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Criteria for diagnosing cognitive development of preschool children with autism spectrum disorders: A literature review

Hanna Andriienko*

Postgraduate Student

Poltava V.G. Korolenko National Pedagogical University

36003, 2 Ostrohradskyi Str., Poltava, Ukraine

<https://orcid.org/0009-0005-5784-5527>

Abstract. The relevance of the problem under investigation was determined by the introduction of inclusive education, which ensured the realisation of the right of all children, regardless of their mental and physical health, to receive a general education. The aim of the article was to examine approaches to determining the criteria for the cognitive development of children with autism spectrum disorders, based on which the main diagnostic criteria were identified, enabling a comprehensive characterisation of the cognitive development of preschool children with the studied nosology. The methodology of the study was based on a comprehensive analysis of contemporary scientific literature in the field of cognitive development of children with autism spectrum disorders, particularly focusing on the study of cognitive development criteria. Throughout the research, a detailed analysis of conceptual approaches to defining the term "cognitive development" was conducted, as well as the identification of specific characteristics of cognitive development in children with autism spectrum disorders. Special attention was paid to the challenges faced in diagnosing the cognitive development of such children, as well as to the analysis of complex disorders typically observed in preschool children with autism spectrum disorders. The article outlined the peculiarities of perception, attention, speech, intelligence, control, and planning of activities, among others. A review of the main diagnostic methods for cognitive functions, motor skills, and perceptual abilities was provided, with an emphasis on their potential application in corrective work with children with autism spectrum disorders. The findings obtained can be used to diagnose and correct the cognitive sphere of children with autism spectrum disorders, with the aim of integrating them into the system of inclusive education and ensuring access to quality education in accordance with their individual capabilities and the characteristics of their cognitive development

Keywords: atypical behavioural disorders in autism; inclusive education; cognitive development indicators; development of cognitive functions; cognitive impairment

Introduction

A modern child is forced to grow up in a world that is saturated with information. There are growing demands on a child, especially on their cognitive abilities, ability to perceive, process and transform information, as well as to acquire practical experience. In today's reality, even a child with normal and typical development often has peculiarities in the functioning of the cognitive sphere, and what was considered normal a few years ago is now viewed quite differently. There are completely different requirements for a child, and different criteria for their development are applied.

At the same time, there is a tendency of the frequency increase of mental disorders in children, including

autism spectrum disorders (ASD), in clinical practice. An analysis of statistical data from the Ministry of Health of Ukraine, as reported by the Ukrinform (2023), revealed that by the end of 2023, 20,936 children in Ukraine had been registered with ASD. This was related to the influence of objective factors (environmental, genetic, social), on the one hand, and to the improvement of diagnostics, the establishment of clear diagnostic criteria for distinguishing ASD from other conditions, on the other. Yu. Grechanina (2019) presented data showing that 70-75% of children with autism (particularly those with atypical autism) experienced some degree of intellectual deficiency. The author

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*Corresponding author



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emphasised the uneven development of intellectual functions in individuals with autism. While certain intellectual abilities might surpass age norms, others might significantly lag behind, illustrating the heterogeneous nature of autism's impact on cognitive development.

In addition, ASD was associated with several comorbidities that affect the development of the cognitive sphere (epilepsy, analyser disorders, neuroinflammation, etc.). Several researchers, as H. Hughes *et al.* (2023) and N. Usui *et al.* (2023) highlighted neuroinflammation as one of the main comorbid conditions associated with ASD. Neuroinflammation was often cited as a key contributor to cognitive impairments in individuals with autism. Studies showed that neuroinflammation, through mechanisms like immune dysfunction and oxidative stress, played a significant role in the cognitive and behavioural challenges faced by children with ASD.

Ukrainian researchers, such as D.I. Shulzhenko & M. Porodko (2020) studying cognitive functions in children with autism, emphasised the specifics of memory, thinking, attention and speech development. Their work analysed how certain cognitive aspects were disrupted by the characteristic features of autism, such as deficits in social interaction and communication, as well as an excessive focus on details. The findings of these studies formed the foundation for creating corrective programmes that addressed the unique needs of children with autism, particularly in adapting educational strategies and employing individualised approaches to learning. European and American scientists drew attention to this aspect.

Scientists have been increasingly interested in studying the cognitive sphere of children with ASD. P. Ampe & E. Rammant (2023) referred to the data from the National Autistic Society and the High Health Council of Belgium, which showed that 0.6-1.1% of the population fell within the autism spectrum. Difficulties in grasping meaning were often associated with intellectual disabilities (in 60% of cases, the IQ of individuals with autism is below 50). However, even among those with average or above-average intelligence, challenges in interpreting and comprehending the meaning of information persisted. According to P. Ampe & E. Rammant (2023), individuals with autism were limited in their ability to interpret information and understand its significance. This limitation highlighted the need for tailored interventions that considered both cognitive and sensory processing difficulties common among autistic individuals. According to the authors, despite these variations, current diagnostic criteria adopted a single autism label. These criteria implicitly emphasised commonalities among individuals, such as core social-communication difficulties and challenges related to restricted, repetitive behaviours. This perspective underscored the need for a nuanced diagnostic approach that accommodated the diverse profiles within the autism spectrum. It called for criteria that not only identify shared

difficulties but also highlighted the unique developmental trajectories and needs of individuals.

G. Russell *et al.* (2019) reported that approximately 50% of the population with ASD also presented with intellectual disability (ID). However, the authors highlighted a significant selection bias in most studies on cognitive development in individuals with autism. This bias stemmed from recruitment challenges, as children and adults with more severe intellectual and functional difficulties were harder to engage and retain in research studies. Consequently, the existing body of research might disproportionately represent individuals with higher intellectual abilities, leading to an incomplete understanding of the full spectrum of cognitive profiles in ASD. This underscored the need for more inclusive research methodologies that better account for the heterogeneity of cognitive and intellectual abilities within the autism spectrum.

Numerous studies of the development of children with ASD do not solve the whole range of problems related to the diagnosis and correction of their cognitive disorders. The issue of defining clear criteria for the diagnosis of cognitive development remains problematic, which would allow to distinguish autism from other diseases and develop appropriate recommendations for the correction of the identified disorders. Thus, the purpose of the article was to study defining criteria for the cognitive development of children with ASD.

The research involved analysing contemporary scientific studies. Specific inclusion and exclusion criteria were established: studies focused on the cognitive development of children diagnosed with ASD; peer-reviewed articles published in reputable journals; and research emphasising the use of validated tools or criteria for assessing cognitive development. Excluded were studies without clear diagnostic criteria for ASD, those focusing solely on interventions without considering cognitive development characteristics, and non-empirical research. For the analysis, scientific databases such as PubMed, Scopus, Web of Science, Google Scholar, and specialised repositories like SpringerLink, ScienceDirect were utilised. The literature search employed keywords such as: "autism spectrum disorder", "cognitive functions", "intellectual development disorders", "cognitive development in autism", "praxis development", "motor skills assessment", and "sensory-motor integration". Searches were conducted in both English and Ukrainian. Search queries were constructed using logical operators to refine results, for instance: "autism spectrum disorder" AND "praxis assessment"; "motor coordination" OR "dynamic balance" AND "children with developmental disorders". The analysis included studies published from 2010 to 2023.

Various text analysis methods were applied for synthesising and interpreting the included studies: content analysis, comparative analysis (examining differences in criteria, methodologies, and conclusions across

studies to identify trends and gaps), and categorisation (grouping studies by variables such as age groups, assessment methods, and intervention strategies). In the initial phase of the search, 345 sources were identified. After analysing titles, abstracts, and full texts, 76 relevant studies met the inclusion criteria. The final analysis included 58 publications that satisfied the following criteria: clear methodology, presence of a control group, and a focus on the development of cognitive functions in children with ASD.

Definition of cognitive development and its features in children with ASD

Theoretical aspects of a child's cognitive development were covered by J. Piaget (1990). His works were foundational in the study of cognitive development and had significant implications for understanding and supporting children with ASD. His theories of developmental stages-sensorimotor, preoperational, concrete operational, and formal operational highlighted the progressive nature of cognitive growth and provided a framework for assessing the unique developmental trajectories of children with ASD (Chekster, 2008). It was necessary to define the concept of cognitive development in order to determine qualitative diagnostic criteria. Some scientists associated cognitive development exclusively with the development of thinking (Cole *et al.*, 2005). J.S. Bruner (2015) focused on narrative thought and the use of symbolic systems (e.g., language, storytelling) further supported strategies for enhancing communication and cognitive skills in children with ASD. His research on language acquisition and its interaction with cognition provided valuable insights for addressing the linguistic and cognitive challenges faced by children with ASD. His work on semantic development and the mechanisms through which children acquired meaning contributed to understanding how children with ASD processed language differently. This understanding helped in creating tailored interventions to support their linguistic and cognitive development, emphasising the interplay between language and thought. In cognitive psychology (Schopler *et al.*, 1980), development was described as "complex result of the development of thinking, which begins from the very moment of birth". S.D. Odermatt *et al.* (2022) emphasised that individuals with autism often exhibited cognitive and developmental impairments, in addition to the core symptoms of limited social communication skills and repetitive behaviours. Based on research in this area, the concept of uneven cognitive profiles in autism was developed. This concept suggested that individuals with autism might show strengths in certain cognitive areas while struggling in others. For example, many people with autism performed better on non-verbal tasks such as abstract reasoning and spatial abilities. The findings of these researchers highlighted that individuals with autism experienced difficulties, particularly in motor

and language skills, which should be considered in autism treatment alongside the core symptoms and intellectual functioning. Moreover, the authors pointed out that motor skills were often overlooked in autism diagnostics, and they might deserve more attention. Minor group differences in social-emotional skills could result from compensatory effects in individuals with average cognitive abilities within the autism sample. This emphasised the importance of a nuanced approach to both, diagnosis and treatment. Researchers also compared the cognitive development of children with ASD and their typically developing peers. These studies aimed at understanding the differences and identifying specific areas of cognitive strengths and challenges.

D.G. Amaral (2017) and colleagues at the UC Davis MIND Institute studied cognitive variations in children with ASD, highlighting how certain cognitive skills, such as problem-solving, differed between children with ASD and those with typical development. This work emphasised variability in cognitive skills within the ASD population. L. Kenworthy (2009) and her team investigated executive functioning and cognitive flexibility in children with ASD compared to typical peers. Their work explored how deficits in these areas impacted everyday functioning and learning. Research published by the Society for Research in Child Development (Pellicano, 2010) suggested that cognitive skills in children with ASD were not static but could improve with targeted interventions. This highlighted the developmental trajectories of children with ASD versus typically developing children.

Traditionally, the main criteria for cognitive development were the development of all types of cognitive processes, such as perception, thinking, memory, imagination and attention in accordance with age-related norms. Proponents of test-based concepts saw IQ as a criterion of cognitive development, which was also defined differentially based on age. However, it was difficult to trace the dynamics of all components of the cognitive sphere on the basis of intelligence tests (Wexler, Guilford, Stanford-Binet) (Peeters, 1997).

The analysis of existing publications demonstrated the heterogeneity of approaches to the definition of "cognitive development". While some authors as M.I. Porodko (2017) and L.I. Prokhorenko *et al.* (2020) focused more on the development of cognitive processes (competence approach), other authors (Mohammadzaheri *et al.*, 2021) considered cognitive development as a more extensive process that included all possible components of development – from sensory (sensation and perception) through motor to intellectual and communicative ones.

When analysing the data presented in the scientific literature, it was notable that the correlation between ASD and cognitive development was uncertain. For example, psychiatrist E. Bleuler (2022), who was considered to be the author of the term "autism", called the

restructuring of all mental activity, profound changes in thinking and the affective and volitional sphere an important symptom of autism. E. Bleuler contrasted autistic thinking with real, normative thinking. According to him, it was not guided by the laws of logic or the realities of objectively existing reality, but by one's own internal needs and affective drives. L. Yau (2019) analysing Brewer's (William F. Brewer) works concluded that his insights on cognitive processes contributed significantly to understanding the dynamics of information encoding and retrieval. She emphasised how predecessor's research highlighted the interplay between memory structure and individual contextual experiences, which was particularly relevant in cognitive developmental studies and adaptive learning strategies. This conclusion reflected Brewer's foundational work on the schema theory and its implications for cognitive flexibility and developmental adaptations in diverse learning contexts. For example, exploration of how schemata influence memory and comprehension informed broader theories of cognitive development, particularly when applied to populations with atypical development such as ASD.

Some authors, such as D. Spain *et al.* (2015) suggested, based on their own research, that children with autism showed a general deficit in cognitive skills, especially when it came to the processes of multilevel planning and behaviour regulation. Thus, the presence of cognitive development deficits in children with ASD became evident and had different degrees of severity and different forms of manifestation.

The peculiarities of cognitive development of children with autistic disorders have been actively studied in worldwide science. T. Attwood (2004) studying Asperger's syndrome drew attention to the impairment of certain cognitive functions and social intelligence. K.D. Tsatsanis & K. Powell (2014) studied the neuropsychological characteristics of children with autism. Among Ukrainian researchers, special attention should be paid to the works of K. Ostrovska *et al.* (2018), T.V. Skrypnyk (2019), who described the symptoms of autism and approaches to correcting behaviour and cognitive functions. Kh.V. Kachmaryk (2017) paid special attention to the development of communication and cognitive skills. Certain aspects of diagnostics and correction of intellectual development, formation of social competences, and development of the communicative sphere of children with ASD were presented by the scientific school of V.M. Syniov & V.Ye. Kovalenko (2019).

K. Denisova & Z. Lin (2023), in their research on cognitive functions in autism, emphasised the importance of understanding atypical neural connectivity and processing patterns, particularly in relation to sensory integration, memory, and executive functions. Their studies suggested that disruptions in these areas could lead to challenges in adaptive functioning and learning. They also highlighted the variability in

cognitive profiles among individuals with autism, which necessitated personalised approaches in assessment and intervention strategies. In many cases, such as mental retardation, hearing or visual impairment, and speech disorders (sensory allergy, childhood aphasia, complex forms of dysarthria), secondary autism could be observed, which often led to misdiagnosis. This was emphasised by M.F. Casanova *et al.* (2020). The work discussed the distinction between secondary autism, which known causes (such as genetic syndromes or metabolic disorders), and idiopathic autism, which causes remained unknown. According to the authors, clarifying these forms was essential as it affected approaches to diagnosis, treatment, and rehabilitation. They also emphasised a nuanced understanding of autism, focusing on the interplay between neurodiversity, autonomy and human dignity. This perspective challenged traditional deficit-based systems and explored how people with ASD could thrive through personalised approaches to their cognitive and social needs.

V. Mandelli *et al.* (2024) emphasised the heterogeneity of early linguistic, intellectual, motor, and adaptive features (LIMA), which stood out as some of the most distinguishing characteristics of different types of autism. K.M. Antshel & N. Russo (2019) explored the parallels between the mechanisms of ASD and Attention Deficit Hyperactivity Disorder (ADHD), emphasising the shared cognitive impairments. They identified issues with attention, perception, and motor control as central challenges in both conditions. These impairments hindered the acquisition of information, social experiences, and practical skills. Moreover, they were significant contributors to behavioural disorders, including impulsivity and difficulty adapting to changes or interacting with others. The authors argued that these cognitive difficulties were primary obstacles to learning and skill development. Their findings highlighted the importance of designing programmes that addressed the unique cognitive needs of individuals with ASD and ADHD, aiming to improve educational and therapeutic outcomes. This perspective underscored the necessity for interdisciplinary approaches combining psychological, educational, and neurological interventions to effectively support individuals with these conditions. Qualitative diagnostics of the cognitive sphere allowed not only to determine the child's readiness for school, the level of support and the content of education, but also to develop an appropriate correctional route, which was important for the implementation of corrective measures (Bleuler, 2022).

The dynamics of the development of the cognitive sphere was the subject of consideration by representatives of various scientific concepts, however, they all agreed that cognitive development was determined by the maturation of brain areas associated with the implementation of certain cognitive functions. In a child, the development of these processes occurred in

accordance with scientifically defined stages of ontogenetic development and in parallel with the development of other body and mental functions.

The brain structures responsible for the implementation of higher mental functions were highly differentiated areas that created various interacting systems that united both cortical and subcortical levels of the brain. Therefore, the development of the relevant functions was determined not only by ontogenetic factors but also by individual characteristics (the speed and quality of maturation of the relevant brain structures, the presence of functional disorders, and social factors).

The classic of cognitive development research, the author of the constructivist theory of cognitive development, associated this process with the stage-by-stage transition of the human psyche to a higher level with the involvement of newly formed structures. J. Piaget (1990) believed that the basis of the ontogeny of the human psyche was the development of its intellect, and the stages of mental development, according to his theory, were the stages of intellectual development. The author associated development with the process of human adaptation to the environment. According to her, intelligence was the core of mental development because it ensured adaptation to the world through understanding internal and external processes. Adaptation was always an active interaction of an individual with the environment, not a passive process. Activity was a necessary condition for development, as the scheme of the world was not given to a child in a ready-made form at birth, but was developed in the process of active interaction between a person and the environment. Intelligence helped to analyse environmental influences, formed appropriate responses to these influences, and adjusted reactions in accordance with the changes that occurred in the environment.

A child with ASD often had a disruption of the adaptation process, which was associated with detachment from the world, impaired perception and processing of information from the outside, and limited communication (communication problems interfered with learning from the experience of others and communicating to coordinate actions with other people).

It was widely believed that autism was a problem of involving different areas of the brain in communication with each other, so brain development followed a different path from the norm. I. Sukhina *et al.* (2017) suggested that "certain disorders of the nervous system cause incorrect mental reflection at the level of sensations, which in turn causes disruptions in many mental functions and processes, including social cognition".

Thus, in normal and typical development, during the first stage (sensorimotor stage according to J. Piaget (1990)), a child learnt about the world through their own sensations and primitive actions (looking, listening, touching, smelling and tasting, crushing, throwing, pulling, etc. Initially, innate reflexes became

the basis for the child's exploration of the environment, on the basis of which new schemes of cognition of the world were gradually formed. However, in the case of children with ASD, new schemes of cognition of the world and reactions to stimuli were not formed or were formed with significant delays. The child continued to use primitive reflexes, which sometimes made their behaviour strange and their reactions inadequate to the situation. In addition, researchers L. Balasco *et al.* (2020) reported impaired auditory, visuospatial and tactile perception (distinguishing tactile stimuli and processing tactile information) in children with ASD. At the sensory level, a child with ASD might have specific problems in the functioning of analysers. Many visual images, sounds, smells, and tactile sensations could be perceived as unpleasant and even painful for children with autism. A human voice could be perceived by a child with ASD as a piercing scream, and a light touch as a sharp pain. Sensory deficits were very common among children with ASD. Hyper- and hyposensitivity to certain stimuli, excessively selective attention and impaired attention shifting between different sensory signals, as well as disorders related to the coordination of different sensory modalities were problems that almost every child with ASD faced.

Some authors, such as B.F. Pennington & S. Ozonoff (1996), suggested that children with autism showed a general deficit in cognitive skills in the processes of multi-level planning and in regulating their behaviour. These processes, called regulation and control functions, provided effective solutions to cognitive tasks. These functions allowed to block inappropriate behaviours, perform meaningful actions, continuously maintain the process of performing a task, conduct self-monitoring, establish feedback, and smoothly transition from one task to another. The existence of a general deficit in cognitive skills in leadership roles for people with autism was evidenced by the difficulties they experience in some cognitive activities. These included: organising, planning, changing cognitive attitudes, releasing distracting stimuli, processing information in changing, non-trivial conditions, and generalising previously learnt information to analyse new situations (Ozonoff *et al.*, 2011).

V.Y. Bocheliuk *et al.* (2023) noted that from the point of view of neuropsychology, children with autism were characterised by the following disorders: reduced ability to receive, process, store and use information; difficulties in verbal mediation; slowed formation of concepts; difficulty in forming the motive-goal-task triad. According to the authors, due to such neurobiological features of the brain as impaired formation of connections between brain areas that would ensure the integration of different types of information and the formation of a holistic perception of the world, autistic children processed information mainly as monochannel, that is, the child's attention could be focused on only

one sensory channel (mainly visual) at a time, while information from other perception channels was ignored.

According to the works of authors, such as S.H. Baum *et al.* (2015), autism could be characterised by sensory dominance and excessive selectivity in the perception of certain stimuli. The concept of sensory dominance and selectivity in autism was discussed in research related to sensory processing difficulties, which were common in individuals with ASD. For example, children with ASD often demonstrated food selectivity linked to sensory sensitivities, such as texture, smell, or temperature of food. Researchers like A. Ali-brandi *et al.* (2023) highlighted that sensory issues, such as heightened or diminished responses to sensory stimuli, contributed to behaviours like food refusal or preference for certain foods. Sensory dominance was the tendency to focus attention on stimuli of a certain type while reducing the perception of other stimuli. Excessive stimulus selectivity was a tendency to focus attention on certain characteristics of objects or the environment while ignoring other, equally important characteristics. With such peculiarities of perception, it often seemed that a child with ASD had tunnel vision or hearing, which interfered with the holistic perception of objects and phenomena around them and made it very difficult for them to explore the world around them. As a result, certain properties of perception (objecthood, integrity, structure, constancy and meaningfulness) might be impaired or agnosia-like states might occur.

The next stage was characterised by the acquisition of speech. Unlike the previous stage, where a child had the opportunity to reflect the surrounding reality with the help of specific visual, auditory, olfactory and other signals, at the operational stage (normally from 2 to 7 years), the child began to perceive the surrounding reality with the help of generalised abstract concepts expressed in words: through understanding the meaning of words spoken by the child or others, and visible words, written or printed ones. This contributed to the expansion of experience and the acquisition of the first mental operations. These actions, however, were limited to the child's immediate experience and were therefore local, specific and egocentric. Speech was a way of interacting with the world and a manifestation of intellectual activity, and in case of communication disorders, observed both a delay in speech activity and impaired development of the cognitive sphere.

According to the age periodisation of cognitive development proposed by J. Piaget (1990), the first two stages corresponded to the period of preschool childhood. The formation of more complex forms of thinking, arbitrariness of mental processes fell on later periods of child development and was not the subject of this article. Although, it was quite obvious that the foundation for the development of complex forms of thinking and methods of self-regulation was laid in the first two stages. It was worth noting that preschool age laid the

foundation for the further development of all mental structures: cognitive, emotional and volitional, motivational spheres and the social component of personality development (Pierce *et al.*, 2011). Therefore, the problems of passing through the previous stages affected the development of not only the cognitive sphere, but also the psyche as a whole. For example, non-integrated reflexes and underdevelopment of the sensorimotor sphere hindered the formation of conscious actions, and speech disorders interfered with communication and the development of intelligence and higher forms of thinking. Uninformed basic thought operations did not allow a child to adequately perceive the surrounding reality, analyse and abstract what is happening around them.

Criteria for cognitive development in ASD and problems of cognitive function assessment

The problems of determining diagnostic criteria for cognitive development and finding appropriate diagnostic methods were covered in the works of S. Baron-Cohen & A.M. Leslie (1985). This hindered the development of new skills and new forms of interaction with the world. Diagnostics of ASD was based on the diagnostic criteria of ICD-10 and DSM-IV, which considered ASD as not a disease with a specific aetiology and pathogenesis, but as a syndrome with atypical behavioural disorders and signs of deformed general development. R. Lordan *et al.* (2021) provided a comprehensive analysis of diagnostic criteria and tools used for ASD. They emphasised that current diagnostic practices relied heavily on observational screening instruments designed to measure the social and cognitive abilities of children. Two key tools widely used in ASD diagnostics were the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition) and M-CHAT (Modified Checklist for Autism in Toddlers). These tools focused on identifying persistent deficits in social interaction and communication. The DSM-5 outlined specific behavioural and developmental domains, providing a structured framework for diagnosing ASD. M-CHAT was particularly effective for early detection in toddlers, using a checklist format to screen for risk factors and developmental delays in social engagement and communication. Both tools were aimed to ensure a holistic understanding of a child's developmental profile, which was crucial for forming accurate diagnoses and tailoring interventions.

In children with ASD, there were usually two types of cognitive skills deficits or cognitive deficits (Happé & Frith, 2020): specific cognitive deficits associated with a lack of skills in processing socially significant emotional information; general cognitive deficits associated with a lack of information processing, planning and concentration skills. However, while deficits in the processing of socially relevant emotional information were mostly considered as a specific diagnostic criterion for ASD, general cognitive deficits could be a sign of other

disorders, including those associated with trauma and organic brain disorders.

M. Williams & S. Schellenberg (1996), in their modification of the learning pyramid (Fig. 1) reflected the importance of sensorimotor and perceptual-motor spheres for the success of cognitive (learning) skills.

The pyramid demonstrated that cognitive and learning abilities were at the top of the pyramid and were the result of progressive development, with each previous stage serving as a basis for the next. Violations that were detected on one "layers" of the pyramid caused problems further.

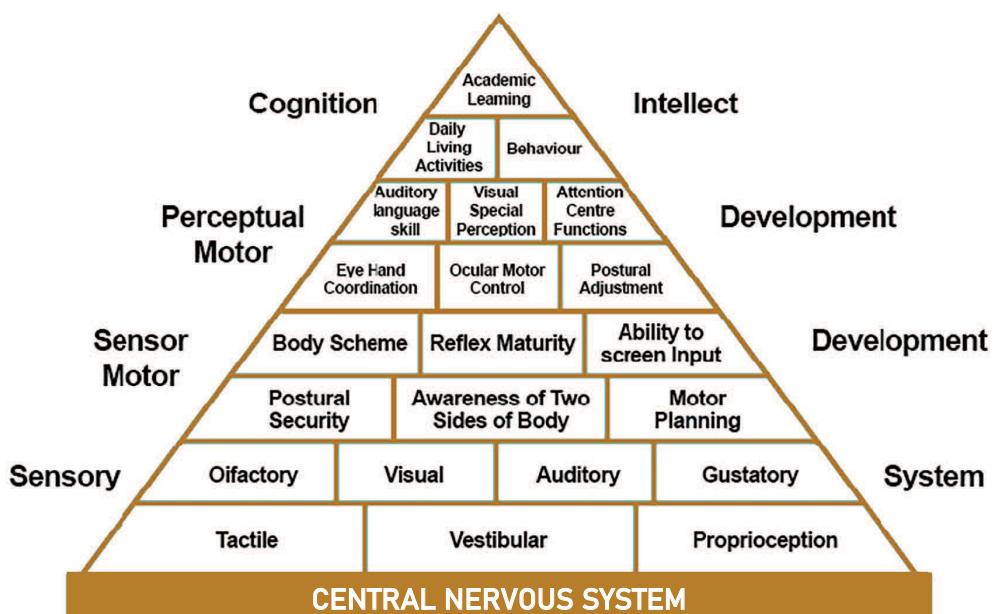


Figure 1. The Pyramid of Learning

Source: M. Williams & S. Schellenberg (1996)

At the bottom of the pyramid was the development of analysers and, accordingly, basic structures: tactile, proprioceptive sensations and the vestibular system. According to such researchers as T. Peeters (1997) and K. Gilbert *et al.* (2020) a large number of children with ASD impaired analyses (vision, hearing) and vestibular disorders associated with comorbid conditions (hormonal imbalance, neuroinflammation, epilepsy, etc.). The formation of the lower layer determined the development of the sensorimotor component (body sensation, spatial orientation, perception). The perceptual-motor level was, in fact, the level that allowed to talk about the formation of basic cognitive functions. The cognitive functions of the brain were the ability to understand, recognise, learn, realise, perceive and process external information.

Thus, it could be argued that cognitive development was not limited to the development of cognitive processes (attention, memory, thinking), but it was a process that included a wider range of processes that led to the development of cognitive functions. This fact should be taken into account in the process of diagnosing cognitive development, especially when it came to children with ASD or other mental disorders.

Disorders in ASD were mostly complex, and disorders of one function could cause changes in the functioning of the entire system (Bazyma *et al.*, 2022).

Symptoms of ASD in children often looked ambiguous, which complicated diagnosis. The reason for this was the high variability of clinical manifestations and free interpretation of the child's symptoms. According to K. Gilbert *et al.* (2017), the development of the cognitive sphere was not considered a diagnostic criterion for ASD, as people on the spectrum could demonstrate a full range of intellectual functioning and speech abilities, varying degrees of sensory system development, and the formation of perceptual abilities (i.e. from profound impairment of these individual cognitive functions to the absence of any problems in these areas). The University College London (UCL) considered autism in terms of the following cognitive paradox: people with autism could process information about the physical world competently, but they had great difficulty processing information about the social world (Peeters, 1997).

A general description of cognitive functions allowed to identify problematic aspects that could serve as diagnostic indicators for ASD: attention, gnosis (perception), memory, psychomotor function (praxis), speech, function of control, social intelligence (Denisova, 2024). Attention was regarded as the ability to maintain the level of mental activity necessary for cognition, to respond promptly to signals from the senses, to concentrate and maintain mental performance for the required time, and to separate information flows.

Gnosis (perception) was considered as the ability to build holistic images based on information received from the senses. Memory was seen as the ability to memorise, store and repeatedly reproduce the information received. Psychomotor function (praxis) comprised the ability to make, store and execute motor programmes. Speech was defined as the ability to communicate verbally, including understanding of addressed speech, building own statements, reading, and writing. The function of control was identified as the ability to plan and control cognitive activity and behaviour, including choosing a goal (goal setting), building a programme (programming), moving from one stage of the programme to another (switching, intellectual flexibility) and comparing the result with the goal (control). T. Attwood (2004) argued that social intelligence was the ability to understand other people's emotions and logic.

In the course of the research on children with ASD and other disorders (including cognitive developmental disorders) Ukrainian researcher Kh.V. Kachmaryk (2017) established several correlations between the development of sensorimotor and motor-perceptual spheres and other mental functions. In particular, the author noted that sensory integration disorders had a high level of correlation with all components of the cognitive sphere: "movements and actions" (praxis), gnosis, speech functions, memory, intelligence, and the ability to navigate in space. Among the problems that the author associated with a low level of development or disorders of the sensorimotor sphere were insufficient orientation of the child in space and situation, in their personal data (name, age, parents' names, address of residence), inadequate behaviour (distractibility, field behaviour, refusal to follow instructions and communicate, inadequate emotional reactions, symptoms of aggression and auto-aggression, etc); low level of functioning in the field of gnosis, which was manifested in errors or inability to recognise real images, crossed and superimposed images, inability to correctly assess the rhythmic structures perceived by ear, low acoustic attention, inability to recognise spatially oriented figures, inability to recognise and qualitatively identify emotions; low level of speech functions, which revealed in the absence of extended speech, characterised by speech spontaneity, the presence of echolalia, difficulties in naming images, as well as comprehension, i.e.

correlation of words with pictures, understanding of logical and grammatical structures and low memory development, namely, the ability to memorise unrelated words, poor motor memory, which manifested itself in the inability to memorise and reproduce movements, as well as poor visual memory, which became noticeable in the low ability to memorise and recognise images; low level of intelligence, which proved to be evident in the inability to understand the meaning of the story and plot pictures, low ability to draw analogies and reject concepts; low level of ability to spatially organise stimulus material, which appeared in the inability to copy shapes correctly.

A study published in the journal *iScience* (Gardner *et al.*, 2024) revealed important findings related to the early sensorimotor characteristics and cognitive abilities of toddlers later diagnosed with ASD. The results showed that children with ASD and low IQ significantly altered sensorimotor features compared to children with ASD and high IQ. It was interesting that the sensorimotor characteristics of children with ASD and high IQ were hardly different from those of children with typical development. This indicated that high IQ might provide resistance to atypical sensorimotor manifestations, and poor sensorimotor function might be a key marker of low IQ in childhood autism (Denisova & Lin, 2023).

U. Frith & C. Frith (2024), describing the cognitive sphere of children with ASD, emphasised that even without significant deviations in the development of cognitive processes, some children demonstrated certain features, such as the absence of pretend play with a single, limited cognitive deficit, a tendency to local stimulus processing and ignoring global signals. F. Happé & U. Frith (2020) proposed the idea that autistic cognition was characterised by a detailed style of processing stimuli entering the brain. The authors put forward a theory (the EF theory) that offered a clear description of cognition in ASD, defining a set of mental abilities that coordinated and controlled other cognitive processes. They include planning, inhibition, mental flexibility, generativity, initiation and self-control and were necessary for performing purposeful, effective, non-standard actions. Thus, based on the analysis of theoretical and empirical studies, the following criteria for the cognitive development of a child with ASD could be identified (Table 1).

Table 1. Criteria for the cognitive development of a child with ASD

Criterion	General characteristics	Diagnostic possibilities
Attention	Ability to maintain the level of mental activity necessary for cognition, to concentrate on the task	Observation
	Distribution, concentration, switching of attention	Correctional tests for children
Gnosis (perception)	Recognition of objects by contours, colour recognition, recognition of objects by individual elements	Gnostic tests
Memory	Memorising unrelated words, numbers, images, the location of objects	Mnemonic tests

Table 1. Continued

Criterion	General characteristics	Diagnostic possibilities
Psychomotor function (practice)	Development of psychomotor skills (static and dynamic coordination of movements, speed, rhythmicity, fine motor skills) Kinesthetic and kinetic finger praxis (development of kinesthetic and kinetic oral praxis in children) Dynamic practice	Fist-rib-palm test, Vaizman test, Kulikova test Motor tests
Speech	Verbal imitation Understanding of the addressed speech Pronunciation Vocabulary Development of coherent speech	Speech therapy examination
Controlling functions	Goal setting and control	Observation
Social intelligence	Ability to recognise emotions	Story pictures Mimicry tests
General intelligence	General awareness Formation of thinking operations	Tests of intelligence, "Classification", "Choose the odd out" tests

Source: compiled by the author

Most studies of cognitive functioning in ASD focused on phenomena that were assessed at the group level. This obscured the fact that even the most commonly accepted cognitive characteristics of ASD were by no means universal and specific to ASD. F. Mohammadzaheri *et al.* (2021) warned against a unified approach to assessing cognitive function in ASD, as the use of group mean comparisons, in their view, did not take into account important characteristics of cognitive profiles, i.e. that their strengths and difficulties were relative rather than absolute. For example, if there were two children with ASD, one of whom had an IQ of 140, was very verbal and performed well on tests, and the other showed a high degree of executive dysfunction and had an intelligence in the low average range, they both scored in the average range for the general population on the indicator. That was why it was necessary to take into account as many indicators as possible, which would help not only to determine which of the cognitive functions is most impaired, but also to establish a connection between the dysfunctions of the cognitive sphere.

Given the diversity of symptoms of the autism spectrum, individual characteristics, and the possibility of combining sometimes completely opposite manifestations, the described criteria did not provide an exhaustive picture of the cognitive development of a child with ASD, however, the identified criteria allowed to identify priority areas of development of the child's cognitive sphere, which should be targeted by means of psychological and pedagogical correction. The progress made in these areas in the course of correctional work was a factor in the effectiveness of psychological support for a child with ASD.

Conclusions

The analysis of available research in the field of cognitive development allowed to determine its main

criteria and specificity in children with ASD. It was established that the basis of cognitive development was the development of the sensory and motor-perceptual spheres. They mostly determined the development of other cognitive functions. The research available in modern science confirmed that in preschool children with ASD, sensory integration disorders had a high level of correlation with all components of the cognitive sphere and cause disorders of attention, memory, perception, goal setting and control, speech and communication disorders, and intellectual disability. The cognitive functions studied in the article were considered to be the main criteria for cognitive development and allowed to identify priority areas of development of the child's cognitive sphere, which should be targeted by means of psychological and pedagogical correction. It was established that there were significant individual differences in the cognitive profiles of children with ASD, making the diagnosis of cognitive functions crucial for developing intervention programs. However, existing tests and diagnostic methods might be insufficient to fully understand the cognitive development of these children. The criteria for cognitive development identified in this study could serve as a foundation for creating corrective programs aimed at supporting the development of those aspects of the cognitive domain that were most vulnerable in children with ASD. Following this, the research focused on systematising existing diagnostic tools and developing a diagnostic programme in accordance with the defined criteria.

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Conflict of Interest

None.

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Критерії діагностики когнітивного розвитку дітей дошкільного віку з розладами аутистичного спектру: огляд літератури

Ганна Андрієнко

Аспірант

Полтавський національний педагогічний університет імені В.Г. Короленка

36003, вул. Остроградського, 2, м. Полтава, Україна

<https://orcid.org/0009-0005-5784-5527>

Анотація. Актуальність досліджуваної проблеми обумовлена впровадженням інклюзивного навчання, яке передбачає реалізацію права всіх дітей, незалежно від стану їх психічного та фізичного здоров'я, на отримання загальної освіти. Метою статті було дослідження підходів до визначення критеріїв когнітивного розвитку дітей з розладами аутистичного спектру, на основі аналізу яких визначаються основні діагностичні критерії, які дозволяють максимально повно охарактеризувати когнітивний розвиток дітей дошкільного віку з досліджуваною нозологією. Методологія дослідження базувалася на комплексному аналізі сучасних наукових джерел у галузі когнітивного розвитку дітей з розладом аутистичного спектру, зокрема на вивченні критеріїв когнітивного розвитку. У процесі дослідження було проведено детальний аналіз концептуальних підходів до визначення терміну «когнітивний розвиток», а також виокремлення специфічних характеристик когнітивного розвитку дітей із розладами аутистичного спектру. Особливу увагу приділено труднощам, що виникають при діагностиці когнітивного розвитку таких дітей, а також аналізу комплексних порушень, які є типовими для дітей дошкільного віку з розладами аутистичного спектру. В статті описано особливості сприймання, уваги, мовлення, особливості інтелекту, контролю і планування діяльності тощо. Здійснювався огляд основних методик діагностики когнітивної сфери, моторних та перцептивних функцій з акцентом на можливості їхнього застосування в практиці корекційної роботи з дітьми з розладами аутистичного спектру. Отримані результати можуть бути використані для діагностики та корекції когнітивної сфери дітей з розладами аутистичного спектру з метою їхнього включення в систему інклюзивного навчання і отримання якісної освіти відповідно до їх індивідуальних можливостей та особливостей розвитку когнітивної сфери

Ключові слова: атипові розлади поведінки при аутизмі; інклюзивна освіта; показники когнітивного розвитку; розвиток когнітивних функцій; когнітивні порушення