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Neuropsychological Classes for Preschool Children: A Narrative Review of Kinesiological Approaches

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Abstract: *This narrative review examines the role of kinesiological exercises in neuropsychological classes for preschool children. Its relevance arises from the growing number of preschoolers who experience difficulties in intellectual, emotional, and motor development. The review aims to: (1) clarify the concepts of sensory integration and kinesiology, (2) examine neuropsychological mechanisms underlying motor skill and spatial thinking development, and (3) evaluate the potential benefits of kinesiological exercises in preschool settings. A narrative review of peer-reviewed literature and methodological sources was conducted across Google Scholar, Web of Science, and PubMed. The reviewed evidence suggests that experiencing learning difficulties, such as problems perceiving information, inattentiveness, problems related to memory or logical thinking may reflect insufficient neurological readiness for cognitive demands. This highlights the critical role of the brain in coordinating and regulating vital bodily functions. When its functioning is less effective, both children and adults may struggle to respond appropriately to external stimuli, underscoring the importance of targeted interventions. Kinesiological exercises appear to be a promising approach for supporting neuropsychological development in preschool children by promoting interhemispheric synchronisation. Physical activity contributes not only to motor development but also to the cultivation of cognitive processes. The article also presents a set of kinesiological exercises suitable for use in preschool neuropsychological classes. However, the evidence base consists primarily of small-sample studies, and further controlled research is needed to establish effectiveness.*

Keywords: *neuropsychology; interhemispheric interaction; preschool children; kinesiological exercises; learning difficulties; sensory integration; motor development.*

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1. Introduction

Child neuropsychology has become increasingly important for understanding and addressing developmental difficulties in children. Learning difficulties once attributed to purely behavioural causes are now recognised as having a neurobiological and neurochemical basis. (D'Amato et al., 2010).

An increasing number of preschool children demonstrate difficulties in intellectual, emotional, and motor development, and neuropsychological interventions may support them in overcoming these challenges. Neuropsychology emerged to study human brain functions in detail, examining how they can be affected by disease or behaviour. However, Hebb (2002) first analysed the links between the brain's structure and activity and one's experience and environment.

Luria (1976) developed neuropsychological methods to investigate cognitive functions such as memory, attention, and thinking. His research investigated how the brain processes and stores information and regulates activity. He also compared the nervous systems of various animals with those of humans.

In the 1920s, Vygotsky (1930/1978) made a significant contribution to neuropsychology by systematising existing knowledge into an autonomous field of study.

Chaban and Burdeinyi (2024) note that neuropsychology examines how brain function, mental processes, and behaviour are interconnected. Neuropsychologists are involved in diagnosing disorders and providing rehabilitation. They also work in educational settings, considering individual differences to promote the holistic development of children.

At the same time, Chaban and Burdeinyi (2024) emphasise that the brain regulates vital bodily functions and underpins behaviour, with thoughts, emotions, movements, and moods closely linked to its activity.Interhemispheric interaction is described as "a special mechanism of uniting the left and right hemispheres of the brain into a single system, formed under the influence of both genetic and environmental factors; it is necessary for brain activity and information transfer" (Lishchyshyna-Haruk, 2022, p. 21). It is possible to improve health and address difficulties in memory, speech, and movement. This, however, can only be accomplished through structured corrective work. Smoliak et al. (2024) state that higher mental functions can be assessed neuropsychologically through rapid tests, comprehensive clinical evaluations, observation, and longitudinal methods.

This study adopts a narrative review methodology. A narrative review was considered appropriate given the heterogeneity of the available literature, which spans foundational theoretical works, regional methodological manuals, and small-scale empirical studies across different populations and settings. The search for relevant publications was conducted across Google Scholar, Web of Science, and PubMed. Sources ranged from foundational works (Luria, 1976; Vygotsky, 1930/1978) to recent studies (2010–2025).

1.1. Selection Criteria

To ensure the quality of the sample, the following criteria were established:

• *Inclusion criteria*: articles published in peer-reviewed journals; monographs and methodological manuals with an evidence base; studies containing empirical data on work with preschool and primary school children; research devoted to the neurocorrection of developmental disorders.

• *Exclusion criteria*: publications lacking a scientific framework; popular articles in non-specialised media; works not related to the neuropsychological aspects of motor activity.

It should be noted that the review draws substantially on Ukrainian-language sources and regional methodological literature, which limits the international generalisability of the findings. Source selection and screening were conducted by the authors without independent inter-rater verification.

1.2. Literature Review Procedure

The literature review followed the procedure outlined below:

Screening: initial selection based on titles and abstracts (over 50 sources were identified).

Content analysis (full-text review): detailed examination of 21 sources that most fully met the aims of the study.

Data synthesis: comparison of approaches used by different authors (both Ukrainian and international) and systematisation of specific kinesiological techniques.

1.3. Theoretical Framework

The study is based on 1) the theory of systemic and dynamic localisation of higher mental functions (Luria, 1976); 2) the concept of sensory integration (Ayres & Robbins, 2005), and 3) the principles of neuropedagogy, which consider the brain as a plastic system sensitive to motor stimulation.

This article aims to: 1) explain the concepts of 'sensory integration' and 'kinesiology', 2) investigate neuropsychological methods for improving children's motor skills and spatial thinking, and 3) highlight the advantages of including kinesiological exercises in preschool neuropsychological programmes.

2. Exploring Child Neuropsychology: Sensory Integration and Intellectual Development

Child neuropsychology has received much attention, with Morgan and Ricker (2008) making a significant contribution. Their multi-volume work provides an in-depth analysis of neurodevelopmental disorders. The first volume focuses on conditions such as hydrocephalus, epilepsy, childhood traumatic brain injuries, brain tumours, and autism spectrum disorder. The second edition includes fifty new chapters, featuring articles by leading neuropsychologists.

Baron (2018) provides comprehensive information on the theory and practice of child neuropsychology. The scholar examines the mental state of children referred for neuropsychological assessment and highlights key characteristics of their brains. In addition, he offers tests to assess intellectual development, speech, attention, concentration, motor and sensory-perceptual functions, visual-perceptual and spatial skills, and memory.

Jensen and McConchie (2020) and Miller et al. (2019) discuss learning based on the principles of brain functioning. They provide a detailed account of brain activity and offer techniques and methods that can facilitate learning in young learners. Rowe et al. (2019) claim that the brain may not be ready for increased cognitive demands in cases of learning difficulties. To support such children, neuropsychologists have developed comprehensive exercise programmes. These exercises, designed for parents to use with children of different ages, aim to promote balanced and harmonious development.

Racu and Druguș (2024) emphasise that children with learning difficulties benefit from a supportive and comfortable educational environment. This often involves a dedicated classroom where communication among all participants is carefully organised. The scholars highlight common barriers to effective communication, such as misinterpreting the interlocutor, insufficient feedback, resistance to criticism, and intrusion on personal space. They propose solutions to improve teacher–child communication, including a model specifically designed for children with learning difficulties. They also stress that teachers must recognise the importance of communication, as every child is unique and has a strong need to interact.

Hankle et al. (2021) offer engaging tasks that effectively support intellectual development. They range from drawing with both hands to creating stories from keywords, along with other approaches. Calo (2025) suggests some techniques for improving children's thinking, attention, and memory.

Ayres and Robbins (2005) highlight the role of sensory integration in child development. Children raised even in stimulating environments may still exhibit inattentive or disruptive behaviour at school if they experience difficulties with sensory integration. In addition to the traditional five senses, the vestibular and proprioceptive systems play a critical role in organising sensory input. Sensory integration enables the brain to process, filter, and prioritise incoming information, supporting coordinated motor responses, perceptual accuracy, and emotional regulation (Ayres & Robbins, 2005). When sensory integration functions adequately, children are better equipped to control their movements, attend to learning tasks, and respond appropriately to their environment.

Trykoz and Blech (2019) note that intellectual difficulties, particularly delayed mental development, frequently result from organic damage to the cerebral cortex, though they emphasise that such difficulties represent a specific developmental trajectory rather than a fixed limitation of the child's potential. Children with intellectual difficulties may acquire skills more slowly and may not achieve certain developmental milestones within typical timeframes. The severity of these difficulties ranges from mild to profound. Children with mild developmental delays may lag behind peers in motor and language milestones, show reduced curiosity about their environment, demonstrate limited vocabulary, and experience difficulties in peer interaction, including following the rules of games and communicating effectively (Trykoz & Blech, 2019).

Despite these difficulties, Trykoz and Blech (2019) state that children who regularly participate in correctional and developmental classes benefit from targeted methods. Such children are provided with the opportunity for comprehensive development and successful learning.

3. Neuropsychological Approaches to Developing Motor Skills and Spatial Thinking in Children

Turubarova and Kirillova (2025) present current approaches to neuropsychological practice. They provide a range of exercises designed to correct graphomotor skills and develop spatial representations in children of primary school age. The authors note that underdevelopment of certain mental functions is a key cause of specific written speech difficulties. Dysgraphia and dyslexia are often associated with weak fine motor skills, poor spatial-temporal movement organisation, and reduced coordination.

To develop general and fine motor skills and improve a child’s coordination, Turubarova and Kirillova (2025) propose neuropsychological exercises for corrective intervention. Motor skills can be enhanced through drawing, modelling, finger games, and puzzles. Visual-spatial skills benefit from activities that promote spatial orientation and understanding. Spatial imagination and reasoning are developed by working with construction sets to strengthen problem-solving. Graphomotor skills are practiced through tracing, shading, and completing drawings. Sequencing and movement patterns improve by copying models to practice order and coordination. Movement regulation and control can be trained with exercises alternating between slow and fast movements. Inter-analysator coordination is fostered by combining tactile and drawing tasks with verbal guidance. Attention and visual memory are supported through exercises that involve memorising and recreating patterns.

At the same time, Berezovska (2022) suggests a range of activities to support the development of spatial representations in preschool children. These include mathematical tasks, outdoor walks, active games, music lessons, and visual arts, as well as everyday routines such as dressing, undressing, and taking turns. Children should also become familiar with maps, plans, diagrams, and markings to strengthen their spatial awareness. In addition, literary texts and dramatisation games can further enhance this understanding. Educators are advised to structure activities from simple to complex while using engaging game-based methods.

Kuksa (2013) provides guidance on organising classes aimed at developing graphomotor skills in children with cerebral palsy. Graphic activities in correctional classes should focus on several key areas: 1) *correction of motor dysfunctions* (exercises designed to reduce spasticity in

small muscles, strengthen weak muscles, and develop fine movements through finger gymnastics, dynamic coordination, and serial organisation of movements); 2) *development of fine motor skills* (manipulative games to enhance grasping, hand and finger mobility, coordination of fine movements, kinesthetic awareness, and stereognosis); 3) *enhancement of visual-spatial perception and visual-motor coordination*; and 4) *cultivation of graphic activity skills* (Kuksa, 2013).

Panhelova and Krutsevych (2019) highlight the close relationship between motor function and speech. Physical activity supports not only motor development but also cognitive growth and key mental processes. Active movement facilitates preschool children's intellectual and emotional development, while also supporting the establishment of behavioural routines (Panhelova & Krutsevych, 2019).

4. Kinesiological Exercises to Support Motor, Cognitive, and Emotional Development in Preschool Children

Sydoruk and Yarmoshevych (2025) emphasise the value of kinesiological exercises for preschool children, particularly those with Down syndrome. They note that the development of general motor and physical activity, articulation, and finger gymnastics are the most important indicators of a child's condition.

The term 'kinesiology' is used in diverse ways across disciplines. In the context of this review, it refers to the application of structured movement exercises, including active and passive movements and therapeutic exercises, aimed at achieving specific developmental outcomes (Sydoruk & Yarmoshevych, 2025). In the neuropsychological literature reviewed here, kinesiology is understood more specifically as the use of movement to stimulate brain development and interhemispheric coordination (Lishchyshyna-Haruk, 2022). It should be noted that this usage differs from the broader academic discipline of kinesiology (the study of human movement) and from applied kinesiology, a controversial practice in complementary medicine.

Kinesiological exercises promote harmony and coordination between the left and right hemispheres of the brain. They also support the development of memory, imagination, attention, and thinking, as well as the acquisition of reading and writing skills.

Researchers recommend including a range of exercises for children with Down syndrome in neuropsychological classes at kindergartens or rehabilitation centres. General and fine motor skills can be developed through walking along a narrow path, running, and jumping, while drawing and arranging small objects improve fine motor skills. Facial gymnastics allows children to express emotions (e.g., joy, sadness, or surprise). Breathing exercises involve blowing up balloons or moving a paper ribbon with a fish.

Given that fine motor skills support communication and play, they are rather important. Kinesiological exercises should progress from simple to more complex movements, be demonstrated clearly, and performed at a comfortable pace. Activities should be enjoyable and encourage children to practice them independently.

Lishchyshyna-Haruk (2022) presents a wide range of kinesiological exercises and emphasises how physical movement is transformed into a neurophysiological impulse. Neuroplasticity and the corpus callosum are essential for linking theoretical principles and their practical implementation. At the same time, the corpus callosum serves as the main 'bridge' for the exchange of information between the hemispheres.

To illustrate the neuropsychological principles discussed above, the following exercises, which were drawn from the reviewed literature, demonstrate how kinesiological activities can be linked to specific neural mechanisms.

These examples are not an exhaustive clinical protocol but rather illustrative cases showing the theoretical rationale for movement-based interventions in preschool settings.

1. Brain gymnastics (Drawing with both hands)

Theoretical justification. The fine motor skills of each hand are controlled by the opposite hemisphere (Luria, 1976). Simultaneous use of both hands requires the hemispheres to operate in a coordinated temporal and spatial rhythm.

Neuropsychological mechanism: This exercise activates the corpus callosum, thereby enhancing the conductivity of neural pathways. It also promotes the integration of visual perception (processed by the right hemisphere) and graphic production (regulated by the left hemisphere). As a result, it improves reading and writing processes, which rely on the rapid transmission of symbolic information between the brain's analytic centres.

2. Tree (Stretching and balance)

Theoretical justification: The exercise engages the vestibular and proprioceptive systems (Ayres & Robbins, 2005). Slowly elongating the body and balancing activates brainstem structures and the cerebellum.

Neuropsychological mechanism: This exercise activates the first functional unit of the brain (the block regulating tone and wakefulness). It also ensures adequate energy tone, which is essential for sustained attention. Furthermore, it helps develop the body schema, forming the foundation for understanding spatial prepositions ('above', 'under', 'left', and 'right'). A reduction in muscle tension leads to a rise in the child's energy potential and the maturation of self-control.

3. Steps (Moving fingers in different directions)

Theoretical justification: Based on the theory of reciprocal coordination, the exercise requires simultaneous inhibitory and excitatory responses, with one finger moving while another remains fixed or moves differently.

Neuropsychological mechanism: This exercise develops the frontal lobes, the third functional block according to Luria (1976), which are responsible for planning and controlling activity.

It synchronises the motor areas of the cortex to prevent movement perseverations. It also prepares the hand for writing and supports speech fluency, since articulation and fine motor skills share common regulatory areas.

4. Candle (Breathing exercises)

Theoretical justification: The only function of the autonomic nervous system that individuals can control is breathing. It serves as a bridge between unconscious processes and voluntary regulation.

Neuropsychological mechanism: Oxygenation of the brain activates the limbic system, supporting emotional intelligence. Rhythmic breathing calms the right hemisphere (emotional processing) and allows the left hemisphere to focus on logical analysis. Emotional stability improves and anxiety is reduced before complex educational tasks.

The systemic connection between theory and practice is that movement acts as a 'trigger' for neural connections. If the connection between the hemispheres is weak, information can become 'stuck' in one of them, appearing as forgetfulness or inattention. Exercises such as *Brain Gymnastics* and *Tree* physically encourage neurons to create new pathways for interaction, forming the basis of successful learning (see Table 1).

Thus, kinesiological exercises are a promising approach for supporting the neuropsychological development of preschool children.

They help to synchronise the activity of the brain's hemispheres, which is essential for coordinated functioning. Systematic use of such exercises enhances cognitive activity, regulates the body's rhythm, and improves the child's readiness for learning.

Table 1. Detailed empirical findings on kinesiological exercises in preschool classes

No.	Author, year	Sample parameters (n) and age	Statistical indicators (p, d)	Key empirical findings
1	Sydoruk & Yarmoshevych (2025)	n = 24; 5–6 years (Down syndrome)	$p < 0.05$; increase on Ozeretsky scale	Improvement in static coordination by 28% and dynamic coordination by 19%
2	Lishchyshyna-Haruk (2022)	n = 42; 4–6 years (preschool)	$p < 0.01$; high correlation movement/language	Increase in active vocabulary by **35%** compared with control group
3	Smoliak et al. (2024)	n = 56; 5–7 years	Cohen's $d > 0.8$ (large effect size)	Attention concentration increased by 42% over 3 months (correction test)
4	Kuksa (2013)	n = 18; 6–7 years (cerebral palsy)	$p < 0.05$; positive GMFM dynamics	Graphic test completion time reduced by an average of 45 sec
5	Turubarova & Kirillova (2025)	n = 38; 6–8 years (New Ukrainian School)	$p < 0.001$; significant difference in errors	Specific letter substitution errors decreased by 2.4 times

Source: Compiled by the authors from the cited sources. Sample sizes are small (n = 18–56), and methodological details of the original studies (e.g., control group design, randomisation procedures) vary. Results should be interpreted with caution and are presented to illustrate the direction of findings rather than to establish definitive effect sizes.

5. Limitations and Precautions when Using Kinesiology Exercises

Despite being a promising approach, the practical application of the neuropsychological approach has certain limitations that teachers and parents should consider.

Individual health status. Kinesiological exercises that actively stimulate brain function may be contraindicated for children with epilepsy, severe organic lesions of the central nervous system, or during exacerbation of somatic diseases. In some cases, they may require strict dosage. Excessive stimulation can provoke undesirable neurodynamic activity

Time delay and regularity. The effect of neuropsychological classes is cumulative. Short-term or episodic performance of exercises does not lead to stable structural changes in interhemispheric interaction. The minimum period for noticeable results is usually two to six months of regular training.

Risk of nervous system fatigue. For children with increased exhaustion (asthenia), overly intense or prolonged classes can have the opposite effect, leading to overfatigue, irritability, and reduced cognitive performance. It is important to alternate periods of exercise with relaxation.

Need for a comprehensive approach. Kinesiology cannot completely replace other forms of correction (speech therapy, psychological intervention, or medication) if the disorders have a deep pathological basis. It is a powerful but auxiliary component of the overall rehabilitation system.

Incorrect performance of exercises, such as violating the sequence of movements or ignoring the child's posture, therefore negates their benefit. Teachers must understand the neurophysiological basis of each movement, rather than simply copying it mechanically.

Methodological limitations of the review itself should also be acknowledged. The reviewed studies rely on small sample sizes (n = 18–56), and several key sources are published in Ukrainian-language regional journals and conference proceedings rather than in internationally peer-reviewed outlets.

The present review did not employ systematic review procedures such as independent screening by multiple reviewers or formal risk-of-bias assessment. Consequently, the findings should be regarded as indicative rather than conclusive, and future research employing larger samples, randomised controlled designs, and validated outcome measures is needed to confirm the effectiveness of kinesiological interventions for preschool populations.

6. Conclusions

This narrative review examined the role of kinesiological exercises in neuropsychological classes for preschool children. Three main findings emerge from the reviewed literature. First, the available evidence suggests that kinesiological exercises represent a promising approach to supporting the neuropsychological development of preschool children. Studies reviewed here report improvements in motor coordination, attention, vocabulary, and graphomotor skills following structured kinesiological interventions, though these findings come from small-sample studies with varying methodological rigour. Second, the theoretical rationale for kinesiological exercises is well-grounded in established neuropsychological frameworks. Movement-based interventions may promote interhemispheric synchronisation through activation of the corpus callosum, and they engage multiple functional brain systems simultaneously - including those responsible for motor regulation, attention, and executive function. Third, practical implementation of kinesiological exercises in preschool settings is feasible and can be integrated into existing educational programmes, provided that educators understand the neurophysiological basis of the exercises and adapt them to individual children's needs and health status. However, the evidence base remains limited. Future research should employ randomised controlled designs with larger, more diverse samples and validated outcome measures to establish the effectiveness of kinesiological interventions more conclusively. Longitudinal studies examining whether short-term gains translate into sustained developmental benefits would be particularly valuable.

7. Statement on the Use of Artificial Intelligence

The authors used ChatGPT (OpenAI) to assist with language editing and manuscript organisation. The conceptual framework, literature analysis, interpretation of findings, and formulation of conclusions were conducted exclusively by the authors. The AI tool was not used to generate content, conduct literature searches, or evaluate sources.

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