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**BEHAVIORAL CONTROL AND THEORY OF MIND IN
PRESCHOOLERS WITH TYPICAL DEVELOPMENT AND
SPECIFIC LANGUAGE IMPAIRMENT**

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Abstract

The article considers the mutual relations of theory of mind, behavioral control and language. Behavioral control has three components: cognitive control, emotional control and control of action. Behavioral control is assessed by the Day-Night task, the Test of Child Anxiety by Tamml, Dorky and Aman and a series of neuropsychological tasks. Theory of mind is assessed by the following tasks: visual perspective understanding tasks, the task for the understanding of desires, the task for the understanding of “seeing leads to knowing”, the first-order false belief task and the understanding of false belief and deception in stories task. Verbal and non-verbal mental age is assessed by the Wechsler Preschool and Primary Scale of Intelligence-III. 25 typically developing children and 25 children with specific language impairment 4-5 years old (48-71 months old, 29 males) have participated in the study. The results of typically developing children and children with specific language impairment matched for verbal and non-verbal mental age, and chronological age are compared. The children with specific language impairment have lower overall score theory of mind (generalized indicator of tasks) and the poorer control of action (motor skills) than typically developing children. The relationship between language and the development of theory of mind and behavioural control are discussed.

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1. Introduction

Among mental abilities which developing intensively during the first years of life there are theory of mind (ToM) and self-regulation.

ToM is an ability of social understanding. It suppose that one understands that other people have mental states, beliefs, knowledge, emotions, attitudes and so on like oneself's own. It is fundamental ability for understanding lies, false beliefs, humor, irony and another point of view in wide sense.

Self-regulation we consider as behavioural control. It is an integrative ability including cognitive, emotional and volitional component. It plays a crucial role in goal-directed behavior organizing mental resources for goal achievement. It consists of three interrelated components: cognitive control (close to executive functions), emotional control and control of action.

Both these abilities are studied widely and intensively and a lot of factors and conditions are discovered now. One of the most important conditions for successful development of ToM and self-regulation is an adequate level of speech development.

A lot of studies dedicate to relations between speech and ToM and self-regulation. Some of them investigate a development of ToM and executive functions (EF) as an important part of self-regulatory capacities in children with language impairment. They are shown a poorer performance in ToM and EF tasks in children with specific language impairment comparing with typically developing children but it is unclear is it relate with language delay specifically or these children have some features beyond speech impairment which conditioned delays in development of ToM and self-regulation.

The role of language in the development of ToM is also great, a certain level of its development is necessary for a successful understanding of the mental world of another person (Sergienko, Lebedeva, & Prusakova, 2009). The findings of early comparative researches of the development of theory of mind in typically developing children, children with autism and children with SLI were initially interpreted as demonstrating intact ToM in children with specific language impairment (SLI) (Leslie & Frith, 1988; Ziatas, Durkin, & Pratt, 1998). However, because these researches involved children with SLI whose chronological age was much older than the age at which explicit false belief understanding typically develops (4-5 years) and there were few research participants, it left open the possibility of delayed ToM development in children with SLI.

2. Problem Statement

Throughout the early school childhood (4-6 years), there is a close relationship between the EF and speech (Carlson, Davis, & Leach, 2005; Gooch, Hulme, Nash, & Snowling, 2013; Müller, Jacques, Brocki, & Zelazo, 2009). Children with a specific language impairment are delayed in EF, they show poor inhibition, weakened fluency and updating, planning and working memory (Gooch, Thompson, Nash, Snowling, & Hulme, 2015; Wittke, Spaulding, & Schechtman, 2013). When children with SLI are matched to typically developing children for age and non-verbal IQ similar results were obtained (Reichenbach, Bastian, Rohrbach, Gross, & Sarrar, 2016). It was found that children with SLI (5 years old) have poorer auditory short-term memory, and there is also a tendency to lower results on inhibition and speed of

information processing when comparing with typically developing children. However, these groups were not matched by verbal mental age.

Close to these findings are results obtained by Henry, Messer, & Nash (2012), where children with SLI were compared with children having a mild delay in speech development and with typically developing children. Even controlling age, non-verbal IQ and verbal IQ, children with SLI show the poorest performance of tasks on verbal and non-verbal working memory, verbal and non-verbal fluency, non-verbal inhibition and non-verbal planning among three groups.

Acosta Rodríguez, Ramírez Santana, & Hernández Expósito (2017) examining typically developing children and children with speech disorders found a different profile of EF impairments depending on whether only the expressive speech is affected or receptive one as well (in the latter case, the impairments are more extensive). However, in both groups of children EF impairment were not limited to verbal tasks, but also extended to non-verbal ones.

The analyzed data suggest that the delay in self-regulation in children with SLI is not caused only by speech delay and is not limited to functions related to speech. Perhaps, these children have any specific disorders in the development of self-regulation that are not associated only with speech delay's restrictions.

The results of more recent ToM research have found that SLI is associated with delayed development of ToM (Farrant, 2016; Jester & Johnson, 2016; Andrés-Roqueta, Adrian, Clemente, & Katsos, 2013). Thus, the meta-analysis of 17 studies involving a total of 745 children aged 4-12 years old finds that children with language impairment had a significantly lower level of ToM development than typically developing children at the same age (Nilsson & López, 2016).

3. Research Questions

- Are there any differences in behavioural control between children with and without SLI when they are on a par on chronological, verbal and nonverbal mental age?
- Are there any differences in ToM between children with and without SLI when they are on a par on chronological, verbal and nonverbal mental age?

4. Purpose of the Study

The aim of this study is the comparison of the development of the behavioral control and ToM of preschoolers with specific language impairment and typically development matched by chronological age, verbal and non-verbal mental age.

If we find some differences, it will be mean a specificity in development of children with language impairment which do not relate with speech delay only.

5. Research Methods

5.1. Subjects (cases)

The subjects under test were 50 children at the age of 4-5 years old, 25 children with SLI and 25 typically developed children matched to chronological age and verbal and non-verbal mental age (characteristics of both group are shown in table 1).

Table 01. Characteristics of the subjects

Groups	Children N	Sex (m/f)	Chronological Age Range (Median)	Verbal mental Age Range (Median)	Non-verbal mental Age Range (Median)
Typically developing children	25	13/12	48-69 (62)	36-72 (54)	36-84 (63)
Children with specific language impairment	25	16/9	53-71 (61)	33-69 (54)	33-81 (63)

The chronological age, verbal and non-verbal mental age of the children with SLI were not significantly different from that of the matched subgroup of typically developing children ($U = 302.5$, $p = .846$; $U = 278$, $p = .501$; $U = 303$, $p = .852$).

5.2. Methods

The tasks to understand the visual perspective of first and second levels, to understand the desires, the principle of the "seeing leads to knowing", the false beliefs (similar to "the Sally-Anne test"), the false beliefs in stories ("Little Red Riding Hood") and the deception in stories ("Masha and the Bear" - Russian folk story) (Baron-Cohen, 2000; Vilenskaya & Lebedeva, 2014) were used to assess theory of mind. All the variables of ToM were measured on the basis of dichotomous scale: 0 = the task was not performed correctly; 1 = the task was performed correctly. Overall score of theory of mind was the sum of all tasks performed (The Cronbach's alpha is 0.731).

Behavioural control was assessed by the following methods:

- cognitive control by means of the Day-Night task (Gerstadt, Hong, & Diamond, 1994). The number of errors was recorded (the range of 0-18).
- control of the actions by means of some tasks from the Ozeretsky scale (Golovei & Rybalko, 2001); for children of 5 years of age as well as the tasks from the Luria's neuropsychological battery (Akhutina, 2016) (the range of 0-7).
- emotional control with the help of the Children Anxiety test of Temml-Dorki-Amen (the range of 0-100%).

The assessment of verbal mental age of children was carried out using the Wechsler Preschool and Primary Scale of Intelligence Test- III (Ilyina, 2006), the subtest "Vocabulary" as the most revealing in its series.

For statistical analysis we used Statistica 6.0. and SPSS 19, with nonparametric Spearman rank order correlation. We used Fisher's angular transformation criterion to determine the differences in the success of performing certain tasks on theory of mind (ϕ).

The session lengths and number of sessions were adapted to the children needs and school schedules.

6. Findings

6.1. Behavioural control's tasks performance

The results of children behavioural control tasks' performance are presented in table 2.

Table 02. Behavioural control in children with SLI and typically developing children, descriptive statistics

Variable	Children with SLI			Typically developed children		
	Valid N	Median	Std.Dev.	Valid N	Median	Std.Dev.
Anxietiesness	25	43,0000	12,31557	25	42,0000	20,15755
Motor Tasks	25	68,0000	13,87480	25	60,0000	13,89544
Day-Night	25	0,5000	6,60808	24	0,5000	6,77267

In table 3 the results of comparison two samples are presented (Mann–Whitney U-test was used).

Table 03. Differences between children with SLI and typically developing children.

Variables	Rank sum	Rank Sum	U	Z	p-level
Anxietiesness	637,50	637,50	312,50	0,00	1,00
Motor tasks	773,50	637,50	176,50	2,64	0,008
Day-Night	602,00	623,00	277,00	-0,46	0,65

We found differences only in performance of motor tasks (in the table in bold).

Recently, a lot of studies investigate relation between EF and motor development in childhood. Oberer, Gashaj, & Roebbers (2018) report about relation between visual-motor coordination in children from 5 to 6 years. In 5-6-year-old children, inhibition (Stroop test) is associated with the performance of motor tasks (Pennequin, Sorel, & Fontaine, 2010). Another interesting study was done by Houwen, Kamphorst, van der Veer, & Cantell (2019) where authors analyzed the results of 3-4-year-old children performed by motor tasks. As a result, 3 profiles of children's abilities were identified. When examining the likelihood of ADHD symptoms and motor disorders, it became clear that children with ADHD syndrome and motor disorders are more likely to have Profile 2 than Profile 1 and 3 more likely, and more likely to have Profile 3 than 1. Language development, gender and age are not significant. Thus, the difference in motor skills in children can reflect basic impairment of EF in children with speech disorders. We assume that behavior control is the integrative system, that is, differences in the control of actions (the most early developing component, the basis for the development of control of behavior in general) may reflect early developmental disorders leading to a delay as in speech development as in behavioral control.

6.2. ToM tasks performance

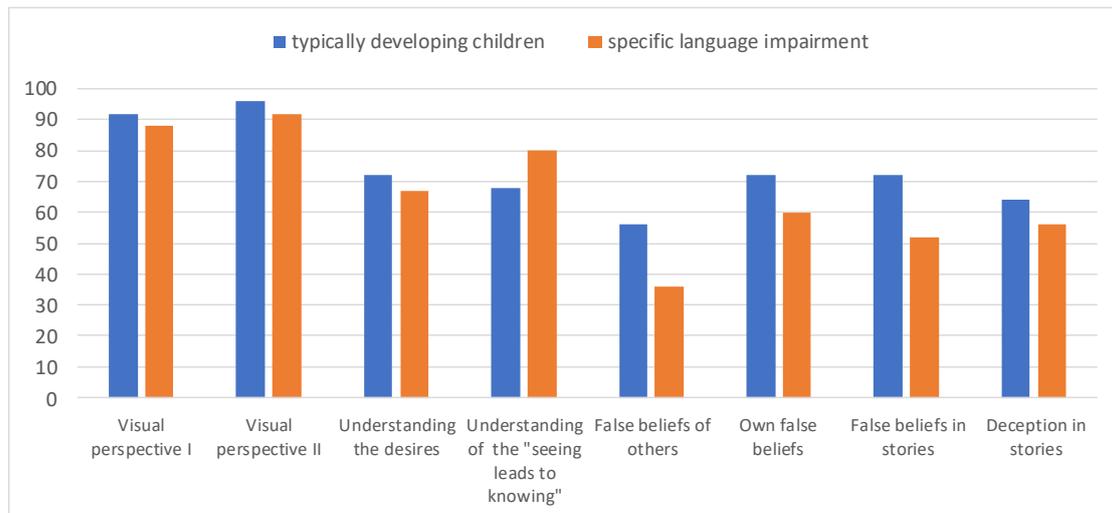


Figure 01. Results of ToM tasks performance (%) by 4-5-year-old typically developing children and children with language impairment

According to our findings presented in Figure 01, there were no significant differences in ToM certain tasks performance between 4-5-year-old typically developing children and children with language impairment. But there were the significant differences in the overall score of ToM ($U = 149.5$, $p = .001$). This indicator was significantly lower in children with SLI than 4-5-year-old typically developing children. The difference between the performances of the groups on the false belief tasks was also in the expected direction but was only marginally significant. Probably, increasing the number of study participants will make these differences more significant.

The present results are consistent with previous research demonstrating slower development of ToM in children with SLI (Farrant, 2016; Jester & Johnson, 2016; Andrés-Roqueta et al., 2013). In recent study the performance of a group of children with SLI on a range of ToM tasks was compared with the performance of a group of typically developing children matched for non-verbal ability, gender, and age (Farrant, 2016). It was found that the children with SLI scored significantly lower on the diverse desires, knowledge access, contents false belief and low verbal false belief tasks compared to the matched group of typically developing children. The author concluded that children with SLI experience delays in the development of a range of ToM skills.

In recent mini review was concluded that children with SLI have problems with emotion recognition and understanding, false belief understanding compared to age-matched control children (Vissers & Koolen, 2016).

7. Conclusion

The current study found that, compared with the performance of typically developing children matched for verbal and non-verbal intelligent, and age, children with SLI performed significantly less well on a range of ToM and the control of actions. We can suppose that children with SLI difficulties in behavioural control and social understanding don't relate with verbal and non-verbal IQ only. Thus, the

current findings provide further support for a relationship between language and the development of theory of mind and behavioural control in pre-schoolers.

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