



## **Measuring the Level of Development of Neuropsychic Functions in the fields of Language and Memory in Preschoolers**

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### **Abstract**

*The main purpose of the research was to assess the level of language development in correlation with mnemonic function in preschool age. A formative psycho-pedagogical experiment was performed. The research involved two categories of preschool children aged between 5 and 7 years: with typical development and language disorders (pronunciation-polymorphic dyslalia). The NEPSY test battery was applied to assess the level of development of neuropsychic functions. The research results demonstrated the existence of statistically significant differences between preschoolers with typical development and preschoolers with polymorphic dyslalia, from the perspective of the investigated psychic levels, respectively language and memory.*

**Key words:** Language disorder; language; memory; neuropsychic functions; NEPSY battery

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## 1. Introduction

Among the oral language disorders, the most common are articulation disorders, which are defined in the literature by the impossibility of correctly emitting one or more sounds and consist of distortion, omission, substitution, replacement or reversal of sounds in spontaneous speech and reproduced. Vrăsmăș and Preda (2010) observed that the presence of language disorders, if not treated properly, can predispose to serious disturbances of the regulatory and self-regulatory function of language, which prevents a good organization of mental life, self-actualization - is deficient and causing a decrease in self-confidence. In the absence of adequate social interactions, the child's ability to learn to identify and name their own emotions and feelings is affected, reaching to appreciate the situations of interaction incorrectly, and the language itself does not have the conditions to develop properly. Regarding specific language disorders, Paul (2007) described two theories: *the theory of auditory processing deficit*, which shifts the emphasis on auditory input, which is of decisive importance in the processing of verbal stimuli and in language acquisition; *the theory of limited processing capacity*, which highlights the fact that mnemonic disorders are responsible for certain forms of language disorders.

It is known in the literature that, in most cases, a child with dyslalia will also have dyslexia, when he enters the school environment, as stated by Verza (2003) and Vrăsmăș (2007). Visu-Petra and Cheie (2012) addressed pronunciation disorder (dyslalia) and reading disorder (dyslexia) as learning difficulties or developmental disorders, showing that in recent years they are no longer considered distinct, but rather on a continuous axis, being maintained by deficits at the level of working memory (Ioan, 2007, p.95). Gathercole et al. (1994) have described several psychological mechanisms involved in tasks that require the repetition of pseudo-words in high and preschool children (phonological working memory, phonological analysis and articulatory processing), mechanisms that are related to three important language acquisitions: vocabulary acquisition, language comprehension and reading. Cowan (2014) concluded in a study that limiting ML capacity has a negative impact on cognition, development and learning in both typical and atypical children and affects the ability to extract information and learn skills. basis in mathematics, language and social interactions.

We advanced the purpose of the research to study the peculiarities of language development and communication *in relation to the mnemonic function*, in older preschool children. We initiated an experiment in which preschool children participated, aged between 5-7 years with speech disorders (pronunciation-polymorphic dyslalia) and children with typical development, respectively 80 and 70. Next we refer to the results received on the Language segment and Memory and Learning, areas included in the NEPSY Test Battery.

The main purposes of the research were:

- to evaluate the level of phonological processing and receptive and expressive language skills in relation to chronological age;
- to measure the level of memory functioning in relation to the chronological age.

The first hypothesis was as follows:

There are significant differences between preschoolers with language disorders (LD) and typical preschoolers in terms of language development level (phonological processing and receptive and expressive language skills).

The second hypothesis was:

There are significant differences between preschoolers with LD and typical preschoolers in terms of the development of memory function.

## **2. Methodology**

### **2.1 Participants**

The research was conducted on two groups of children: 5-7 years old, with language disorders (pronunciation-polymorphic dyslalia) and children with typical development. The evaluation of the language at semantic and morpho-syntactic level is made by reference to the chronological age.

### **2.2. Research methods and instruments**

The Phonological Processing subtest evaluates the ability to identify words from word segments and the ability to form an auditory gestalt, the child identifying an image with an indication of a word segment presented orally. The Quick Naming subtest assesses the ability to quickly name familiar words, such as geometric figures, their shape, size, and color, and quick access to and production of words. The Understanding Instructions subtest assesses the ability to process and respond quickly to increasingly complex verbal instructions (such as pointing to bunnies of different sizes, colors, facial expressions, to demonstrate comprehension of the language received, or indicating certain shapes, taking into account color, location, relationship with other figures, in response to verbal instructions).

The NEPSY standardized test battery allows the evaluation of neuropsychic functions in children aged 3-5 years, respectively 5-12 years, *in 5 areas of development: Attention / executive functions; Language; Sensor motor; Visual-spatial processing; Memory and learning* (Korkman, Kirk, Kemp, 2007). Within the NEPSY battery there is a basic evaluation, performed with the help of some basic subtests. At these subtests, performances can be obtained on several *qualitative levels: upper level (values of standardized scores over 14), above average level (value range of scores 13-14), intermediate level (scores between values 8-12), below medium level (scores between values 6-7), low level (standardized scores below value 6)*.

The results of the evaluation are expressed in an individual profile of neuropsychological performance. The Nepsy battery manual includes the standardized standards on the Romanian population, for the NEPSY battery subtests. We will present the results of preschoolers on two neuropsychic fields: Language and Memory. The NEPSY battery memory and learning tests include three subtests: Face Memory, Name Memory, Narrative Memory. For a start, we present the distribution of results. The Face Memory subtest assesses the child's ability to recognize faces. The task is to identify some faces from the test manual and specify the gender of the child presented, then recall the image of a child from several variants (memory and visual learning). The Name Memory subtest evaluates the memory of names, respectively the ability to learn the names of some children (proposed images), during several tasks (memorization and visual-verbal learning). The Narrative Memory subtest evaluates the ability to retell a story, in conditions of free updating, then in the conditions of updating based on clues (primed).

## **3. Results**

### **3.1. Results in NEPSY battery language tests**

Regarding the development of phonological processing capacity, the performances of the subjects from group D (Table 1) are framed more at the average performance level (55%), and less at the below average performance level (45%). On the other hand, the performances of the subjects from group N are registered at the average level (70%), and some of the subjects are classified at the level above average performance (30%). The formation of an auditory gestalt (word), respectively phonological processing, was performed with slight difficulty in subjects

with polymorphic dyslalia, especially from the perspective of completing words that had the missing initial part or words that were represented only by the middle syllable. The accomplishment of the tasks was facilitated by the imagistic support, represented by three images, from which the child had to choose the correct variant of the word.

Table 1. Performance of subjects in groups D and N on developmental levels, subtests  
*Phonological processing, Quick naming, Understanding instructions - NEPSY test*

Performance based on the value of the standard score in the subtest	<b>Lot D</b>		<b>Lot N</b>	
	No. subjects	Percentage	No. subjects	Percentage
<i>Phonological Processing Subtest</i>				
Above average performances (13-14)	-	-	21	30
Average level performances (8-12)	44	55	49	70
Below average performances (6-7)	36	45		
Total nr. de subiecți	80	100%	70	100%
<i>Quick Appointment subtest</i>				
Superior performances (peste 14)	-	-	41	58.6
Above average performances (13-14)	20	25	14	20
Average level performances (8-12)	41	51.3	15	21.4
Below average performances (6-7)	19	23.7	-	-
Total no. of subjects	80	100%	70	100%
<i>Subtest Understanding instructions</i>				
Superior performances (peste 14)	-	-	8	11.4
Above average performances (13-14)	-	-	26	37.1
Average level performances (8-12)	61	76.2	36	51.5
Below average performances (6-7)	19	23.8		
Total no. of subjects	80	100%	70	100%

Most of the LD preschoolers are classified at the average performance level (51.3%), but also at the above average performance level (25%) or below the average performance level (23.7%). Regarding the results of typical preschoolers, most achieved performance at a higher level (58.6%), and the rest achieved almost equal performance at average level (21.4%), but also at above average level (20%). Subjects in group D encountered some difficulties compared to those in group N in terms of the ability to access and produce word tags quickly and correctly, included in alternative patterns (names of objects according to shape, size, color), sometimes the verbal labels are mispronounced (due to the existence of polymorphic dyslalia), other times these children need more time to produce a correct answer (Table 2, Figure 1).

From the perspective of developing the ability to process and respond quickly to verbal instructions of increasing complexity, most of the LD preschoolers are rated at the average performance level (76.2%), and a quarter of them at the below average performance level (23 , 8%). On the other hand, half of the typical preschoolers obtained performances at an average level (51.5%), and the other half performances at above average level (37.1%) and at a higher level (11.4%). Slightly lower performances of LD preschoolers included difficulties in understanding more complex verbal messages, with a certain semantics and syntax, tasks that required a more elaborate auditory and verbal processing, related to the recognition of target objects (bunnies / facial features) in function of color, position, relationship between figures.

By referring to the composite scores corresponding to the field of language and framing them in percentile intervals, we made a comparison between the performances of the two categories of children, as seen below.

Table 2. Performance of subjects in groups D and N by language development levels, NEPSY test

Percentile intervals <i>Language development levels according to the composite score (of the domain)</i>	<b>Lot D</b>		<b>Lot N</b>	
	No. subjects	Percentage	No. subjects	Percentage
Performances above expected level (over 75)	-	-	55	78.6
Expected level performances (26-75)	56	70	15	21.4
Limit performances (11-25)	24	30	-	-
Total	80	100%	70	100%

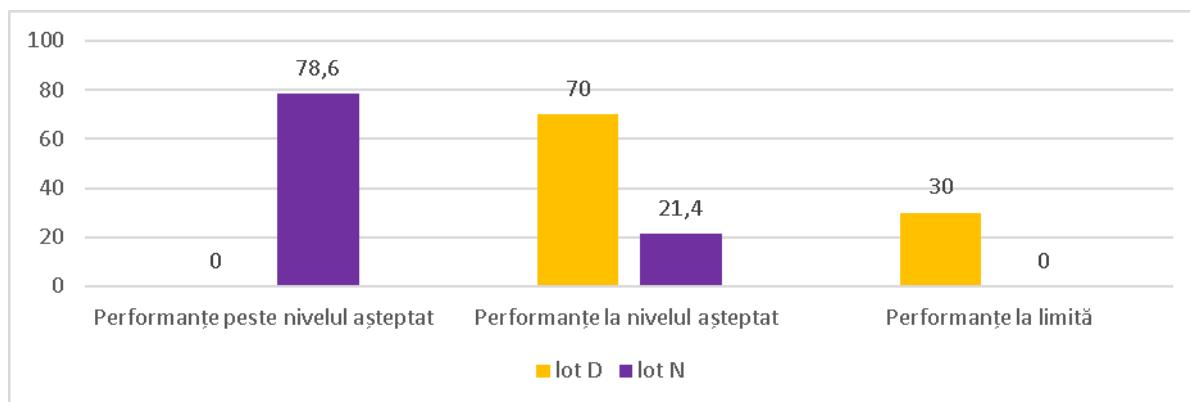


Figure1. Performances of subjects in groups D and N, on *Language development levels, NEPSY test*

Overall, there is a slightly lower yield in LD preschoolers, compared to typical ones, in solving tasks involving *phonological processing*, consisting of completing words from segments (middle, final syllables), in accessing and reproducing familiar words quickly, contained in alternative patterns (shape, size, color), as well as in the ability to understand and develop responses to increasingly complex instructions (recognition of target objects by *color, position, relationship between figures*), based on the existence polymorphic dyslalia.

Regarding the performances in the language field, the average of the standardized scores for the group of LD preschoolers is lower in value ( $M = 37.87; \sigma = 3.823$ ) compared to the average of typical preschoolers ( $M = 41, 71; \sigma = 2.890$ ). The differences between these averages are statistically significant ( $t = 6,859$ , at  $p = 0$ ). The homogeneity condition of the samples was met at this level ( $f = 1,296$ , at  $p = 0.257$ ).

This confirms the working hypothesis that there are significant differences between LD and typical preschoolers, in terms of language development level, phonological processing and receptive and expressive language skills (understanding instructions and speaking quickly).

### 3.2. Results of NEPSY battery memory and learning tests

The results obtained at NEPSY battery and learning tests are distributed as follows in Table 3. At the level of *Face Memory* subtest, both categories of subjects encountered some difficulties, but in LD preschoolers they were more pronounced. Immediate updating of the faces presented, by identifying the target face in three sets (this being with two distractors, other than those previously exposed), and after a delay of 30 seconds, was more difficult in preschoolers with

polymorphic dyslalia. This finding indicates a lower ability of these subjects to process the amount of information presented in a single learning attempt or some difficulty in encoding visual information, representing facial details.

Table 3. Performance of subjects in groups D and N, by development levels, subtests *Face memory, Name memory, Narrative memory - NEPSY test*

<i>Performance based on the value of the standard score in the subtest</i>	<b>Lot D</b>		<b>Lot N</b>	
	No. subjects	Percentage	No. subjects	Percentage
<i>Face Memory subtest</i>				
Above average performances (13-14)	-	-	-	-
Average level performances(8-12)	17	21.3	55	78.6
Below average performances (6-7)	48	60	15	21.4
Poor performances (under 6)	15	18.7	-	-
Total no. of subjects	80	100%	70	100%
<i>Name Memory Subtest</i>				
Above average performances (13-14)	-	-	-	-
Average level performances (8-12)	45	56.2	70	100
Below average performances (6-7)	35	43.8	-	-
Total nr. de subiecți	80	100%	70	100%
<i>Narrative memory subtest</i>				
Performanțe peste medie Above average performances (13-14)	-	-	15	21.4
Average level performances (8-12)	54	67.5	55	78.6
Below average performances (6-7)	26	32.5	-	-
Total	80	100%	70	100%

The results of *Name Memory* subtest reveal some difficulties of LD preschoolers in terms of the ability to acquire (encode) and update verbal tags (the name of 6 children) in a visual-verbal learning task, finding a slight impairment, ability access to information from memory, respectively a lower capacity to process visual-verbal information, to them.

At the level of the *Narrative Memory*, both categories of children solved the tasks better in the context of the initiated update - different clues were offered in order to coherently reproduce the story heard: “*What is the boy / dog's name? What size / color was the dog? What was next to Ionut's house? Who was Ana?*” and so on LD preschoolers found that mnemonic processing was less efficient, they retained less detail in the story, and the verbal information processed was less organized than in typical preschoolers.

By referring to the composite scores corresponding to the field of *memory and learning* and framing them in percentile intervals, we made a comparison between the performances of the two categories of preschoolers, as seen below (Table 4, Figure 2).

Table 4. Performance of subjects in groups D and N, on *memory / learning development levels, NEPSY test*

Percentile intervals <i>Memory/ learning development levels according to the composite score</i>	<b>Lot D</b>		<b>Lot N</b>	
	No. subjeccts	Percentage	No. subjects	Percentage
<i>Performances above expected level (over 75)</i>	-	-	-	-
Expected level performances (26-75)	23	28.7	60	85.7
Limit performances (11-25)	57	71.3	10	14.3
Total	80	100%	70	100%

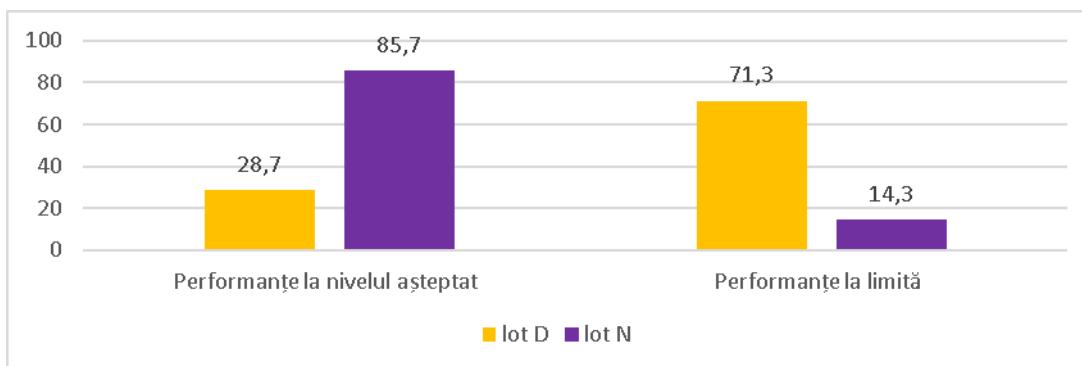


Figure 2. Performances of subjects in groups D and N, on *memory / learning development levels, NEPSY test*

The interpretation and presentation of the subjects' results on developmental levels, by reference to the composite score of the memory-learning field, highlights the lag of preschoolers with polymorphic dyslalia compared to typical preschoolers, both in each subtest and in the whole field. Preschoolers with LD mainly have performance at the limit (71.3%), and to a lesser extent performance at the expected level (28.7%), in terms of the development of memory function. Typical preschoolers have cantoned / evaluated performances at the expected level (85.7%), but also limit performances (14.3%). This finding indicates a lower capacity of LD preschoolers, compared to typical preschoolers, to process the amount of visual and auditory-verbal information presented, to retain the details exposed in complex syntactic constructions (story), and to organize information in order to updating them according to the requirements, against the background of the presence of polymorphic dyslalia.

The *average of the standardized scores* for the group of LD preschoolers is lower ( $M = 24.81; \sigma = 1.942$ ) than the average for the group of typical preschoolers ( $M = 29.51; \sigma = 2.145$ ). The application of the t test for independent samples revealed a statistically significant difference between the performances of the subjects in the two samples ( $t = 14.085$ , at  $p = 0$ ). The condition of homogeneity of the groups was verified, this being fulfilled ( $f = 2.506$ , at  $p = 0.116$ ). Thus, the working hypothesis, which states that there are significant differences between preschoolers with pronunciation disorders and typical preschoolers in terms of the development of memory function is confirmed, and these differences are statistically significant.

### 3. Conclusions

The experimental research revealed, through the methods of evaluation and statistical calculation used, the existence of statistically significant differences between preschoolers with typical development and preschoolers with polymorphic dyslalia, from the perspective of the investigated psychic levels, respectively language and memory.

Regarding the level of language development, with reference to the level of phonological processing and receptive and expressive language skills, there are statistically significant differences between the categories of children. If many of the typical preschoolers have performances above the expected level and less, at the expected level, in relation to the performances corresponding to the chronological age, in the case of preschoolers with polymorphic dyslalia there are performances at the expected level, but also at the limit. There is a slight lag behind LD preschoolers compared to those with typical development, in terms of the level of language development.

There are statistically significant differences between groups of preschoolers in the field of *memory and learning*, respectively in memory and visual-verbal learning and *narrative memory*.

(mnemonic functions). Preschoolers with pronunciation disorders present mainly performance at the limit and less performance at the expected level, a situation reversed in preschoolers with typical development. This finding tells us about the impact of dyslalic disorder (in extended form) on the evolutionary path of mnemonic functioning, the statistically significant difference being confirmed.

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