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Dialectical and Formal-Logical Thinking in Senior Preschoolers

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Abstract: **Introduction**. The article presents an empirical study into the correlation problems between the development of formal-logical and that of dialectical thinking at preschool age. This has been the first ever approach towards comparing these lines of thought development. The study aims to answer the questions raised by J. Piaget, K. Riegel, and M. Bassechez in their works on the relationship between dialectical and formal-logical thinking.
Methods. To assess the development of dialectical thinking we used the following methods: *Drawing an Unusual Tree, Cycles and What Happens to be both at the Same Time?*
Development of formal intellect was determined using the Piaget tests *Scales, Probability and Cylinder*. The data on the development of dialectical and formal-logical thinking were compared using correlational and regression statistical methods. The longitudinal study involved 87 children aged 5-6 years and 6-7- year-olds at a later stage, who attended Moscow kindergartens.
Outcomes. According to the regression analysis, predictors of the success in the Probability task in the preparatory group were the scores of Piaget's *Probability* and *Cylinder* tests and dialectical thinking measured by the *Cycles* and *What Happens to be Both at the Same Time* methods, which were assessed when preschoolers attended the older group (R = 0.606 (>0.5); F = 3.957, p=0.003). Of interest is the correlation between the *Probability* test outcomes and those of the *Cycles* method (r=0.203, p=0, 021).
Discussion of outcomes. The results suggest that the formal operations of multiplication and the dialectical operations of transformation, reversal and mediation are part of a unified cognitive structure. Based on K. Riegel's assumption, it may also be argued that it is possible to solve dialectical problems in preschool childhood.

Keywords: formal-logical thinking, dialectical thinking, preschool age, seriation, multiplication, mediation, symbolization, mental operation, longitude

Highlights

- Preschool age marks the development of dialectical thinking which involves dialectical operations of transformation, integration, and mediation;

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- Six-year-olds engage in thought operations of multiplication and operations of reversal, transformation, and mediation which form part of one common cognitive structure;
- In their 7th year preschoolers undergo significant changes in the development of both formal and dialectical thinking, indicating a heterochronic nature of the development of thought operations in formal-logical and dialectical thinking.

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Introduction

The understanding of the specificity of dialectical logic has evolved within the mainstream of Russian philosophy and Western cognitive psychology. The philosopher E.V. Ilyenkov (Ilyenkov, 1979) determined that the distinctive feature of dialectical logic is related to the resolution of contradictions. Kopnin believed that formal logic reflects qualitative stability, while dialectical logic unfolds the phenomena of reality more multilaterally, in motion, a particular moment of which is rest, qualitative stability. "In studying forms of thought, formal logic abstracts from their concrete content, while dialectical logic, studying the process of development of concepts, judgments, etc., does not and cannot abstract from their content because by abstracting from content one fails to understand this process." (Kopnin 1962, p. 57)

The definition of dialectical logic as an independent form of logic gave rise to the question about the understanding of dialectical thinking. The philosopher V. I. Maltsev (Maltsev 1964) assumed the existence of corresponding thought operations. At the same time, there was a difficulty in describing formal dialectical operations that would describe processes in their development. The answer to these questions was found in the works of J. Piaget, who, in considering intelligence as the formation of formal-logical structures, also singled out dialectical structural transformations. Analyzing the issue of contradictions in children's judgments, J. Piaget saw their cause in the insufficient equilibration of logical structures. He emphasized that "dialectics is a genetic aspect of all processes of equilibrium" (Piaget 2008, p. 10). At the same time, dialectical thinking became possible not until after formal structures were formed, i.e., postformally (Over, 2015; Ferraz, Viana, Pocinho, 2018; Pronenko, Bunyaeva, 2019). This notion is also reflected in the works of K.F. Riegel (Riegel, 1973), M. Basseches (Basseches, 1984, 2005). Bassechez, analyzing the works of J. Piaget, suggested that considering dialectical thinking as a process of achieving the equilibrium of structures leads to the fact that the equilibration of logical structures makes their structure closed. Bassechez put forward a proposition that dialectical thinking is not so much a process of reaching an equilibrium as a process of working with this equilibrium. He identified 24 dialectical schemes with which an adult solves problems that he finds difficult to cope with.

Another line of studying dialectical thinking, which was also pursued in the context of human cognitive development, is related to the analysis of sensitivity to contradictions. At the same time, it was suggested that unlike their European counterparts, members of Eastern culture are less likely to feel stressed when confronting a contradiction (Peng, Nisbett 2000) and there may exist different cultural bases for dialectical thinking (Wang, 2006; Spencer-Rodgers, Anderson,

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Ma-Kellams, Wang, Peng, 2018). In one paper (Zhang et al., 2015) on a comparative study of dialectical thinking of British, Chinese, and Japanese students, the outcomes obtained did not confirm the conclusions of K. Peng and R. Nisbet about a greater dialecticism of thinking in oriental cultures.

Dialectical thinking in preschoolers. Problematics of formal components in dialectical thinking has been considered by domestic psychologists (Davydov, 1972, 1986; Veraksa, Belolutskaya, 2021; Shiyan, Belolutskaya, Le-Van, Zadadaev, 2021; Zadadaev, 2012; Veraksa, Veresov, 2018). Thus, N. Veraksa's research showed that the process of operating the relations of opposites is carried out through several thought actions. Mental actions of transformation and reversal aim to transform one opposite into another as the action of transformation is associated with turning an object from into B, and that of reversal involves turning it in the reverse direction from B into A; the action of mediation is aimed at finding a situation where the opposites act as components of a whole; the action of integration, by contrast, aims to find in the situation two opposites that constitute a contradiction and so on. As researches have shown, from the age of 4 years children are capable of solving contradictory tasks (Veraksa, 1981, 1987). Thus, within the structural-dialectical approach, attempts were made to describe thought actions and it was found that children were just as capable of making transformations of opposites.

Mechanisms of dialectical thinking. Dialectical thinking allows children to solve the following tasks: 1) make a new (creative) product; 2) overcome contradictions; and 3) understand simple (cyclical) developmental processes (Veraksa, 2019). Let's consider the mechanisms involved in solving these tasks. When we talk about creating a new product, there is one major point to be taken into account. It lies in the fact that this process has to do not with a new product in general, but with a concrete new one. It is obvious that in this case the mechanism of creating a new product can be built on the fact that some property of an existing concrete object or the whole of the object will be transformed into its opposite. This means that the mechanism of creating the new presupposes the subject's ability to perform a dialectical mental action of "transformation." First, however, the subject needs to define in terms of substance the opposite in relation to which the transformation action is to be performed. Thus, the mechanism of creating the new can be as follows: first the subject determines the initial opposite in a concrete semantic field; and then he carries out the transformation of one opposite into another.

The situation of contradiction is characterized by the fact that the subject encounters the presence of mutually exclusive properties or relations. He is thus confronted with the task of finding such conditions in which the existence of such relations ceases to be mutually exclusive. In this case the subject performs an action of dialectical mediation. The action of dialectical mediation presupposes first performing an action of dialectical integration. This action of dialectical integration is performed twice. First, it is done when the subject realizes that he or she has encountered a contradictory situation, in other word he or she realizes that there exist two opposites at the same time that seek to exclude each other. Then he should find a situation or one single whole in which these opposites will not exclude each other. What it means in reality is that before proposing such a situation, the subject should first see in it the presence of "peacefully" coexisting opposites, i.e., he or she must perform an action of dialectical integration for a second time. It is not until he does it for a second time that he can start mediating the opposites. In this way the situation is not only mediated, but it is also transformed from one of contradiction to one of non-contradiction. The mechanism of such transformation is as follows:

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1) establishing a contradictory situation (performing a dialectical thought action of integration); 2) searching for a situation in which these properties coexist (performing an action of integration); 3) performing an action of transformation, which consists in turning the action of integration into that of mediation; 4) solving the problem through an action of mediation.

The understanding of cyclic processes (elementary developmental processes) presupposes that the subject presents the cyclic process as consisting of two half-cycles: the forward half-cycle, which can be described as an action of dialectical transformation, and the reverse half-cycle, described as an action of dialectical reversal. The essential point of understanding is the fact that the subject must be seeing also the opposite fragments of the cycle in addition to the two opposite half-cycles. Let us consider the daily cycle as an example (Fig. 1). It consists of two half cycles built in the direct (night - morning - day) and opposite (day - evening - night) directions.

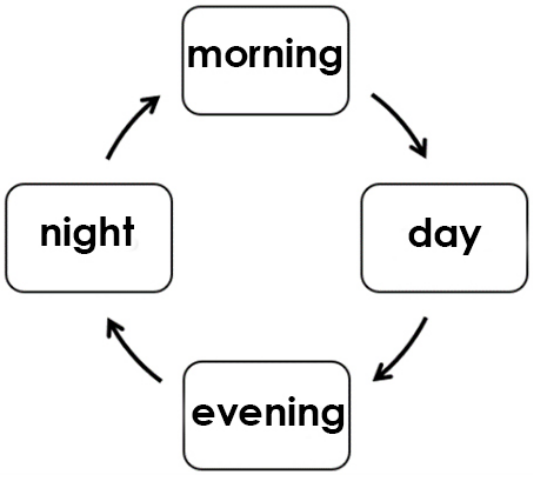

Figure 1: Daily cycle

It is clear that these two half cycles are opposite to each other. But in addition to this, the following fragments of the cycle are opposite: night - day and morning - evening. Thus, we can assume that the mechanism for understanding cyclic processes involves actions of dialectical seriation, transformation and reversal.

Dialectical thinking as a cultural phenomenon. Starting from preschool age children have access to cultural forms "that model fragments of dialectical thinking" (Vygotsky, 1982). Such forms include folk tales reflecting the schemes of transformation of relations between the opposites. Fairy tales can serve as examples of transformation actions because their main characters turn into their opposites: princesses into frogs, monsters into beautiful princes - in an oriental fairy tale called Dragon. In the tale people are oppressed by an evil and treacherous dragon. A brave young man goes to battle with the dragon, defeats him, and turns into a dragon himself. These plots help to analyze situations from the position of transformation and suggest that transformations can be varied. Of special interest are plots which pose a problematic situation only to be solved through a transformation action. For example, the well-known tale of King Solomon delivering his judgement on two women who couldn't divide a child between them. The refusal of one of the women to accept the King's decision to split the baby in two was considered to be an indication

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of her true motherhood. An example of the integration strategy are given by tales based on the idea of a copy. In them the copy appears to be both the same object and a different one at the same time. For example, the tale about an evil mandarin, who wanted to kill his opponent but, in the end, had to face an insurmountable force, as the twin brothers turned out to be five and each of them had a certain quality. This shows the idea of integration because the mandarin thought his opponent to be one person, but in fact there were many of them. An example of the mediation strategy can be found int the plot of the fairy tale "The Wise Bride" where the king says: "If your daughter is really wise, let her come to me in the morning - neither on foot nor on horseback, neither naked nor dressed, neither with a gift, nor without a present" (A.S. Afanasyev, 1986, P.247). The fairy tale emphasizes that it is 'a tricky task'. Thereby dialectical thinking is presented in culture as a special form of mental activity with which children become acquainted in their preschool years.

Methods

The study involved 87 children who were diagnosed first at age 5-6 and then one year later at age 6-7. We planned to compare the mastery of dialectical and formal-logical operations (first of all, the multiplication operation). The study had two objectives: 1) to analyze changes in the success in solving dialectical and formal tasks by children in their sixth and seventh year (on the same sample of children); and 2) to analyze the relations between the development of dialectical thought operations and formal operations in this sample of children. Data analysis was conducted in two stages: the first stage assessed changes in the development of dialectical and formal thinking in children aged six and seven over the course of a year; the second stage, using correlation analysis, examined the relationships between the success of mastering dialectical thinking actions and formal operations in children aged six and seven.

To assess the development of dialectical thinking, we developed three diagnostic techniques: *Drawing an Unusual Tree*, *Cycles*, and *What happens to be both at the same time*?

The *Drawing an unusual tree* method (Veraksa, 2006, 2021) allowed us to assess a child's solution to the creative task of creating a new graphic image. In performing the task, the child could apply both dialectical and non-dialectical transformations. To make a drawing, children used a blank (an A-4 sheet of paper) and a simple pencil. The child was instructed to "please draw an unusual tree." After completing the drawing, the child was asked to describe in detail, what was unusual about the tree he or she had drawn. The child's drawing was considered as a result of ordinary tree image transformation, which allowed for analysis of such transformation strategies to be made.

The *Cycles* technique (Veraksa, 2006, 2021) assessed the child's ability to understand elementary developmental processes. The child was offered three sets of five pictures. Each set characterized a developing situation. In total, three stories were used: *Dissolving lumps of sugar in a cup of tea, Boiling water in a teapot* (Fig. 2), and *Onset of a thunderstorm*.

The child was given the task to arrange pictures in such a way as to make a story. There was but one correct arrangement of pictures that could convey the correct sequence of story developments. Each of the stories could include up to five tasks, depending on the success of their performance. Let's look at the sequence in which the teapot story was arranged. In case of the other two stories, the order in which the tasks were to be performed was similar. In the first task the child was asked to arrange all the five pictures so that they could tell a story (Fig. 2).

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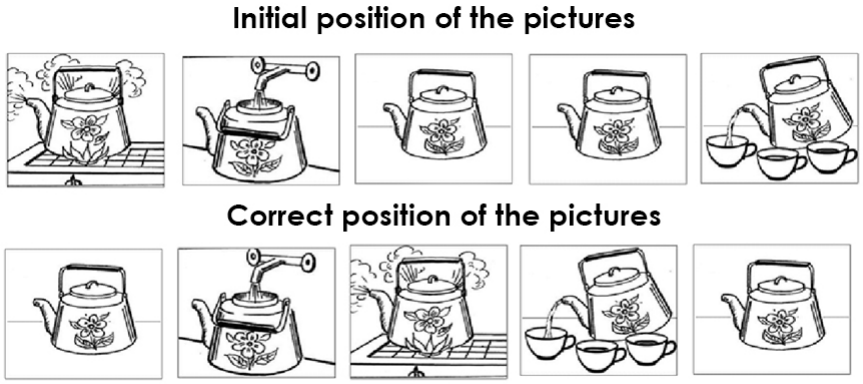

Figure 2: Performing the first task

If the child had difficulty in performing Task 1, he or she was offered to perform Tasks 2 and 3. In Tasks 2 and 3, the child was shown three pictures reflecting one of two half cycles of a cyclic process, which were also to be used to make up a story (Fig. 3).

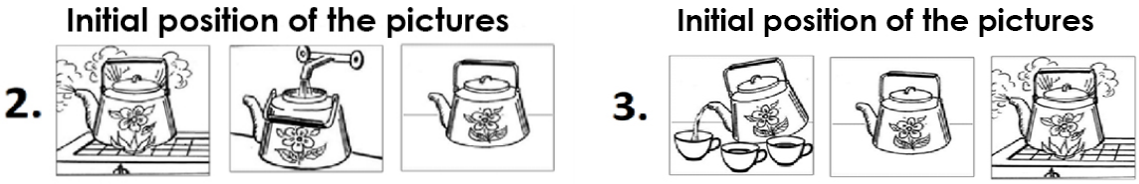

Fig. 3. Initial arrangement of cards in Tasks 2 and 3.

If the child still had difficulty in this case, he or she was given Tasks 4 and 5. In Tasks 4 and 5, the child was shown two pictures from the set with the middle picture missing, and the child had to choose from the other three pictures the one that would correspond to the intermediate state of the process depicted in this fragment of the developing situation (fig. 4).

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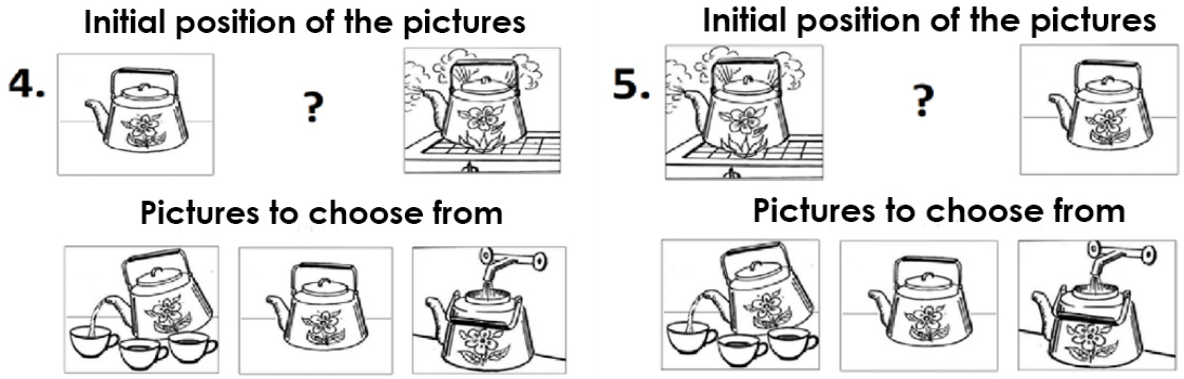

Figure 4: Arrangement of pictures in Tasks 4 and 5

The tasks were presented according to the following scheme. If the child performed Task 1, the test was stopped. Otherwise, he or she was asked to do Task 2 and Task 3. If the child did both tasks, the test was stopped. If the child did only one of two tasks, either Task 2 or Task 3, he or she was given Task 4 and Task 5. Depending on how well the child performed the task, he or she would get from 0 to 5 points for each trial. In other words, the total score could vary from 0 to 15 points.

The *What happens to be both at the same time?* technique (Veraksa, 2006, 2021) was aimed at assessing a child's ability to overcome contradictions. The technique included five questions containing a contradictory pair of attributes. The children were asked to answer the question, "What happens to be both at the same time:

- black and white?
- light and heavy?
- big and small?
- living and non-living?
- same and different?" The child's score on the technique could vary from 0 to 20 points.

The development of formal intelligence was determined using three Piaget tests, which were designed to assess the formation of the multiplication operation and the child's ability to make predictions.

In the *Scales* test (Piaget J., Inhelder B.,1955.), a child was offered a visual task using a balance scale with 12 pegs equidistant from the fulcrum on each side and 16 metal weights weighing 32 grams each (Figure 8). The device also has a mechanical bolt to fix the position of the balance scales. Before starting the procedure, the child is given information about the device and principle of scale operation and he is also given an opportunity to press on the scale arms with the bolt unlocked. During the task presentation, the weights were placed by the experimenter with the bolt locked, so the scales did not change their position regardless of the number of weights placed on each side. Each time the weights were placed, the experimenter asked the child the question, "What happens to the scale when I unlock the bolt?

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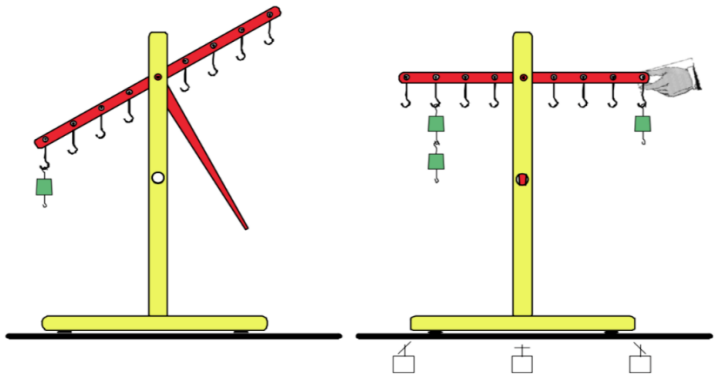

Figure 5. Device for conducting the *Scale* test

Will it stay that way or will it tip this way or that way? Which way? How did you figure it out?" There was a total of five tasks in the test, including two familiarization and three test ones.

In the *Probability* test (Piaget J., Inhelder B., 1955), two sets, each consisting of white and black chips, were placed on the table in front of the child. The child was asked to establish the probability of a white chip falling out. The instructions were as follows: "Imagine that we put the chips in bags and shook them. Now imagine that we take one chip each from here (pointing to the left pile) and one from here (pointing to the right pile). Which side has a better chance of getting a white chip? How did you figure it out?" There was a total of five tasks in the test, including two familiarization tasks and three test tasks.

In the *Cylinder* test (Piaget J., Inhelder B., 1955.), a special set-up was placed on a table in front of the child, consisting of a cylinder, which can be rotated by means of a special handle, with a white sheet of paper attached to it, and a pencil fixed on a special bar above the cylinder which can move along the cylinder and draw a line on the paper. Before starting the tasks, the child was introduced to the set-up by being given an opportunity to move the pencil back and forth and to rotate the cylinder. Then the child was asked to imagine that the pencil placed over the cylinder drew a point on the white sheet of paper attached to it and then the sheet was taken off the cylinder and placed in front of the child. At the same time, a white sheet with a dot in the upper left corner was placed in front of the child. The experimenter explained that the pencil would start moving from it. Two familiarization trials and three test trials were then conducted with the child, in which he or she had to draw on the sheet of paper what should result from the movement of the cylinder and the movement of the pencil. After completion, the drawing was put aside and the child was offered a blank sheet of paper with the point marked.

In each of Piaget's three tests, a child's answer was graded on a 4-point system: if the child did not understand the task, he or she was given 0 points; if the child took into account only one parameter in his or her answer (only the weight or the distance to the center of the balance scale; the number of either white or black chips; solely the movement of the pencil or only the revolutions of the cylinder), he or she was given 1 point; if the child mentioned both parameters in his answer, while relying on only one of them to make a prediction (for example, he counted the number of white and black chips, but chose a pile only for the number of white chips), he got 2 points; if a child tried to correlate the two parameters (guessing that they were contradictory or trying to mathematically relate them), he got 3 points. For each sample, the median was calculated.

Outcomes

Let us first consider the outcomes of the techniques that assessed the development of dialectical thinking. The success in solving a creative task (designing a graphic image of the unusual tree) is shown in Table 1.

Table 1

Correlation of Unusual Tree Drawing test results for preschoolers in the older and prep groups

Older group	Prep group			Total
	Normative	Symbolic	Dialectic	
Normative	12	23	10	45
Symbolic	4	26	6	36
Dialectic	0	6	0	6
Total	16	55	16	87

Due to mathematical limitations, we could not use the statistical Chi-square criterion. However, the data obtained could be analyzed in the context of comparing the dynamics of the task when preschoolers attended the older group and one year later, when they started attending the preparatory group (prior to school). As shown in Table 1, at Year 6, 45 children executed the "normative" image, and at Year 7, 16 preschoolers drew a normative tree. At the same time, most of the children (12 of 16) who drew a normative tree in the preparatory group, also acted similarly in the older group, in other words, they executed a "normative" tree image.

The "dialectical" drawing of a tree in the older group was done by 6 preschool children, and by 16 in the preparatory group. Note, however, that none of the children who managed to make a "dialectical" drawing of a tree in the older group did a drawing of the same kind (i.e., a dialectical drawing of a tree) in the preparatory group.

A 'symbolic' drawing of a tree in the older group was done by 36 children, and 55 preschoolers in the preparatory group.

The outcomes of the *Cycles* technique are presented in Table 2. It shows the values of averages, medians, standard deviations, maximums and minimums of scores awarded to preschool children in the older and prep groups.

Table 2

Cycles test results for preschoolers in the older and prep groups

Group	Average	Median	Std. er.	Minimum	Maximum
Older Prep	6,30 10,38	7,00 10,00	3,485 2,516	0 4	14 15

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Application of the Kolmogorov-Smirnov criterion showed that the distribution of scores on the *Cycles* technique was normal in both the older and the prep groups, which allowed parametric criteria to be used.

Using Pearson's correlation coefficient, it was found that the scores in the senior and prep groups were unrelated (r=0.129; p=0.228).

The application of the Student's t-distribution criterion for paired samples showed that the preschoolers' scores in the senior and prep groups differ significantly (t= 9.557; p<0.001) with the scores in the prep group being higher.

Figure 6 shows the "High-Low" chart for the total score on the *Cycles* technique in the older and prep groups. For almost all preschoolers, the score in the prep group became higher than it was in the older group (Table 3).

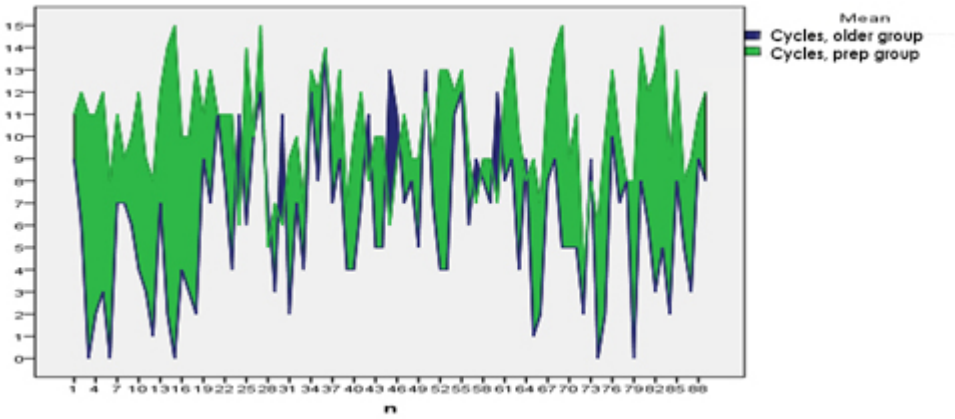

Figure 6. "High-Low" chart for the total score for the *Cycles* technique in the older and prep groups

Table 3

Results of preschoolers' performance of the tasks of the *What happens to be both at the same time?* method

Group	Average	Median	Std.er.	Minimum	Maximum
Older	4,60	4,00	3,804	0	17
Prep	9,17	9,50	4,718	0	18

The distribution of scores in the *What happens to be both at the same time?* technique for children in the older and prep groups was normal (Kolmogorov-Smirnov test), which allowed us to use parametric criteria.

Using Pearson's correlation coefficient, it was found that the scores of preschoolers in the older and preparatory groups were unrelated (r=0.148; p=0.169).

The application of the Student's t-test criterion for paired samples showed that the scores of preschoolers in the prep group were significantly higher than the those of preschoolers in the

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older group (t= 7.645; p<0.001).

Figure 7 shows the "High-Low" chart for the total score on the *What happens to be both at the same time?* technique in the older and prep groups. For almost all preschoolers, the score in the prep group proved higher than it was in the older group.

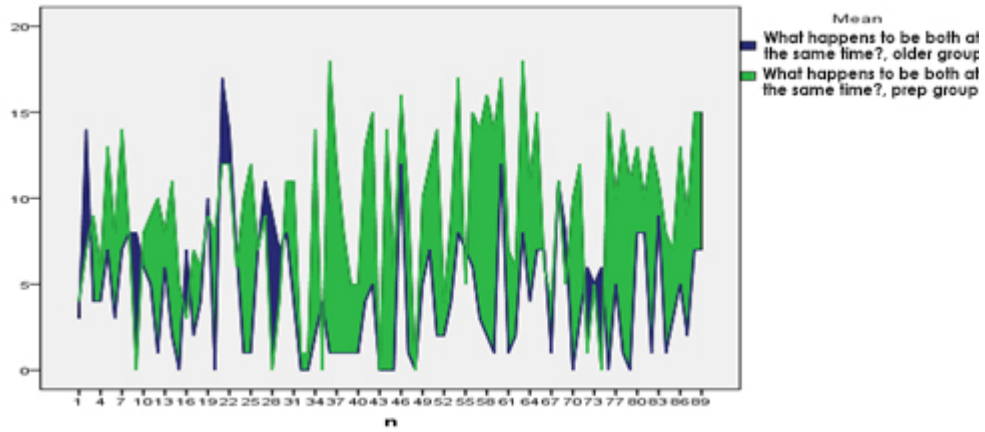

Figure 7. High-Low chart for the total score on the *What happens to be both at the same time?* technique in the older and prep groups

The outcomes of the Piaget trials for children in the older and preschool groups are shown in Table 4.

Table 4

Results of Piaget tests by preschoolers in the older and prep groups

Trial, group, parameter	Average	Median	Std. er.
Probability, older, maximum point	1,06	1,00	0,654
Probability, prep, maximum point	1,15	1,00	0,356
Probability, older, median	0,91	1,00	0,477
Probability, prep, median	1,12	1,00	0,329
Probability, older, score	2,83	3,00	1,368
Probability, prep, score	3,35	3,00	0,908

Trial, group, parameter	Average	Median	Std. er.
Scale, older, max. point	0,97	1,00	0,519
Scale, prep, max. point	1,16	1,00	0,528
Scale, older, median	0,92	1,00	0,490
Scale, prep, median	1,08	1,00	0,412
Scale, older, score	4,53	5,00	2,335
Scale, prep, score	5,40	5,00	1,696
Cylinder, older, max. point	1,69	2,00	1,286
Cylinder, prep, max. point	1,82	2,00	0,721
Cylinder, older, median	1,42	1,00	0,855
Cylinder, prep, median	1,61	2,00	0,695
Cylinder, older, score	4,37	5,00	2,589
Cylinder, prep, score	4,82	5,00	1,813

For all trials, the mean values increase from the older to the prep group, and data scatter decreases.

The Student's t-test for pairs of the related samples was used to test the significance of differences in the scores of the older and preschool group children on the parameters in question. The outcomes are presented in Table 5.

Table 5

Differences in Piaget test scores between older and prep children

Trial, parameter	T	P
Probability, max. point	-0,779	0,439
Probability, median	-7,493	<0,001

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Trial, parameter	T	P
Probability, score	-2,756	0,007
Scale, max. point	-2,411	0,018
Scale, median	-2,435	0,017
Scale, score	-3,046	0,003
Cylinder, max. point	-2,029	0,045
Cylinder, median	-1,901	0,060
Cylinder, score	-1,913	0,058

In the *Probability*, *Scale*, and *Cylinder* tests, the outcomes of preschoolers in the older and prep groups differed significantly (they tend to become significantly higher in the prep groups). What differed in the *Probability* test were the median values and sums, rather than maxima, suggesting that the preschoolers in the prep groups often began to show their maxima in each of the 3 trials way back when they were in the older group. The outcomes of the *Cylinder* test differed significantly on the maximum score parameter, suggesting that children in the prep groups were more likely to get the correct score in one of the 3 trials. For the other two parameters of the *Cylinder* test, the differences appeared to be at trend level.

We can assume that the mechanisms behind the *Probability* test are stabilizing, while those behind the *Cylinder* test are qualitatively developing, and those behind the *Scale* test are stabilizing for some children and developing for others.

K. Riegel, describing Piaget's approach, emphasized that the decisive role in the development of formal-logical thinking is assigned to dialectical thinking. In this case, dialectical operations are to play the role of predictors of formal-logical thinking. In order to test this hypothesis, we conducted a linear regression analysis.

The following outcomes of preschoolers in their sixth year were taken as expected predictors: the total score on the *Cycles* technique, the total score on the "What happen to be both at the same time" technique, the sum of scores on each type of Piaget trials, and the total score of understanding emotions in the older group.

Table 6 shows the coefficients of the regression equation for the dependent variable "probability," the sum of scores of Year 7 children, in which the scores of Year 6 children were taken as independent variables ($R = 0.606$ (>0.5); $F = 3.957$, $p=0.003$).

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Table 6

Regression equation coefficients for the Probability test results (total) in the preparatory group

Model	Non-standard coefficients		Standard coefficients	T	p
	B	Std. Er.	Beta		
Constant	2,741	0,683		4,017	<0,001
What happens to be both at the same time, total score	0,062	,029	0,298	2,144	0,038
Cycles, total score	-0,073	0,034	-0,296	-2,157	0,037
Probability,Year 6, score	0,343	0,122	0,398	2,819	0,007
Scale,Year 6, score	-0,066	0,053	-0,166	-1,236	0,224
Cylinder, Year 6, score	-0,141	0,046	-0,407	-3,100	0,003
TEC, total score	0,044	0,041	0,141	1,067	0,292

The predictor of the success of the *Scales* task for children in Year 7 was only the "sum of points" score obtained in the *Scales* test by children in Year 6.

No regression models satisfying statistical criteria were found for the *Cylinder* test or for indicators of dialectical thinking. In addition to the analysis performed, we determined correlations between the results of measuring the indicators for children in their 6th and 7th years that were obtained using all the methods (see Tables 7 and 8).

Table 7

Correlational relationships between the results of the method tasks by children in their 6th year

	Scale	Probability	Cylinder	Cycles	Unusual Tree Drawing	What happens to be both at the same time?
Scale	1	***0,294***	***0,222***	0,031	0,000	-0,001
Probability		1	***0,181***	***0,203***	-0,085	-0,015
Cylinder			1	0,162	0,157	0,096

	Scale	Probability	Cylinder	Cycles	Unusual Tree Drawing	What happens to be both at the same time?
Cycles				1	***0,211****	0,165
Unusual Tree Drawing					1	0,116
What happens to be both at the same time?						1
*Note: *p < 0.05, **p < 0.01*						

Table 8

Correlations between the results of the method tasks by children in their 7th year

	Scale	Probability	Cylinder	Cycles	Unusual Tree Drawing	What happens to be both at the same time?
Scale	1	0,003	0,043	0,025	0,056	0,178
Probability		1	-0,004	0,094	-0,223	-0,063
Cylinder			1	0,123	-0,066	0,049
Cycles				1	-0,011	0,128
Unusual tree drawing					1	0,171
What happens to be both at the same time						1

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Discussion

Returning to the analysis of the results of the tasks to assess the developmental level of dialectical thinking in children, we note that it is important for us to determine how these indicators changed over the year. First of all, we can say that the development of dialectical thinking is not the main line of cognitive development in preschool children. Considering the outcomes of the *Drawing an Unusual Tree* technique shows clearly structural changes in children's cognitive development. Indeed, if the older kindergarten group executed 45 normative drawings, 36 symbolic drawings, and only 6 dialectic drawings, one year later the same children presented 16 normative drawings, 16 dialectic drawings and 55 symbolic ones. Thus, we can see that children's thinking in solving creative tasks by the beginning of school age was oriented toward using the mechanism of symbolization, which is characteristic of imagination. The same circumstance confirms the importance of play for developing preschoolers' imagination.

It should be noted that those preschoolers who used dialectical operations when constructing a graphic image, when they attended the older group, did not use dialectical operations in the prep group. It is noteworthy that those preschoolers who performed normative drawings in the prep group also did normative pictures a year ago. These outcomes indicate that there is a tendency to standardize children's thinking in favor of a formal-logical perspective (Smirnova, 2019; Rzhanova, Alekseeva, and Fominykh, 2020).

Based on the fact that the creative task was predominantly carried out by creating a symbolic image, we can draw the following conclusions: in the older preschool age the development of children's ability to create a creative graphic image occurs mainly due to the development of imagination; dialectical thinking is not supported by the educational culture of kindergarten.

The performance of the *Cycles* tasks, shown in Table 2 and on the High-Low chart (Fig. 9), shows that the maximum score achieved by a portion of the preschool group children is 15 points or close to it. This outcome indicates that there are preschoolers who reflect cyclical processes quite adequately. They understand that a cycle consists of two half cycles, that there are fragments of cycles that are opposite to one another. It means that they build representations of cyclic processes on the basis of actions of seriation, reversal and transformation. Thus, we can conclude that the dialectical actions of seriation, reversal, and transformation are the first to develop with the other dialectical actions developing at a later stage.

The outcomes indicate that the older preschool age is sensitive to the development of dialectical thinking operations such as seriation, transformation and reversal. At the same time, development occurs in leaps and bounds. The latter conclusion is based on the fact that the scores in the prep and senior groups are not related to each other.

The preschoolers found it difficult to perform the tasks of the *What happens to be both at the same time?* method based on the outcomes presented in Table 3 and on the High-Low chart

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(Fig. 10). Indeed, it should be noted that although the outcomes of the preschoolers were higher than those obtained by children a year ago when they attended the older group, the tasks of the *What happens to be both at the same time?* technique still caused some difficulties for the children. This is evidenced by the fact that the children's outcomes did not reach their maximum values. For example, in the *Cycles* method the average values received by the children differed from the maximum values by only one third, while for the *What happens to be both at the same time?* method the maximum values differed from the average by more than two times.

The outcomes allow the conclusion that the senior preschool age is sensitive for the development of the thinking operation of dialectical mediation. However, the development of this operation follows that of the understanding of cyclic processes and occurs in leaps and bounds. This conclusion derives from the fact that the scores in the preparatory and older group were unrelated.

As shown by regression analysis, predictors of success in the *Probability* task in the prep group were the indicators assessed when preschoolers attended the older group. The predictors included Piaget's probabilities (*Probability, Cylinder*) trials and dialectical thinking, as measured by the *Cycles* and *What happens to be both at the same time?* methods. This outcome testifies in favor of K. Riegel's position, but requires more thorough verification.

As follows from the data of the correlation analysis, there are significant, but rather inconspicuous links between the outcomes of the Piaget trials. They show that they represent the multiplication operation, which consists in conserving two features simultaneously in the process of analysis. This operation is a part of the mechanism of double perspective, which allows preschoolers to role play and develop imagination. This appears to account for a large number of children who have performed symbolic drawings of the unusual tree. The presence of such an image indicates the children’s preference to use mechanisms of formal-logical thinking to solve creative tasks rather than those of dialectical thinking.

Of interest is the connection between the outcomes of the *Probability* test and the outcomes of the *Cycles* technique. This link testifies to the fact that the mental operations of multiplication and those of reversal, transformation and mediation are part of a uniform cognitive structure. It may be a dialectical (cyclic) structure. Also of interest is the fact that there is a connection between the outcomes of performing the *Drawing of an unusual tree* method and the *Cycles* method. Probably, this connection is explained by the presence of the common dialectical operation of Transformation.

The outcomes of the study suggest that in Year 7, significant changes occur in the development of both formal and dialectical thinking in preschoolers. In particular, there are no correlations that were established in these children a year ago, when they attended the older kindergarten group. The established structure may be disintegrating. This outcome shows the heterochronic nature of the development of thought operations in formal-logical and dialectical thinking. It also

suggests that the operation of mediation is mastered by children later than those of transformation, reversal and seriation. It should be borne in mind that the use of the mediation operation also presupposes the use of the association operation. This may be the reason preventing children from mastering the mediation operation.

Conclusion

Dialectical thinking represents a special form of thought activity consisting in the ability to operate with relations of opposites. There are different ways of operating with relations of opposites (dialectical operations).

In preschool age the development of dialectical thinking is associated with mastering dialectical operations. At first the operations of seriation, transformation and reversal are mastered. Preschool age is sensitive to the development of dialectical thinking. Dialectical thinking participates in the development of formal-logical thinking and acts as a predictor of this development. This point corresponds to the position expressed by K. Riegel and needs further study.

Dialectical thinking is a cultural phenomenon. It is represented in folk literature in the form of fairy tales of the peoples of the world and is addressed to children. However, dialectical thinking is not supported by the educational system and is not considered as an important line of cognitive development of preschool children.

Dialectical thinking together with formal thinking can create cognitive structures whose units are thought operations. These structures are part of the mechanisms for solving creative tasks and allow preschool children to create original products. They have a dynamic character and can disintegrate.

The outcomes show that disintegration of correlational relationships occurs in preschool children in the 7th year of life, that is before school. It is possible that preparation for school may influence the developmental process of dialectical thinking by making it heterochronic. This proposition needs further study.

References

Afanasiev, A. N. (1986). Folk Russian fairy tales by A. N. Afanasyev. In 3 vols. T. 3. Science.

Veraksa, N. E. (1981). Features of the transformation of conflicting problem situations by preschoolers. Questions of Psychology, 3, 123–127.

Veraksa, N. E. (1987). Development of prerequisites for dialectical thinking in preschool age by preschoolers. Questions of Psychology, 4, 135–139.

Veraksa, N. E. (2006). dialectical thinking. Vagant.

Veraksa, N. E., Almazova, O. V., Airapetyan, Z. V., Tarasova, K. S. (2021). Heterochronism of the development of dialectical thinking in children of older preschool age. Psychological Journal,

42(4), 59–73. https://doi.org/10.31857/S020595920015202-8

Veraksa, N. E., Belolutskaya, A. K. (2021). Emotional and cognitive development of preschool children: analysis of foreign and Russian studies of the role of dialectical thinking in affect regulation and recognition of complex feelings. Bulletin of the Peoples' Friendship University of Russia. Series: Psychology and Pedagogy, 18(1), 104–121. https://doi.org/10.22363/2313-1683-2021-18-1-104-121

Vygotsky, L. S. (1982). Collected works: in 6 volumes. Vol. 1: Questions of theory and history of psychology. Pedagogy.

Davydov, V. V. (1972). Types of generalizations in teaching. Pedagogy.

Davydov, V. V. (1986). Problems of developmental education: the experience of theoretical and experimental psychological research. Pedagogy.

Zadadaev, S. A. (2012). Methods of structural dialectics. The border.

Ilyenkov, E. V. (1979). The problem of contradiction in logic. In Dialectical Contradiction (pp. 122–143). Politizdat.

Kopnin, P. V. (1962). Dialectical logic and its relation to formal logic. In B. M. Kedrov (ed.), Dialectics and Logic. Laws of thought (pp. 33–62). Academy of Sciences of the USSR.

Maltsev, V. I. (1953). Dialectical materialism and questions of logic (doctoral dissertation). Moscow.

Pronenko, E. A., Bunyaeva, M. V. (2019). Features of semantic processes and phenomena in team interaction. Russian Psychological Journal, 16(1), 32–51. https://doi.org/10.21702/rpj.2019.1.2

Rzhanova, I. E., Alekseeva, O. S., Fominykh, A. Ya. (2020). Gender differences in indicators of the cognitive sphere in children of preschool and primary school age Bulletin of the Moscow University. Series 14. Psychology, 2, 141–157. https://doi.org/10.11621/vsp.2020.02.07

Smirnova, E. O. (2019). The specifics of modern preschool childhood. National Psychological Journal, 2(2), 25–32. https://doi.org/10.11621/npj.2019.0205

Shiyan, O. A., Belolutskaya, A. K., Le-Van, T. N., Zadadaev, S. A. (2021). Cognitive development of preschoolers: the relationship of normative, transformative and symbolic abilities. Modern preschool education, 6, 14–25. https://doi.org/10.24412/1997-9657-2021-6108-14-25

Basseches, M. (1984). Dialectical thinking and adult development. Ablex.

Basseches, M. (2005). The development of dialectical thinking as an approach to integration. Integral Review, 1, 47–63.

Ferraz, I. P. R., Viana, F. L. P., & Pocinho, M. M. F. D. D. (2018). Piaget's logical operations, phonological awareness and letter knowledge in preschool education. Calidoscópio, 16(1), 4–15.

Over, D. E. (2009). New paradigm psychology of reasoning. Thinking & Reasoning, 15(4), 431–438. https://doi.org/10.1080/13546780903266188

Peng, K., & Nisbett, R. E. (2000). Dialectical responses to questions about dialectical thinking. American Psychologist, 55(9), 1067–1068. https://doi.org/10.1037/0003-066X.55.9.1067

Piaget, J. (2008). Las formas elementales de la dialectica. Gedis.

Piaget, J., & Inhelder, B. (1966). La psychologie de l'enfant. Presses Universitaires de France.

Riegel, K. F. (1973). Dialectic operations: The final period of cognitive development. Human Development, 16(5), 346–370. https://doi.org/10.1159/000271287

Spencer-Rodgers, J., Anderson, E., Ma-Kellams, C., Wang, C., & Peng, K. (2018). What is dialectical thinking? Conceptualization and measurement. In J. Spencer-Rodgers & K. Peng (Eds.), The psychological and cultural foundations of East Asian cognition: Contradiction, change, and holism (pp. 1–34). Oxford University Press. https://doi.org/10.1093/oso/9780199348541.003.0001

Veraksa, N., & Veresov, N. (2018). Dialectical thinking research in the early years. In N. Veraksa, S. Sheridan (Eds.), Vygotsky's theory in early childhood education and research: Russian and Western values (pp. 25–37). Routledge.

Wang, W.-Ch. (2006). Understanding dialectical thinking from a cultural-historical perspective. Philosophical Psychology, 19(2), 239–260. https://doi.org/10.1080/09515080500462420

Zhang, B., Galbraith, N., Yama, H., Wang, L., & Manktelow, K. I. (2015). Dialectical thinking: A cross-cultural study of Japanese, Chinese, and British students. Journal of Cognitive Psychology, 27(6), 771–779. https://doi.org/10.1080/20445911.2015.1025792

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Information about the conflict of interest

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