social and Behavioral Sciences*, 2014. Vol. 146, pp. 290–295.

18. Pons F., Montangero J. Is diachronic thought a specific reasoning ability? *Swiss Journal of Psychology*, 1999. Vol. 58, no. 3, pp. 191–200.

19. Sidneva A.N., Vysotskaya E.V., Korotaeva I.V., Mozharovsky I.L., Shinelis V.A. How Do primary schoolchildren use concept definitions in recognition tasks? *Psychology in Russia: State of the Art*, 2022. Vol. 13, no. 2, pp. 29–46. DOI:10.11621/pir.2020.0203

20. Thomas L., Pons F., de Ribaupierre A. Attentional capacity and cognitive level in the balance task. *CPC*, 1996. Vol. 15, no. 2, pp. 137–172.

Литература

1. Белолуцкая А.К. Развитие диалектической стратегии мыслительного оперирования противоположностями у детей и взрослых // Педагогический журнал Башкирии. 2011. № 2. С. 50–58.

2. Брофман В.В., Мастеров Б.М., Текоева З.С. Терапия развитием: опосредствование и окно детских возможностей // Современное дошкольное образование. 2022. № 4. С. 32–49. DOI:10.24412/1997-9657-2022-4112-32-49

3. Веракса Н.Е. Диалектическое мышление. Уфа: Вагант, 2006. 212 с.

4. Веракса Н.Е., Алмазова О.В., Айрапетян З.В., Тарасова К.С. Гетерохронность развития диалектического мышления у детей старшего дошкольного возраста // Психологический журнал. 2021. Т. 42. № 4. С. 59–73. DOI:10.31857/S020595920015202-8

5. Веракса Н.Е., Айрапетян З.В., Алмазова О.В., Тарасова К.С. Развитие формально-логического и диалектического мышления у детей 5-8 лет // Культурно-историческая психология. 2022. Том 18. № 4. С. 4–14. DOI:10.17759/chp.2022180401

6. Выготский Л.С. Собрание сочинений в 6 т. Т. 6. М.: Научное наследство, 1984.

7. Пиаже Ж., Инхельдер Б. Психология ребенка. М.: Питер, 2003. 159 с.

8. Пиаже Ж. Психология интеллекта. СПб.: Питер, 2004. 192 с.

9. Ржанова И.Е., Алексеева О.С., Фоминых А.Я. Половые различия по показателям когнитивной сферы у детей дошкольного и младшего школьного возраста // Вестник Московского университета. Серия 14. Психология. 2020. № 2. С. 141–157. DOI:10.11621/vsp.2020.02.07

10. Чичина Е.А., Бухаленкова Д.А., Чурсина А.В., Болдырева А.Я. Особенности использования цифровых устройств современными мальчиками и девочками 6-7 лет [Электронный ресурс] // Психолого-педагогические исследования. 2023. Том 15. № 3. С. 38–51. DOI:10.17759/psyedu.2023150303

11. Шиян О.А., Белолуцкая А.К., Ле-Ван Т.Н., Зададаев С.А. Когнитивное развитие

Веракса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.
Динамика развития диалектического и формально-
логического мышления в старшем дошкольном и
младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.
Dynamics of the Development of Dialectical and
Logical Thinking in the Senior Preschool and Primary
School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

дошкольников: взаимосвязь нормативных, преобразующих и символических способностей // Современное дошкольное образование. 2021. № 6. С. 14–25. DOI:10.24412/1997-9657-2021-6108-14-25

12. Joukova E.S., Artemenkov S.L., Bogoyavlenskaya D.B. The Formation of Giftedness and Intelligence at School Age // *New Ideas in Child and Educational Psychology*. 2022. Vol. 2. № 1-2. P. 80–92. DOI:10.11621/nicep.2022.0205

13. Leybina A.V., Kashapov M.M. Understanding Kindness in the Russian Context // *Psychology in Russia: State of the Art*. 2022. Vol. 15. № 1. P. 66–82. DOI:10.11621/pir.2022.0105

14. Piaget J. *Les Formes Élémentaires de la Dialectique*. Gallimard, 1980.

15. Piaget J., Inhelder B. *La genese de l'idee de hasard chez l'enfant*. Paris: PFU, 1951.

16. Piaget J., Inhelder B., Sieminska A. *La géométrie spontanée de l'enfant*. Paris: PFU, 1948.

17. Pogozhina I. Development of the logical operations in preschool children // *Procedia, Social and Behavioral Sciences*. 2014. Vol. 146. P. 290–295.

18. Pons F., Montangero J. Is diachronic thought a specific reasoning ability? // *Swiss Journal of Psychology*. 1999. Vol. 58. № 3. P. 191–200.

19. Sidneva A.N., Vysotskaya E.V., Korotaeva I.V., Mozharovsky I.L., Shinelis V.A. How Do primary schoolchildren use concept definitions in recognition tasks? // *Psychology in Russia: State of the Art*. 2022. Vol. 13. № 2. P. 29–46. DOI:10.11621/pir.2020.0203

20. Thomas L., Pons F., de Ribaupierre A. Attentional capacity and cognitive level in the balance task // *CPC*. 1996. Vol. 15. № 2. P. 137–172.

Information about the authors

Nikolay E. Veraksa, Doctor in Psychology, Professor, Faculty of Psychology, Department of Educational Psychology and Pedagogics, Lomonosov Moscow State University, Moscow, Russia, ORCID: <https://orcid.org/0000-0003-3752-7319>, e-mail: neveraksa@gmail.com

Zlata V. Airapetyan, Junior researcher, Faculty of Psychology, Department of Educational Psychology and Pedagogics, Lomonosov Moscow State University, Moscow, Russia, ORCID: <https://orcid.org/0000-0002-4466-9799>, e-mail: zлата.a.v@yandex.ru

Olga V. Almazova, PhD in Psychology, Associate Professor, Department of Developmental Psychology, Lomonosov Moscow State University, Moscow, Russia, ORCID: <https://orcid.org/0000-0001-8852-4076>, e-mail: almaz.arg@gmail.com

Kristina S. Tarasova, PhD in Psychology, Scientific Researcher, Faculty of Psychology, Department of Methodological Psychology, Lomonosov Moscow State University, Moscow, Russia, ORCID: <https://orcid.org/0000-0002-9072-8761>, e-mail: christinap@bk.ru

Информация об авторах

Веракса Николай Евгеньевич, доктор психологических наук, профессор, факультет психологии, кафедры психологии образования и педагогики, ФГБОУ ВО «Московский государственный университет имени М.В. Ломоносова» (ФГБОУ ВО «МГУ имени М.В. Ломоносова»), г. Москва, Российская Федерация, ORCID: <https://orcid.org/0000-0003-3752-7319>

*Веракса Н.Е., Айрапетян З.В., Алмазова О.В.,
Тарасова К.С.*
Динамика развития диалектического и формально-
логического мышления в старшем дошкольном и
младшем школьном возрасте
Психолого-педагогические исследования. 2023.
Том 15 . № 4. С. 111–127.

*Veraksa N.E., Airapetyan Z.V., Almazova O.V.,
Tarasova K.S.*
Dynamics of the Development of Dialectical and
Logical Thinking in the Senior Preschool and Primary
School Age
Psychological-Educational Studies. 2023.
Vol. 15, no. 4, pp. 111–127.

7319, e-mail: neveraksa@gmail.com

Айрапетян Злата Валерьевна, младший научный сотрудник, факультет психологии, кафедра психологии образования и педагогики, ФГБОУ ВО «Московский государственный университет имени М.В. Ломоносова» (ФГБОУ ВО «МГУ имени М.В. Ломоносова»), г. Москва, Российская Федерация, ORCID: <https://orcid.org/0000-0002-4466-9799>, e-mail: zlata.a.v@yandex.ru

Алмазова Ольга Викторовна, кандидат психологических наук, доцент кафедры возрастной психологии, ФГБОУ ВО «Московский государственный университет имени М.В. Ломоносова» (ФГБОУ ВО «МГУ имени М.В. Ломоносова»), г. Москва, Российская Федерация, ORCID: <https://orcid.org/0000-0001-8852-4076>, e-mail: almaz.arg@gmail.com

Тарасова Кристина Сергеевна, кандидат психологических наук, научный сотрудник, факультет психологии, кафедра методологии психологии, ФГБОУ ВО «Московский государственный университет имени М.В. Ломоносова» (ФГБОУ ВО «МГУ имени М.В. Ломоносова»), г. Москва, Российская Федерация, ORCID: <https://orcid.org/0000-0002-9072-8761>, e-mail: christinap@bk.ru

Получена 10.10.2023

Принята в печать 18.12.2023

Received 10.10.2023

Accepted 18.12.2023