

VI International Forum on Teacher Education

## Associations between Cognitive Outcomes and Emotion Recognition among Preschoolers

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### Abstract

The present study intends to address associations between dialectical thinking of 6-7 years old children and their emotional and executive functioning development. Participants were 152 children. One method was used to assess their emotion recognition by facial expression. Executive functioning was assessed in accordance with the Miyake model, which distinguishes three components of that: working memory, cognitive flexibility, and inhibition control. Dialectical thinking was assessed using three techniques aimed at analyzing children's understanding of the principle of cyclicity, ability to identify contradictions and find opposites to phenomena. Also, a number of parents was interviewed using the questionnaire, which allowed for additional analysis of associations between dialectical thinking and demographic variables such as the number of children in families, the level of mother's education and family income level. The results showed that understanding of the cyclicity principle is related to executive functioning. In turn, all three indicators of dialectical thinking were significantly related to emotion recognition. Taken together, these results suggest that dialectical thinking is associated with emotional knowledge and executive functioning in 6-7 years aged children.

*Keywords:* formal-logical thinking; dialectical thinking; emotion recognition; emotional understanding; executive functioning; cognitive flexibility; working memory; inhibition control.

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Published by Kazan federal university and peer-reviewed under responsibility of IFTE-2020 (VI International Forum on Teacher Education)

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## **Introduction**

The research on the relationship between the intellectual and emotional development of children has a long tradition. Lev Vygotsky (2017) pointed to the unity of affect and intelligence. He emphasized that understanding cognitive and emotional development is possible only when considering "changes in their inter-functional connections and relations" (p.142). Jean Piaget also was concerned with the relationship between the intellectual and emotional development of the child (Bringuier & Piaget, 1989). At the same time, he emphasized that emotions do not affect the structure of the thought process, but can stimulate or inhibit it. If we compare approaches of Lev Vygotsky and Jean Piaget, then we see their difference in the fact that according to Lev Vygotsky emotions influence structure of intellectual process while in Jean Piaget's theory such influence is excluded.

Two types of thinking are distinguished in the cognitive development of children and adults: formal-logical and dialectical thinking. It appears first as a development of formal intellect (according to Jean Piaget), and then as a stage of postformal intellect in the form of dialectical thinking of adult subjects (Riegel, 1973; Over, 2009). The description of the process of dialectical thinking itself is based on Hegel's scheme "thesis-anti-synthesis" (Basseches, 1984). Dialectical thinking is a form of mental process different from formal logical thinking and associated with the ability to operate with opposites (Andreev, 1985; Bringuier, Piaget, 1989). Dialectical thinking plays an essential role in the cognitive, moral and creative personal development because of this individual can analyze the development of processes and objects (Andreev, 1985; Bringuier & Piaget, 1989; Veraksa, 2006). In the light of the structural-dialectical approach, dialectical thinking is regarded as creative, productive thinking which is effective in dealing with challenges, reflecting the transitions of developing processes (Bringuier & Piaget, 1989; Veraksa, 2006). We assume that emotional knowledge and self-regulation skills can also be seen as cyclical processes with different phases.

To date, a large amount of data indicating the connection between formal-logical cognitive and emotional development of preschool children has been obtained. However, the connection between dialectical thinking and emotion development remains unexplored. The purpose of our study was to analyze this connection in a sample of older preschool children. We suggest, the lack in dialectical thinking can probably slow down child's emotion recognition because they can probably be considered as evolving processes with their inherent transitions. Therefore, the primary aim of the current study was to investigate association between dialectical thinking and emotion recognition in children aged 6-7 years.

### **Purpose and objectives of the study**

The purpose of our study was to analyze this connection in a sample of older preschool children. We suggest, the lack in dialectical thinking can probably slow down child's emotion recognition because they can probably be considered as evolving processes with their inherent transitions. Therefore, the primary aim of the current study was to investigate association between dialectical thinking and emotion recognition in children aged 6-7 years.

### **Literature review**

The importance of dialectical thinking for emotional development and academic achievements among children aged 6-7 years are indirectly confirmed in empirical studies (Coplan & Weeks, 2009; Rhoades et al., 2011; Torres et al., 2015; Izard et al., 2001; Siyan, 2016). The results of studies indicated that a child's emotional knowledge can be part of various cognitive processes that representing, in fact, dialectical structures. Coplan and Weeks (2009) mentioned that for academic success at school children should be able to manage their own behavior and attention processes, as well as to be quite emotionally competent which in turn are the units of dialectical mediation. Dialectical mediation is the one of dialectical acts which allows an individual to find for pair of oppositions some construct in which these oppositions are present simultaneously. This dialectical action can be illustrated by the child's behavior in the classroom: the child should be emotionally involved in the learning process and in interaction with the teacher and peers, but at the same time he/she has to follow established rules. In study of Rhoades et al. (2011) a dialectical mediation between emotional development and academic performance, where attention became an intermediary link, was introduced. Torres et al. (2015) showed that peers communication acted as a mediator of the mediation act for emotional development and academic success. Izard et al. (2001) also considers the dialectical structure of mediation, which consists of three components: "emotion knowledge", "verbal abilities" and "academic competence". It should be noted that these studies did not address associations between dialectical thinking and the emotional development directly. However, the results suggest that children experiencing difficulties in applying dialectical thinking (primarily, the action of mediation), may have a number of difficulties in emotional development (in emotion recognition and emotional understanding). Question at issue is that changes in the person's emotional states are cyclical processes of transformations reflected in changes in his or her mimicry and posture.

### **Methodology**

A sample of participants was recruited from kindergartens located in Moscow. Participants of the study were 152 typically developing children (53,9% boys). The age of children was 6-7 years ( $M = 79.99$

months,  $SD = 4.43$ ). All parents provided informed consent for their children participation in the current study. The study was agreed with the Ethical Committee of the Russian Psychological Society. The assessment was carried out individually in a quiet, bright rooms located in kindergartens. Due to the long duration of all the methods, it was decided to split up the assessment into three sessions, each of which took less than 20 minutes on average. The study was conducted in the autumn of the 2019.

The study used the following diagnostic tools:

- *Affect Recognition subtest of NEPSY-II* was used to assess the ability of children to recognize emotions by facial expression (Korkman et al., 2007). In this technique, children are shown photographs and are offered to choose among them only those in which the person experiences certain emotions. To avoid the influence of children's verbal abilities on the diagnosis result, children are asked just to point to certain photos, rather than to name the emotions themselves. The instruction in this technique sounds as follows: "Look at this child (pointing to a photo). Can you find and show me the photo with another child on this page who feels the same way?".
- Cognitive development assessment was conducted in two aspects: formal-logical and dialectical thinking. Aspect of formal-logical was assessed to control child's non-verbal intelligence using the method *Raven's Color Progressive Matrixes* (Raven et al., 1991). For each correct answer the child was assigned 1 point. After 4 mistakes in a row the testing stopped. The minimum score was 0, the maximum score was 36.
- The task *What Can Be Simultaneously* was used to assess child's ability to carry out a thought-provoking facilitation operation (Veraksa & Zadadaev, 2012). In this technique, the child is asked to find examples of objects, processes and phenomena that contain the mediation of opposites. The technique contains five questions, such as this one: "What can be black and white at the same time?". Answers to each of the questions were rated on a scale from 0 to 2 points.
- The *Cycles task* was used to assess the child's understanding of the processes of situation development which is the simplest dialectical structures (Veraksa, 2006). In this task the child is asked to model natural and everyday processes from five cards that illustrate the stages of the processes. The instruction in this method sounds as follows: "Place the pictures in such a way that will tell the whole story". The technique contains five samples, each of which shows all stages of cyclic processes. There can only be one correct card arrangement that conveys the correct order of the development process.

- An *Unusual Tree* task has been used to assess the strategies by which a child prefers to think (Veraksa, 2006). The child is asked to draw an unusual tree. This task allows to analyze the process of child's creative thinking and assess the extent to which he or she uses dialectical thinking. It helps trace the sequence of using the means of formal and dialectical logics within the process of solving an unstructured creative problem. The drawings were assessed on a scale from 0 to 2 points depending on the nature of the transformation of the notion of an ordinary tree. If the drawing did not differ from the usual tree, a score of 0 was awarded. In the partial transformation of the notion of a normal tree, the work was awarded 1 point. 2 points were awarded if the drawing, on the one hand, kept the idea of the tree and, at the same time, cardinally changed it. As an example, the drawing of an inverted tree, which grows upside down with its roots on top and its crown on top. revised knowledge test of the fundamentals of family law and its regulations and codes, which allows exploring the cognitive component of adolescents' readiness for family life.

### **Experiment description and procedure**

The analysis of the data obtained was conducted in two stages. In the first stage, a preliminary analysis of the links was carried out to identify and control variables that could affect the purity of further analysis. At this stage, we conducted Spearman's correlation analysis to analyze the links between the indicators of dialectical thinking and child's sex, age non-verbal intelligence coefficient and demographic characteristics of the families in which child are brought up. At the second stage, Spearman's correlation analysis was aimed at revealing the links directly between dialectical thinking and the indicators of children's emotional development. All statistical analysis operations were performed in SPSS 19.0 (IBM, SPSS Software, Armonk, New York, USA). Links and differences were considered statistically significant at  $p < 0.05$ .

### **Results**

The majority of the interviewed mothers have higher education (84.0%); specialized secondary education (13.3%); a small number of mothers have incomplete higher education (1.3%); several mothers in our sample have an academic degree (1.3%). Relative to the financial and economic situation, the most of parents described their families as belonging to the middle-income social class (79.5%), below average or insufficient (14.7%), above average (6.8%). The majority of the interviewed families raise one child (46.2%); two children (37.2%); and three or more (16.7%). The second and third columns of Table 1 provide descriptive statistics on the demographic variables of the sample being studied, as well as on all parameters of mental development of children under consideration.

The results of the study are given in the Tables 1-3.

Table 1. Descriptive statistics for all analyzing variables

	<b>M</b>	<b>SD</b>	<b>N</b>
<b>1. Age (in months)</b>	79.99	4.43	152
<b>2. Number of siblings</b>	1.71	0.74	78
<b>3. Mother's education</b>	3.73	0.70	75
<b>4. Family income</b>	2.90	0.53	73
<b>5. Raven's Progressive Matrices</b>	15.09	7.15	77
<b>6. What Can Be Simultaneously</b>	3.74	2.24	152
<b>7. Cycles</b>	24.86	9.71	152
<b>8. An Unusual Tree</b>	0.94	0.66	151
<b>9. Affect Recognition (AR)</b>	9.15	2.51	74

<sup>1</sup>Mother's education: 1 = secondary and incomplete higher education, 2 = college education, 3 = higher education, 4 = scientific degree. <sup>2</sup>Family income: 1 = insufficient class, 2 = low-income class, 3 = middle-income class, 4 = high-income class.

The normality of scores distribution on indicators of children's dialectical thinking was tested using the Kolmogorov-Smirnov criterion. The results by three methods (What Can Be Simultaneously, Cycles, An Unusual Tree) do not correspond to the normal distribution. Further analysis will be carried out using non-parametric criteria.

Spearman's correlation analysis was used to pre-analyze the links between the indicators of dialectical thinking and children's sex, age, non-verbal IQ of children, and demographics of the families. The results of the preliminary correlation analysis are presented in Table 2.

A preliminary analysis has been made to identify and control certain variables that may affect the purity of further analysis. The data in Table 2 shows that the non-verbal IQ, number of children in families, mother's education and family income are not related to dialectical thinking in the sample under study. However, the sex of the child turned out to be significantly inversely related to the results of the What Can Be Simultaneously task. In the data set, boys were coded as "1" and girls as "2". Thus, we can see that boys done the task significantly better than girls. Because the sex is a nominal variable, we further also analyzed

this link using a non-parametric Mann-Whitney criterion. Comparison of the averages showed that boys are indeed better than girls at the What Can Be Simultaneously task ( $U = 2332,00$ ;  $p = .45$ ). Another identified significant link is between the age of the children and their results in the Cycle task. This association indicates that older children are understanding the principle of cyclicity of natural and everyday processes more successful than younger children. This table is also indicative in several other perspectives. First, we see that understanding the principle of cyclicity is closely related to the age of children, unlike the other two indicators of dialectical thinking. Second, results indicate that there are clear and meaningful associations between all three indicators of dialectical thinking.

Table 2. Results of Spearman correlations analysis of demographic variables

	1	2	3	4	5	6	7	8
<b>1. What Can Be Simultaneously</b>	-							
<b>2. Cycles</b>	.242**	-						
<b>3. An Unusual Tree</b>	.171*	.199*	-					
<b>4. Sex</b>	-.163*	0.02	0.007	-				
<b>5. Age</b>	0.07	.305**	0.084	0.023	-			
<b>6. Raven's Progressive Matrices</b>	0.057	0.132	-0.077	-0.089	0.067	-		
<b>7. Number of siblings</b>	-0.001	-0.108	-0.042	-0.111	-0.073	-0.019	-	
<b>7. Mother's education</b>	-0.069	0.08	0.064	0.175	-0.08	0.09	-0.025	-
<b>9. Family income</b>	0.034	0.082	0.024	0.083	0.074	0.13	0.088	.278*

<sup>1</sup>Sex: 1 = boys, 2 = girls. <sup>2</sup>Mother's education: 1 = secondary and incomplete higher education, 2 = college education, 3 = higher education, 4 = scientific degree. <sup>3</sup>Family income: 1 = insufficient class, 2 = low-income class, 3 = middle-income class, 4 = high-income class. \*  $p < 0,05$  (2-tailed); \*\*  $p < 0,01$  (2-tailed).

Further statistical analysis was aimed to identify the links between dialectical thinking and emotional development. The results of Spearman's correlation analysis revealed a positive correlation between dialectical thinking and both indicators of emotional knowledge (see Table 3).

Table 3. Results of Spearman correlations analysis for research variables

	1	2	3	4
<b>1. What Can Be Simultaneously</b>	-			
<b>2. Cycles</b>	.242**	-		
<b>3. An Unusual Tree</b>	.171*	.199*	-	
<b>4. Affect Recognition</b>	0.01	0.181	-.285*	-

\*  $p < 0,05$  (2-tailed); \*\*  $p < 0,01$  (2-tailed).

The indicators of emotional knowledge were significantly related to all three indicators of dialectical thinking. The ability of children to invent and paint an unusual tree is significantly backward connected with the number of mistakes made in the performance of the task to recognize emotions ( $r = -.285$ ;  $p = .014$ ). In other words, children with high results according to the An Unusual tree method are significantly better able to cope with the tasks of emotion recognition by facial expression.

## Discussions

Current study was conducted to analyze associations between dialectical thinking and emotional development of children aged 6 – 7 years. Three indicators of dialectical thinking were analyzed: understanding of the principle of cyclicity, ability to identify contradictions and find opposites to phenomena. As mentioned in the introduction, we did not find direct references to the development of dialectical thinking among 6-7 years old children in previous publications. This may be due to the fact that the overwhelming majority of modern researchers of thinking are followers of Jean Piaget, who considered dialectical thinking only as a form of thinking activity, typical for the post-formal stage of intelligence development in adults (Piaget & Inhelder, 1973; Riegel, 1973). In this case, the existence of dialectical thinking among children aged 6-7 years is not in the scope of research.

Preliminary analysis showed that only one indicator of dialectical thinking out of three is related to child's age. This indicator is the understanding of the cyclicity principle. That means, as child grows up, he or she shows significantly better results in understanding the principle of cyclicity of natural and everyday processes. This result is interesting in that it shows that, unlike the cyclical principle, two other indicators of dialectical thinking - the understanding of contradictions and the understanding of opposites - are not

related to child's age. In other words, children can handle these tasks equally well regardless of their biological age. The maximum difference in biological age in the sample studied was 12-13 months. This result can be seen as evidence that dialectical thinking is not directly related to age and can be developed even among children aged 6-7 years old. Another result of the preliminary analysis indicates that there is a connection between child's sex and the ability to find contradictory examples in the environment. According to the data obtained in the study, boys performed this task significantly better than girls. Also, in the current study there was not revealed any association between non-verbal intelligence and dialectical thinking. The absence of this connection allows us to exclude the influence of a side variable on the results.

With regard to the links between dialectical thinking and the emotional development of children, it was found that emotion recognition was significantly related to one of the indicators of dialectical thinking studied. Emotion recognition was related to the ability of children to find and build opposites for certain phenomena or objects (An Unusual tree). A possible explanation for these results may be conditioned by the processing of visual information: both tasks are based on the work with visually represented material. On the other hand, this connection can be explained by the child's comprehension of emotions with the help of opposite states: joy - sadness, calmness - anger, calmness - fear. Moreover, the instruction in this task sounds as follows: "Look at this child (pointing to a photograph). Can you find and show another child on this page who feels the same way about him/her? In this sense, in order to perform this task the child needs to navigate through the concepts of "same" and "different".

Current study results are consistent with the findings of Coplan and Weeks (2009), Rhoades et al. (2011), Torres et al. (2015) and Izard et al. (2001), who have shown that high cognitive development of children does not guarantee high academic success, because in order to solve practical life tasks, cognitive development must be mediated by additional units, such as, for example, child behavior, attention development, and self-regulation and emotional competence. In fact, this mediation is a dialectical structure that the child either produces or does not produce. In other words, even if the child has outstanding data, child may still experience difficulties in learning and solving practical social problems if he or she does not apply dialectical thinking.

## **Conclusion**

Thus, the results of this study suggest that there are links between dialectical thinking and emotional development of children controlling for non-verbal intelligence and demographical variables. This result confirms the Vygotsky-Piaget formula about the identity of affect and intellect. Based on the results of this

study, we suppose that creating conditions in which children develop not only formal-logical but also dialectical thinking would also increase the ability of children to recognize emotions by facial expression.

### Acknowledgements

This research was funded by the Russian Fund for Basic Research grant number 19-013-00475.

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