

# Description of kinesthetic and kinetic motor praxis in older preschool children with logopathology

Olena Bielova<sup>1ABCDE</sup>, Svitlana Konopliasta<sup>1ABCDE</sup>

<sup>1</sup> Kamianets-Podilskyi Ivan Ohienko National University, Ukraine

<sup>2</sup> Dragomanov State University of Ukraine, Ukraine

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

## Abstract

**Background and Study Aim** The development of kinesthetic and kinetic hand praxis in older preschool children is a prerequisite for successful learning in school conditions. The purpose of this study is to identify the current state of neuromotor functionality kinesthetic and kinetic hand praxis, which affects readiness for schooling, in older preschool children with speech pathology.

**Material and Methods** Research methods are aimed at studying the components of neuromotor functionality: kinaesthetic and kinetic wrist praxis. To study the kinesthetic praxis of the hands, the task "Fine motility of the fingers" was used. Kinetic praxis was studied during the task "Differentiated movements of the hand". They studied the formation of object-kinetic praxis during "Performing actions with objects".

**Results** The results of the experimental study give a clear idea that there are significant differences in the formation of neuromotor functionality between the groups of children with logopathology and those with normotypical psychophysical development. In older preschool children with speech disorders, low abilities were found when performing tasks of kinaesthetic and kinetic praxis: wrist (fussy movements of fingers and hands; searching for the right position, the incorrect joining of fingers, hand positions; the presence of perseveration of previous movements; underdeveloped fine motility of fingers of hands; difficulties in subject activities). Children are passive during classes, they need constant support from the teacher.

**Conclusions** The revealed unformed state of neuromotor functionality confirms our hypothesis. Impairment of neuromotor function of kinesthetic and kinetic hand praxis is present in a significant percentage of preschoolers with speech disorders, which becomes a characteristic feature of this category of children and affects further physical, intellectual, and semiotic development.

**Keywords:** children of older preschool age, wrist praxis, speech disorder, kinesthetic hand praxis, kinetic hand praxis.

## Introduction

Neuromotor functionality of the cognitive component of speech readiness includes wrist, oral, articulatory kinaesthetic and kinetic praxis. Neurophysiological research shows that praxis (Greek: praxis – action) is a system of voluntary, purposeful motor actions that provide practical skills for various types of activities. Motor control and movement control are organized by the frontal lobe of the premotor cortex of the cerebrum. Its activity involves the sequential synthesis of separate motor impulses into single "kinetic structures" that are automated during training and provide a dynamic process of complex movements and motor skills. Luria [1] divided all praxis actions into two types of praxis: kinaesthetic praxis (afferent) is sensory and provides insight into one's own body. The information collected from the sense organs (from sensory neurons) is transformed into nerve impulses and reaches the central parts of the brain via afferent pathways, in particular, the parietal

lobe of the left hemisphere; kinetic praxis (efferent) carries out motor activity. From the premotor zone of the cortex of the frontal lobe, electrical impulses are spread, which activate the muscle, tendon and joint systems.

Subject, finger, oral and articulatory types of praxis are distinguished [2]. The ontogenesis of the child is connected with the gradual development of *subject praxis* [3]. Manipulation actions with the subject, in addition to the formation of cognitive processes (attention, memory, thinking, imagination, perception, etc.) are also aimed at the development of visual and auditory gnosis, wrist praxis. Mastery of subject activity determines the readiness of an older preschooler in school conditions to master more complex educational actions – abstract, symbolic (symbolic subject praxis is an action with an object; non-symbolic – a conditional action without an object) [4].

Research by scientists testify that finger motility, namely, *wrist praxis* develops in parallel with speech mechanisms and cognitive processes [5]. The development of fine motor skills is a

prerequisite for children to master oral [6, 7] and written communication [8, 9] and is evaluated as an indicator of general mental development [1]. The motor activity of the fingers through kinesthetic impulses innervates speech zones in the cerebral cortex, in particular Broca's center. Insufficient development of fine motor skills in older preschool children may indicate a delay in speech functions.

Research in neuropsychology makes it clear that various forms of apraxia arise as a result of damage to the left hemisphere [1, 2]. In particular, damage to the parietal region leads to violations of the kinesthetic organization of movements (fingers, oral, articulation system); a frontotemporal lesion causes disorders of dynamic (kinetic) praxis (slowness of action, difficulties when switching from one movement to another, presence of perseveration, etc.); parietal-occipital damage leads to peculiar violations of spatial praxis [4].

*Research Hypothesis.* Taking into account scientific research [10, 11], we can assume that the lack of neuromotor functionality is present in a significant percentage of preschoolers with speech disorders. And this becomes a characteristic feature of this category of children [12].

Experimental research includes variational-statistical (quantitative) and qualitative analysis of study materials [13], which allows understanding of the structure of the studied phenomenon, its variability, dependence, relationships and principles of functioning [14].

*Purpose of the Study.* The purpose of this study is to identify the current state of neuromotor functionality kinesthetic and kinetic hand praxis, which affects readiness for schooling, in older preschool children with speech pathology.

## Materials and Methods

### *Participants*

The study included 607 older preschool children (5–6 years old), of which 250 had normotypical psychophysical development and 357 had logopathology (dyslalia (n = 212), stuttering (n = 40), rhinolalia (n = 28), dysarthria (n = 77)).

### *Ethical consideration*

Ethical approvals. During the collection of experimental data, the consent of the parents of the study participants was obtained. Appropriate ethical norms and rules are followed; no moral pressure was exerted on the research representatives. All the mentioned procedures with the participation of the respondents corresponded to the ethical standards of the institutional and national research committees, as well as the principles of the Declaration of Helsinki.

### *Research Design*

The confirmatory experiment was conducted

by speech therapists and educators on the basis of preschool educational institutions. Research of neuromotor function was carried out individually with each child separately. The duration of tasks is about 20 minutes. The assessment of the results of the tasks was immediately recorded in the research protocol. The duration of the ascertainment experiment was 3 months.

The research of neuromotor functionality in children with logopathology takes place through the study of wrist praxis. The kinesthetic praxis – will determine the child's ability to perform certain differentiated movements (fingers) and exercise control over them. The kinetic praxis – indicates the preschooler's ability to combine various movements into a coordinated action (performing a certain activity with the fingers).

### *Instruments*

The state of formation of neuromotor functionality is studied using methods aimed at researching kinesthetic and kinetic praxis of the wrist [1, 4]. The content of the neuromotor component, methods, evaluation criteria and scoring system are outlined in Table 1.

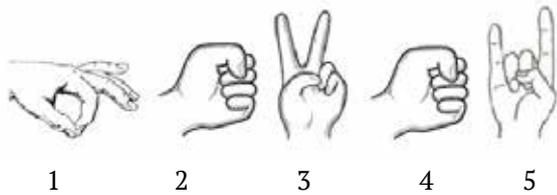
**Table 1.** Research methods of neuromotor functionality.

The content of the neuromotor component	Methods	Evaluation criteria	General number points
Wrist praxis	Amiel-Tison, et al. [5], Luria [1]	kinesthetic praxis: - fine motor skills of the fingers	2
		kinetic praxis: - differentiated hand movements	2
		- performance of actions with objects	2
Total points			6

### *Procedure*

To study wrist kinesthetic praxis, the task 'Fine Motility of Fingers' was employed. During this task, children were presented with various finger positions and instructed to replicate them, first with the right hand and then with the left. The positions were as follows, corresponding to the labels in the figure: 1 - forming a ring by connecting the thumb and forefinger; 2 - making a fist by clenching all fingers; 3 - extending the index and middle fingers forward; 4 - again making a fist; 5 - extending the index and little fingers forward. The task duration was limited to 2 minutes. The depicted hand

positions were designed based on established finger praxis developmental templates [15] (see Fig. 1).



**Figure 1.** Demonstration of the 'Fine Motility of Fingers' task [15].

Kinetic praxis is investigated through the task 'Differentiated Movements of the Hand'. In this task, children are presented with various hand positions and instructed to replicate them. The positions are as follows, with corresponding labels in the figure:

**I. Simultaneous Performance with Both Hands:**

1 - Right hand clenched into a fist, left hand turned downwards with an open palm.

2 - Left hand clenched into a fist, right hand pointing down with an open palm.

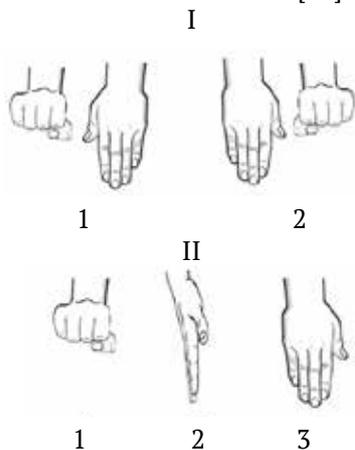
**II. Sequential Execution with One Hand (first with the right hand and then with the left hand):**

1 - Hand clenched into a fist.

2 - Hand opened with the 'rib' downward.

3 - Hand with an open palm down hitting the table.

The task's duration is limited to 2 minutes (see Fig. 2). The depicted hand positions were designed based on established templates for the development of differentiated hand movements [15].



**Figure 2.** Demonstration of the 'Differentiated Movements of the Hand' task [15]."

**Study of Subject Praxis:**

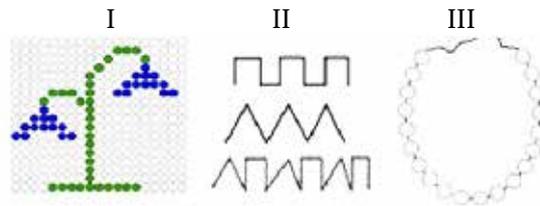
The third task involves 'Performing Actions with Items.' In this task, the child is instructed to carry out a series of actions involving objects:

**I. Mosaic Pattern Arrangement:** The child lays out a mosaic pattern based on the provided sample.

**II. Graphic Drawings:** The child creates graphic drawings.

**III. Stringing a Necklace:** The child threads beads onto a string to create a necklace.

Each group of tasks is allotted a duration of 5 minutes (see Fig. 3). The actions were designed to assess different aspects of subject praxis and are depicted in Figure 3.



**Figure 3.** Demonstration of the 'Performing Actions with Items' task."

Results of the three tasks are evaluated as follows:

- 2 points indicate that the child completes all tasks correctly;
- 1 point is given when the child requires stimulating assistance or makes one or two mistakes;
- 0 points are assigned if there are more than two mistakes.

The highest achievable score for each task is 2 points. Task results are assessed using a three-point scale (2; 1; 0). The total maximum score across the three tasks is 6 points.

*Statistical Analysis*

The disparities in research findings between children with logopathology and those with normotypical psychophysical development have been verified through the application of Student's parametric t-test. The independent sample t-test has been employed to assess the data. During the course of the statistical analysis, we examine two hypotheses:

**H0 (Null Hypothesis):** The differences observed between the groups of children with logopathology and those with normotypical development are incidental or random.

**H1 (Alternative Hypothesis):** The differences between the groups are statistically significant or reliably significant.

In the assessment process, if the calculated tem statistical value is less than the critical ttab value, we accept hypothesis H0; conversely, if the calculated tem statistical value is greater than or equal to the tabular ttab value, we accept hypothesis H1. The confidence level (or significance level) chosen for this analysis is set at  $p = 0.05$ , which signifies a 95% level of confidence in the reliability of the experimental results."

**Results**

The analysis of hand kinesthetic praxis for the task 'Fine motility of fingers' using the Student's t-test revealed significant findings. The empirical indicators demonstrated that the measured values

exceeded the tabular values by a considerable margin. This indicates a notable disparity in motor organization between older preschool children with normotypical psychophysical development and their peers with logopathology. The p-value suggests statistical significance in favor of normotypical development. Furthermore, in the context of normotypical development, the average indicators of the scoring system displayed a remarkable difference compared to children with speech disorders. Specifically, normotypical children exhibited notably higher scores, while the results for preschoolers with dyslalia and stuttering were lower. The observed trends indicated the greatest deviation from the norm in children with rhinolalia and dysarthria, emphasizing the impact of speech development on the motor organization of fingers (Table 2).

Examination of kinetic praxis research materials for the task ‘Differentiated movements of the hand’ revealed noteworthy results. The empirical indicators indicated a significant difference between the measured values and the tabular values. This suggests a distinct contrast in the ability to reproduce hand positions between children with normotypical psychophysical development and older preschoolers with speech disorders. The

p-value indicates statistical significance in favor of normotypical development. Additionally, the statistical outcomes illustrated that children with normotypical psychophysical development excelled in reproducing the position of both hands compared to older preschoolers with speech disorders. The observed trends indicated a notable difference between the two groups. The approximate indicators of normotypical development were higher, while the results for children with speech disorders were comparatively lower. These patterns were evident in children with stuttering and dyslalia, with even lower results seen in those with rhinolalia and dysarthria (Table 3).

Upon investigating subject praxis for the task ‘Performing actions with items,’ the statistical indicators revealed significant findings. The empirical indicators pointed to a substantial difference between the measured values and the tabular values, underscoring an evident contrast in the performance of older preschool children with normotypical psychophysical development and their peers with logopathology. The determined significance level (p-value) underscores the statistical importance of these findings.

Furthermore, the outcomes indicated that older preschool children with normotypical psychophysical

**Table 2.** Results of manual kinesthetic praxis by task “Fine motility of fingers”.

Group	$t_{em}$	$t_{tab}$	p-value	SED	M ± SD
Normotypical development	4.5673	1.964	< 0.0001	0.032	1.8 ± 0.3
Dyslalia	4.9393	1.965	< 0.0001	0.074	1.4 ± 0.7
Stuttering	3.9267	1.965	< 0.0001	0.103	1.4 ± 0.7
Rhinolalia	7.2255	1.969	< 0.0001	0.109	1.0 ± 0.6
Dysarthria	21.7816	1.968	< 0.0001	0.060	0.5 ± 0.5
Children with logopathology	9.8403	1.961	< 0.0001	0.074	1.1 ± 0.7

Clarification of conventional designations:

$t_{em}$  – empirical indicators calculated according to the formula (Student’s t-criteria);

$t_{tab}$  – tabular indicators within the  $p = 0.05$ ;

SED – standard error of the difference, indicates how well the mean represents the sample data;

M ± SD – (M) is the average score; (SD) standard deviation.

**Table 3.** Results of hand kinetic praxis according to the task “Differentiated movements of the hand”.

Group	$t_{em}$	$t_{tab}$	p-value	SED	M ± SD
Normotypical development	11.2250	1.964	< 0.0001	0.045	1.5 ± 0.5
Dyslalia	2.9584	1.965	< 0.0034	0.082	1.2 ± 0.7
Stuttering	1.9077	1.965	< 0.0583	0.129	1.2 ± 0.7
Rhinolalia	4.3641	1.969	< 0.0001	0.146	0.8 ± 0.6
Dysarthria	14.3294	1.968	< 0.0001	0.073	0.4 ± 0.5
Children with logopathology	7.3290	1.961	< 0.0001	0.075	0.9 ± 0.7

Clarification of conventional designations:

$t_{em}$  – empirical indicators calculated according to the formula (Student’s t-criteria);

$t_{tab}$  – tabular indicators within the  $p = 0.05$ ;

SED – standard error of the difference, indicates how well the mean represents the sample data.

M ± SD – (M) is the average score; (SD) standard deviation.

development outperformed their counterparts with logopathology in the task of performing actions with items. The trends observed reflected a notable distinction between the two groups. The average results for children with normotypical development were significantly higher, while those for children with logopathology were comparatively lower. Specifically, the observed distinctions were most pronounced in children with dyslalia, stuttering, rhinolalia, and dysarthria (Table 4).

The comprehensive analysis of the study reveals distinct patterns within the participant groups. Among older preschool children with normotypical psychophysical development, a significant percentage displayed a high level of neuromotor functionality. This was characterized by their ability to accurately reproduce finger and hand positions, successfully complete tasks involving mosaic patterns, graphic depictions, and threading necklaces. Similarly, a substantial proportion of children with logopathology also exhibited a high level of neuromotor functionality. For participants with an average level of speech disorders, along with those with typical development, minor difficulties were encountered in reproducing specific finger and hand positions. Challenges were observed in executing smooth transitions between positions and in completing kinetic and practical tasks. Among children with speech disorders, a smaller subset demonstrated a lower level of neuromotor

functionality. Their performance exhibited characteristics such as chaotic finger and hand movements, difficulty in finding correct positions, occasional errors in connecting fingers, and instances of perseveration of previous movements. Notably, these challenges extended to tasks involving objects, often necessitating consistent assistance from teachers. The observed trends underscore the variations in neuromotor functionality across the participant groups, highlighting the distinct responses based on the presence of speech disorders (Table 5).

According to the statistical analysis, older preschoolers with logopathology had insufficiently developed hand praxis compared to normal psychophysical development. The generalized empirical results indicated a significant difference between the measured values and tabular indicators. The greatest deviation is observed in children with dysarthria, who have the most complex speech disorders. A somewhat smaller deviation was found in children with rhinolalia and dyslalia. Preschoolers with stuttering are more prone to indicators of normotypical development.

Since the empirical values are greater than theoretical ones ( $t_{em} 9.4482 > t_{tab} 1.967$ ), accordingly, hypothesis  $H_1$  at the significance level of 5% ( $p = 0.05$ ) is accepted and confirms the differences between the experimental groups. Speech impairment at the level of neuromotor functions is inextricably linked with

**Table 4.** Results of practical activities for the task “Performing actions with items”.

Group	$t_{em}$	$t_{tab}$	p-value	SED	M ± SD
Normotypical development	4.1121	1.964	< 0.0001	0.029	1.8 ± 0.3
Dyslalia	5.2169	1.965	< 0.0001	0.064	1.5 ± 0.6
Stuttering	4.3447	1.965	< 0.0001	0.099	1.4 ± 0.7
Rhinolalia	6.6943	1.969	< 0.0001	0.110	1.1 ± 0.7
Dysarthria	25.6080	1.968	< 0.0001	0.058	0.4 ± 0.4
Children with logopathology	10.3175	1.961	< 0.0001	0.075	1.1 ± 0.8

Clarification of conventional designations:

$t_{em}$  – empirical indicators calculated according to the formula (Student’s t-criteria);

$t_{tab}$  – tabular indicators within the  $p = 0.05$ ;

SED – standard error of the difference, indicates how well the mean represents the sample data.

M ± SD – (M) is the average score; (SD) standard deviation.

**Table 5.** The general level of formation of kinesthetic and kinetic motor praxis.

Group	Level, %			M ± SD
	High	Average	Low	
Normotypical development	85.6	14.1	0	5.2 ± 0.9
Dyslalia	61.3	21.7	17.0	4.2 ± 1.9
Stuttering	60.0	25.0	6.0	4.5 ± 2.1
Rhinolalia	21.4	50.0	28.6	3.1 ± 1.9
Dysarthria	0	54.5	45.5	1.8 ± 1.4
Children with logopathology	44.8	31.4	23.8	3.3 ± 2.1

**Table 6.** Statistical indicators of neuromotor functionality.

Field of study	Empirical value	Normotypical	Dyslalia	Stuttering	Rhinolalia	Dysarthria	General indicator
The kinesthetic and kinetic motor praxis	$t_{em}$	8.7920	4.6942	3.7358	6.9813	20.3145	9.4482
	SED	0.087	0.200	0.290	0.309	0.167	0.202
	p	0.0001	0.0001	0.0003	0.0001	0.0001	0.0001
	M ± SD	5.2±0.9	4.2±1.2	4.1±2.1	3.1±1.9	1.8±1.4	3.3±2.1
Table value (p=0.05)	$t_{tab}$	250	460	288	276	325	605
		1.964	1.965	1.969	1.969	1.968	1.961

Clarification of conventional designations:

$t_{em}$  – empirical indicators calculated according to the formula (Student’s t-criteria);

$t_{tab}$  – tabular indicators within the  $p = 0.05$ ;

SED – standard error of the difference, indicates how well the mean represents the sample data.

M ± SD – (M) is the average score; (SD) standard deviation.

the development of hand praxis. The more difficult the speech disorder, the more difficult it is to carry out motor activity of the hands. In children with logopathology, hand praxis does not correspond to age development and needs additional educational and developmental influence (Table 6).

## Discussion

Scientific studies of scientists prove that the lack of neuromotor functionality, in particular, kinesthetic and kinetic hand praxis in older preschool children with logopathology delays not only physical but also intellectual [6, 10, 11] and speech [7, 16] development. Konoplyasta [11] claimed in her scientific works that under the conditions of favorable development of the child, her sensorimotor activity is harmoniously switched into a hierarchical structure of voluntary activity. The development of the motor organization affects the regulation of mental processes, the emotional and volitional sphere forming its general behavior. Experimental studies of children with rhinolalia proved that sensorimotor motor activity and physical endurance are reduced in most of them (compared to children with normotypical development). A slow pace of psychomotor development is observed, which the author considers as controlled motor actions.

Our study proves that today the problem has not disappeared, and in which cases it worsens, as indicated by the indicators of kinesthetic and kinetic hand praxis in older preschool children with speech pathology. We note that older preschoolers with dyslalia, in some cases with stuttering and rhinolalia, have a high level of neuromotor functionality, whose motor activity is close to children with normotypical psychophysical development. Average and low indicators are mostly observed in respondents with more complex speech and psychophysical development disorders: dysarthria, rhinolalia, and stuttering, and less often with dyslalia.

Children with speech disorders who have a long-term educational and corrective influence develop

according to normotypical development [16]. We prove the specified statement during the study of “Fine motility of fingers”. During the experiment, it was established that a high level of finger praxis belonged to 85.6% (n = 214) of preschoolers with normotypical development and 45.9% (n = 164) with logopathology. The results of this group of children indicated the ability to independently and correctly reproduce the given positions of the fingers, which indicated a sufficiently formed level of their fine motor skills. Older preschoolers who made minor mistakes during the task and sometimes needed stimulating help from the teacher had an average level of formation of kinesthetic finger praxis. It is observed most in 33.1% (n = 118) of children with logopathology and only 14.4% (n = 36) with normotypical development. The children were asked to quickly complete the task by choosing the right position of the fingers, so they often made mistakes: connecting the thumb and index fingers in a ring (they connected the thumb and the index fingers); transitioning from clenched fingers into a fist to a position where the index finger and little finger are stretched forward. Inattention led to an increased number of attempts and help from an adult.

The relationship between language and motor function is complicated and multifaceted [5], as indicated by the low level of research results was observed in 21% (n = 75) of children with logopathology, who had more than two errors and needed constant support from the teacher, in particular. But this level was most characteristic of children with dysarthria (45.5% (n = 214)), who have weakly developed finger praxis; with a neurotic form of stuttering (15% (n = 6)), in which we note the lack of fine motor skills, the need for additional instruction, a visual sample. Preschoolers of this group did not pay attention to their motor errors, all attempts to complete the task had shortcomings: a long search for the position of joining the thumb and index fingers into a ring (they connected different fingers); difficulty moving from the position of

clenched fingers into a fist to the position where the index and little fingers are stretched forward (extending different fingers forward); difficulty switching from the right hand to the left; trying on the built position of the fingers with the teacher's sample; the need for approval and encouragement from an adult for a correctly completed task. Slowness, increased number of execution attempts, inconsistency of motor actions and adult help indicate insufficient attention, and reduced ability of motor activity of finger kinesthetic praxis give grounds to predict problems during mastering motor skills of written speech.

Having uncomplicated speech disorders or their long-term correction allows children to fully perform differentiated motor exercises [10, 11]. The results of the study of the performance of the task "Differentiated hand movements" showed that high scores belonged mostly to children with normotypical development (49.6% (n = 124)) and 31.4% (n = 112) with logopathology. They demonstrated the ability to independently reproduce various movements according to the example of the teacher. Some of them could make mistakes, but they corrected themselves and performed the task correctly. Performed the exercise with errors and had an average level of 42.9% (n = 153) of preschoolers with logopathology and 40.8% (n = 102) of normotypical development. The children did not perform the task clearly and often made mistakes in changing the position of their hands, sometimes they needed the help of an adult in additional demonstration of the task. Insufficiently formed dynamic praxis and a detected low level are observed in preschoolers 20.2%, 40.8% (n = 72) with speech disorders and 9.6% (n = 24) with normotypical development. This group of children had significant difficulties during the task. It was difficult for them to perform different movements with two hands at the same time: the right hand is clenched into a fist, the left hand is turned downward with an open palm (confusion of hands, not dynamic performance); the left hand is clenched into a fist, the right hand is turned downward with an open palm (difficulties when switching to different movement positions); sequential execution of various movements with one hand: the hand is clenched into a fist, the hand is opened with the "rib" down, the hand with the open palm down hits the table (inhibited reorientation of movement from one position to another). Significant problems in the development of dynamic praxis are observed in children with dysarthria and stuttering, who quickly tire of the task; their movements were not rhythmic, there were difficulties when switching from one position to another; they needed stimulating help from the teacher more than other peers.

In order to learn the skills of a child of older preschool age to perform actions with various

objects, we suggest that she complete the sample task: make a pattern from a mosaic; draw a graphic picture; string beads on a thread. High indicators were demonstrated by 88% (n = 220) of children with normotypical psychophysical development and 45.9% (n = 164) with logopathology. Preschoolers correctly assembled mosaic patterns according to the proposed sample, graphically represented the drawing, and strung a necklace on a thread without the help of an adult. Some could make mistakes during the task but corrected them independently. Minor difficulties arose in the second group of children, who had an average level of subject praxis development. 33.9% (n = 121) of preschoolers with logopathology and 12% (n = 30) with typical development tried to complete the task quickly, so they often made mistakes: in the number of mosaic parts for assembling a pattern; in strokes in a graphic picture; in the number of beads. The correct performance of the task depended on stimulating help from the teacher, who often emphasized "Compare your work with the sample. See if everything is done correctly?". Then, the children noticed the flaws in their performance and quickly revised it.

A study by scientists [9] proves that in children aged 8-10 years, the insufficient formation of motor skills is significantly related to verbal working memory, visual-spatial working memory, and reaction inhibition, but not to the control of obstacles. In our opinion, this problem arises much earlier. What the low indicators of the study indicate. Difficulties arose in children of the third group of preschoolers, 20.2% (n = 72) with speech disorders, who, according to the research indicators, had a low level of development of subject praxis. Preschoolers could incorrectly choose the colours or the number of mosaic parts to make a pattern; extra strokes were depicted in the graphic picture, or they were not drawn; beads were missed, and tasks were not performed correctly even with the help of an adult. In children with dysarthria, rapid fatigue was observed, and slowdown in actions. Insufficiently developed fine motor skills caused difficulties in the operational actions of the fingers: holding a pencil (not adjusting the pressure of the pencil, sloppy drawing, not following the contours of the image), stringing beads on a thread, collecting small mosaic parts to assemble a figure. In preschoolers with a neurotic form of stuttering, we note unstable muscle tone, and impaired fine motility of the hands, which leads to persistent errors when performing practical tasks.

In these children, in addition to the underdevelopment of kinetic hand-hand praxis, there is also a violation of the motor activity of oral and articulatory praxis, which affects the development of speech [10, 11]. It is difficult for them to reproduce movements at first glance, so they

make mistakes or do not complete tasks more often than preschoolers with normotypical development. This indicator is mostly characteristic of children with phonetic-phonemic underdevelopment of speech and general underdevelopment of speech [12].

Experimental analysis of research materials makes it clear that there is a close relationship between motor and cognitive skills of children with speech disorders [6, 9]. Scientists draw a parallel between disorders of motor skills, such as rhythmic coordination, control of walking, positions of body parts (arms, legs, head, etc.), catching objects with malformed cognitive skills, such as internal planning (thinking operations), sensory-perceptual recognition [17], memorization of motor and verbal [10], cognitive information [18, 19], implementation of an executive function [20]. Experimental studies allow us to state that the development of motor skills, such as fine motility of the fingers, coordination of movements in rhythm, sequence of movements contribute to the improvement of cognitive skills and self-regulation.

The described experimental results of all categories of children (rhinolalia, dyslalia, stuttering, dysarthria) prove that the problem is still relevant. Children of older preschool age with logopathology need corrective and developmental work, the lack of formation of hand praxis affects the development of grapho-motor skills, which are necessary for mastering written speech [5]. The revealed unformed state of the neuromotor functionality of the cognitive component in older preschoolers with logopathology provides grounds for the introduction of modern educational and developmental methods that would allow for the formation of kinesthetic and kinetic hand skills (development of fine motility of the fingers). This will contribute to increasing the level of neuromotor development of older preschool children and, in the future, their comfortable integration into the conditions of general education.

## Conclusions

Analysis of research results and statistical confirmation proves that a significant percentage of older preschool children with logopathology have an insufficiently formed state of neuromotor functionality of the cognitive component of the psychological component of speech readiness. *Wrist kinesthetic praxis* in preschoolers with logopathology is not sufficiently formed: it is difficult to perform according to the model of certain finger positions (joining of different fingers); problems switching from one finger position to another; difficulty switching from the right hand to the left; slow completion of tasks. *Wrist kinetic praxis* in

preschoolers with speech pathology is not formed, especially in children with dysarthria and some with stuttering; difficulties during simultaneous execution of various movements with two hands: confusion of hands, impaired performance dynamics; problematic or inhibited switching from one motor position to another. Subject praxis of preschoolers with speech disorders (in most children with dysarthria and some with stuttering) develops slowly. In this group of older preschoolers, fine motor skills are not sufficiently developed, there were difficulties in the operational actions of the fingers: holding a pencil while drawing graphic drawings, stringing beads on a thread, and collecting small mosaic parts to assemble a figure.

Improvement of the neuromotor functionality of hand praxis will be ensured by educational and developmental work, which is able to form control over the actions of the bones of the hands in children with logopathology, as well as develop they fine motility of the fingers. The development of neuromotor functionality should include various educational methods. In particular, the visual method: demonstration of sample positions of fingers and hands. Game method: motor finger games ("playing" songs, poems, fairy tales with the fingers), construction games (modeling from dough, plasticine, stacking, work with origami, quilling, appliqués (laying out drawings with threads, cutting, gluing parts from paper and other materials), lego constructors, cubes, lacing wooden toy materials, stringing a necklace on a thread, fastening buttons, sorting cereals, groping for objects in bags). Method of exercises: motor exercises (flexing and extending fingers, alternate and joint movements of the hands, projecting shadows from the bones of the hands); art exercises (drawing with fingers, tracing the outline of images, connecting a picture by numbers), graphic and motor exercises (writing symbols, numbers, letters as directed).

The outlined type of educational and developmental work will form in children of older preschool age the ability to perform and control differentiated hand movements; perform and control hand and finger movements; carry out manipulations with objects; perform graphic and motor tasks. That will allow to prepare children to study in institutions of general secondary education.

## Acknowledgement

The authors thank the pedagogical teams of preschool educational institutions and the parents of the studied children for their cooperation.

## Conflict of interest

There is no conflict of interest.

## References

1. Luria AR. *Language and Cognition*. New York, NY: Wiley-Interscience; 1982.
2. Kokun O.M. *Psychophysiology*. Kyiv: Center of School Literature; 2006. (In Ukrainian).
3. Malkhazov OR. Biomechanical and psychophysiological constants in the control of motor activity. *Problemi penitenciarnoi teorii ta praktiki*, 2002;1:23–29. (In Ukrainian).
4. Amiel-Tison C, Gosselin J. *Neurological Development from Birth to Six Years: Guide for Examination and Evaluation*. Baltimore M.D: Johns Hopkins University Press; 2001.
5. Wang MV, Lekhal R, Aarø LE, Schjølberg S. Co-occurring development of early childhood communication and motor skills: results from a population-based longitudinal study: Co-development of early communication and motor skills. *Child: Care, Health and Development*, 2014;40(1): 77–84. <https://doi.org/10.1111/cch.12003>
6. Cadoret G, Bigras N, Duval S, Lemay L, Tremblay T, Lemire J. The mediating role of cognitive ability on the relationship between motor proficiency and early academic achievement in children. *Human Movement Science*, 2018;57: 149–157. <https://doi.org/10.1016/j.humov.2017.12.002>
7. Oberer N, Gashaj V, Roebers CM. Motor skills in kindergarten: Internal structure, cognitive correlates and relationships to background variables. *Human Movement Science*, 2017;52: 170–180. <https://doi.org/10.1016/j.humov.2017.02.002>
8. Cameron CE, Cottone EA, Murrell WM, Grissmer DW. How Are Motor Skills Linked to Children's School Performance and Academic Achievement? *Child Development Perspectives*, 2016;10(2): 93–98. <https://doi.org/10.1111/cdep.12168>
9. Van Der Fels IMJ, Te Wierike SCM, Hartman E, Elferink-Gemser MT, Smith J, Visscher C. The relationship between motor skills and cognitive skills in 4–16 year old typically developing children: A systematic review. *Journal of Science and Medicine in Sport*, 2015;18(6): 697–703. <https://doi.org/10.1016/j.jsams.2014.09.007>
10. Bielova O. The state of development of components of speech readiness of older preschool children with speech disorders. *Specialusis Ugdymas / Special Education*, 2021;1(42): 137–189. <https://doi.org/10.15388/se.v1i42.528>
11. Konopliasta S.I. *Rhinolalia from A to Z*. Kyiv: Book Plus; 2020. (In Ukrainian).
12. Yakovenko AO. The basic intellectual and personal component as an integral part of the speech readiness of older preschoolers with speech disorders before studying at school]. *Visnyk Cherkaskoho natsionalnoho universytetu imeni Bohdana khmelnytskoho. Seriya pedahohichni nauky*, 2018; (4): 144–150. (In Ukrainian).
13. Miles MB, Huberman AM. *Qualitative data analysis*. Publishing House UB, Białystok; 2000. (In Poland).
14. Palka S. *Tests. Pedagogical practice*. Gdansk Psychological Publishing House, Gdansk; 2006. (In Poland).
15. Trubitsyna YuP. Development of a child's finger praxis (patterns of tasks from easy to difficult level [Internet]. 2022 [cited 2022 Sept. 27]. (In Ukrainian). Available from: <https://vseosvita.ua/library/rozvytok-paltsevoho-praksysu-dytynyshablony-zavdan-vid-lehkoho-do-uskladnenoho-rivnia-589072.html>
16. Sobotovych YuF. *Selected works on speech therapy*. Kyiv: Dmytro Burago Publishing House; 2015. (In Ukrainian).
17. Wilson PH, Ruddock S, Smits-Engelsman B, Polatajko H, Blank R. Understanding performance deficits in developmental coordination disorder: a meta-analysis of recent research: Review. *Developmental Medicine & Child Neurology*, 2013;55(3): 217–228. <https://doi.org/10.1111/j.1469-8749.2012.04436.x>
18. Jongbloed-Pereboom M, Janssen AJWM, Steenbergen B, Nijhuis-van Der Sanden MWG. Motor learning and working memory in children born preterm: A systematic review. *Neuroscience & Biobehavioral Reviews*, 2012;36(4): 1314–1330. <https://doi.org/10.1016/j.neubiorev.2012.02.005>
19. Desmond JE, Gabrieli JDE, Wagner AD, Ginier BL, Glover GH. Lobular Patterns of Cerebellar Activation in Verbal Working-Memory and Finger-Tapping Tasks as Revealed by Functional MRI. *The Journal of Neuroscience*, 1997;17(24): 9675–9685. <https://doi.org/10.1523/JNEUROSCI.17-24-09675.1997>
20. Anderson VA, Anderson P, Northam E, Jacobs R, Catroppa C. Development of Executive Functions Through Late Childhood and Adolescence in an Australian Sample. *Developmental Neuropsychology*, 2001;20(1): 385–406. [https://doi.org/10.1207/S15326942DN2001\\_5](https://doi.org/10.1207/S15326942DN2001_5)

### Information about the authors:

**Olena Bielova;** (Corresponding Author); <https://orcid.org/0000-0001-6162-4106>; [alena.bielova77@gmail.com](mailto:alena.bielova77@gmail.com); Department of Speech Therapy and Special Methods, Kamianets-Podilskyi Ivan Ohiienko National University; Kamianets-Podilskyi, Ukraine.

**Svitlana Konopliasta;** <https://orcid.org/0000-0001-9233-7505>; [s.yu.konoplyasta@gmail.com](mailto:s.yu.konoplyasta@gmail.com); Department of Speech-language pathology (SLP) and Speech Psychology, Dragomanov State University of Ukraine; Kyiv, Ukraine.

---

Cite this article as:

Bielova O, Konopliasta S. Description of kinesthetic and kinetic motor praxis in older preschool children with logopathology. *Pedagogy of Physical Culture and Sports*, 2023;27(5):386–395.  
<https://doi.org/10.15561/26649837.2023.0505>

---

This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (<http://creativecommons.org/licenses/by/4.0/deed.en>).

Received: 09.07.2023

Accepted: 28.08.2023; Published: 30.10.2023