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AGE-RELATED CHANGES IN THE STRUCTURE OF AUTISM SYMPTOMS IN CHILDREN WITH ASD FROM 3-4 TO 5-7 YEARS OLD

Andrey Nasledov[1], Liubov Tkacheva[1], Sergey Miroshnikov[1], & Yekaterina Pakhomova[2]
[1]Department or Pedagogy and Educational Psychology, St. Petersburg State University (Russia)
[2]Department of Clinical Psychology, St. Petersburg State University (Russia)

Abstract

The aim of the current study was to detect age-related changes in the structure of autism symptoms in preschoolers. In 2020-2022 we examined 383 3-4-year-old children with ASD and in 2023-2024 – 528 5-7-year-old children with ASD. The research used 2 online questionnaires, developed and verified earlier for the purposes of the ongoing study, one containing 434 binary items (1-yes, 2-no) for 3-4-year–olds, the other consisting of 330 binary items for 5-7-year-olds. Data collection and filling out these questionnaires was carried out by specialists (psychologists, speech pathologists) of counseling centers, specialized and mass preschool institutions working with children on a regular basis (in counseling mode). The data were collected for children who had already been diagnosed with ASD prior to the current study. The materials, methods and procedures for data collection are detailed in our previous publications. Analysis of data of 3-4-year-old children with ASD, using confirmatory factor analysis (CFI), including multigroup CFI, revealed a stable 7-factor structure in different parts of the sample, including the following factors: 1) "Persistance on Sameness" (PS); 2) "Emotional disregulation" (ED); 3) "Alienation" (Al); 4) "Speech understanding" (SU); 5) "Disinhibition/hyperactivity" (Hyp); 6) "Echolalia" (Ech); 7) "Sensory desintegration" (SD). The factors form 3 independent, unrelated groups of symptoms: 1) Communication disorders (ED, SU, Ech, Al); 2) Sensory disintegration (PS, SD); 3) Hyperactivity/disinhibition. A similar analysis of data of 5-7-year-olds revealed an equally stable 8-factor structure similar to that for 3-4-year-olds, but instead of the Alienation factor (Al), 2 new factors appeared: impaired Empathy (Emp) and Motor skills (Mot) (Nasledov et al., 2023, 2024a). Just like in 3-4-year-old children, these 8 factors formed 3 groups of symptoms (secondary factors): 1) Communication disorders (SU, ED, Emp); 2) Sensory disintegration (SD, PS, Ech); 3) Praxis impairment (Hyp, Mot). For 5-7-year-olds, unlike for 3-4-year-olds, the secondarily factors significantly overlap, forming a complex interdependent system. Thus, praxis impairment, including symptoms of hyperactivity/disinhibition and motor delay, begin to increase emotional disorders and lack of empathy, which are closely related to speech understanding. On the other hand, it was found that praxis impairment begins to be associated with symptoms of sensory disintegration. Apparently, for older preschoolers, the symptoms of speech and motor disorders are key and determine the further educational route.

Keywords: *Autism, preschoolers, autism symptoms, age-related changes.*

1. Introduction

In recent years the interest to the problem of autism in childhood has grown substantially. It is due to several reasons, among which the primary one is to change the potential trajectory of an autistic child development that is possible only by timely intervention. Another sufficient reason is multiple attempts to elaborate the model of autistic symptoms in preschoolers in order to indicate specific phenotypes of this neurodevelopmental disorder and predict patterns of further development accordingly. That is why our research group has been focused on elaboration models of autistic symptoms in preschoolers. Our first step was to collect the data on a great variety of autistic symptoms for each age range. Thus, several questionnaires have been developed for children of different age to collect data online with the assistance of professionals working with those children on a regular basis. Thanks to this approach models of autistic symptoms were created for each age range in preschool childhood. However, the main interest is an age-related dynamics understanding of autistic symptoms in order to indicate the patterns and see the tendencies behind the process of an autistic children development. This study aimed to check age-related changes in autistic symptoms in 3-4 to 5-7 years old.

In 2020-2022, we examined 383 3-4-year-olds with ASD. The initial data were 436 binary variables-items – the result of using the Autism Marker Questionnaire, implemented as an online survey of specialists working with children (Nasledov, Miroshnikov, Tkacheva, & Fedorov, 2023). The aim of the study, in particular, was to identify the structure of autism symptoms. As a result, a 7-factor structure was obtained, including 78 items (Figure 1), the equivalence of which was confirmed in relation to different parts of the examined sample. The identified factors form 3 groups of symptoms: 1) communication disorders; 2) sensory disorders; 3) hyperactivity/disinhibition. It is important to note that within each group the symptoms are closely related, while between these three groups of symptoms the connections are close to zero. In 2023, a similar survey was conducted on a sample of 374 5-6-year-olds with ASD, using the modified online Autism Marker Questionnaire, including 330 items, and among them 78 items that formed a 7-factor structure for 3-4-year-olds. The assumption was tested that the 7-factor structure of symptoms in 3-4-year-olds would be confirmed in 5-6-year-olds. Indeed, the configuration (Unconstrained) and measurement equivalence (Measurement weights) has been confirmed. However, the equivalence of factor covariances (Structural covariances) has not been confirmed for samples of 3-4 and 5-6-year-olds (Nasledov, Tkacheva, & Miroshnikov, 2024b), i.e. the structure of the interrelationships of factors has changed significantly with age. In the course of the following study, an 8-factor structure of ASD symptoms was identified in an expanded sample of 5-6-year-olds (Figure 1), the equivalence of which was also confirmed for different parts of the sample (Nasledov, Tkacheva, & Miroshnikov, 2024a). The identified factors, as well as for 3-4-year-olds, form similar 3 groups of symptoms, however, with significant links between them.

Figure 1. Factors in the autistic symptoms model for 3-4- and 5-6-year-olds.

Factors in the autistic symptoms model	3-4-year-olds	5-6-year-olds
PS "Persistence on sameness" symptoms related to the stress of change, the need for sameness in rutines and environment, ritualism, resistance to the new	+	+
ED "Emotional dysregulation" symptoms linked with the lack of adequate emotional responses	+	+
AI "Alienation" symptoms of detachment in situations of interaction with others, avoidance of communication	+	-
SU "Speech understanding" symptoms related to difficulties in performing simple actions in accordance with verbal instructions of an adult	+	+
Hyp "Hyperactivity/Disinhibition" symptoms connected with hyper-reactive behavior including agression, reduced behavioral control, disinhibition	+	+
Ech "Echolalia" symptoms of immediate and delayed echolalia and verbal stereotypes	+	+
SD "Sensory disintegration" symptoms of altered sensory sensitivity and corresponding auto-stimulation actions or avoidance of certain stimuli	+	+
Emp "Empathy" symptoms related with the lack of understanding and predicting other people behavior based on their emotions and feelings misinterpretation	-	+
MS "Motor skills" symptoms linked with difficulties in mastering finely differentiated motor movements and delayed motor development	-	+

The results obtained for 5-6-year-olds suggest that praxis impairment, where hyperactivity/disinhibition and motor disorders have a significant contribution, begin to enhance communication disorders. On the other hand, praxis impairment begin to be associated with symptoms of sensory disintegration. It can be assumed that sensory disintegration, manifested in searching or avoiding certain stimuli, slows down the development of motor skills in preschoolers with autism. In 2024, 157 7-year-olds with ASD were additionally examined using a questionnaire for 5-6-year-olds. The purpose of this study was, firstly, to verify the equivalence of the 8-factor structure of ASD symptoms for 5-6- and 7-year-olds, and secondly, to analyze the dynamics of structural changes in autism symptoms from 3-4 to 5-7 years.

2. Method

Data for 157 7-year-olds with ASD were collected by the same specialists using the same online questionnaire as in the previous study (Nasledov et al., 2024a). These data were combined with data for 371 5-6-year-olds with ASD (a total of 528 5-7-year-olds). The equivalence of the 8-factor structure was verified using multigroup confirmatory factor analysis (MCFA). Next, the value of each factor was calculated as the average value of the items included in it. From the 8 variables obtained as a result, an a priori structural model of the relationship of autistic symptoms was constructed, which was checked for fit with the data using structural equation modeling (SEM).

3. Results

Confirmatory factor analysis of an 8-factor structure for the entire sample of children with ASD: in accordance with the modification indices, 14 covariances between factors and 2 covariances between errors were added to the model. The fit indices confirm a good correspondence of the 8-factor final model to the data: $\chi 2 = 459.002$; df = 236 ($\chi 2/df < 2$); CFI = 0.959, TLI = 0.953, RMSEA = 0.042, Pclose = 0.988.

Checking the equivalence of the model for 5-6- and 7-year-olds. As before, multigroup confirmatory factor analysis was used (Nasledov et al., 2024a). The main test results are presented in Table 1.

Table 1. Model consent indexes for 5-6- and 7-year-olds.

The model (levels of constraints)	**χ2**	**df**	**CFI**	**TLI**	**RMSEA**
Unconstrained	809.616	446	0.925	0.908	0.055
Measurement weights	828.549	462	0.925	0.910	0.055
Structural covariances	881.485	478	0.917	0.905	0.056
Measurement residuals	894.059	588	0.912	0.903	0.057

For each previous and subsequent restriction levels, a decrease in CFI and TLI, and an increase in RMSEA does not exceed 0.01, therefore, equivalence at each level is confirmed. Thus, the high configurational, metric, scalar, and strict invariance of the measurement model for groups of 5-6- and 7-year-olds with ASD has been confirmed.

Association of ASD symptoms with age for samples of 3-4- and 5-7-year-olds. Tables 2 and 3 show Pearson's correlations of ASD symptom factors with the age of children in days. Weak correlations indicate a slight trend in ASD symptoms with age, which is further decreasing for older children.

Table 2. Correlations of ASD symptom factors with age for 3-4 year-olds (N=383).

Symptom	**PS**	**ED**	**Hyp_**	**SU_**	**SD_**	**Al_**	**Ech_**
Pearson Correlation	0,235**	0,012	0,025	-0,260**	0,220**	-0,009	0,237**
Sig. (2-tailed)	<0,001	0,808	0,632	<0,001	<0,001	0,863	<0,001

**Correlation is significant at the 0.01 level (2-tailed).

Table 3. Correlations of ASD symptom factors with age for 5-7- year-olds (N=528).

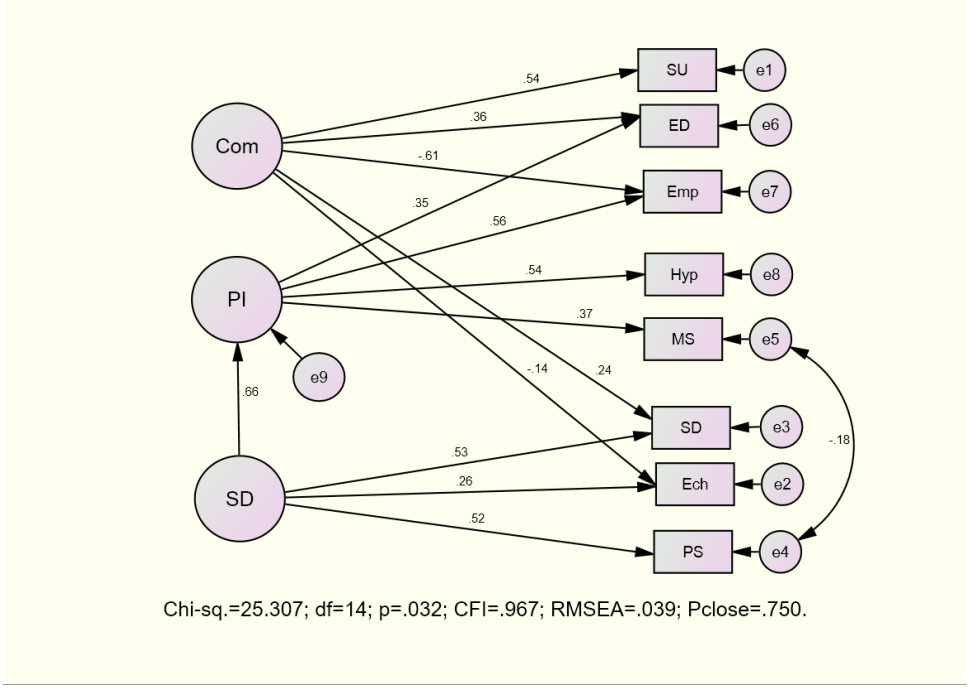
Symptom	**Emp**	**PS**	**Hyp**	**SD**	**Ech**	**MS**	**SU**	**ED**
Pearson Correlation	0,173**	0,147**	0,102*	0,090*	-0,035	0,012	-0,189**	-0,101*
Sig. (2-tailed)	0,000	0,001	0,018	0,037	0,421	0,774	0,000	0,020

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

The structure of the relationship of autism symptoms for 5-7-year-olds. The a priori model assumed that 8 factors form 3 groups of symptoms similar to groups for 3-4-year-olds: 1) Com - communication disorders (SU, ED, Emp, Ech); 2) PI - praxis impairment (Hyp, MS); 3) SD - Sensory disintegration (SD, PS). At the same time, sensory disintegration affects motor skills delay, and this affects communication disorders. A posteriori model was adjusted using model modification indexes, and is shown in Figure 2.

Figure 2. A posteriori model of the relationship of ASD symptoms for 5-7-year-olds.



Sensory disintegration includes impairments of SD, PS, and to a lesser extent, Ech. As expected, there is a significant effect of SD on PI. PI includes Hyp and MS, but also to a significant extent Emp and ED. Com is expected to include SU and ED, but with a negative sign - Emp. Apparently, SU and ED facilitate empathy manifestation. At the same time, Com enhances SD and slightly suppresses Ech. The insignificant relationship between PS and MS residues is probably explained by the fact that PS can interfere with the manifestation of MS.

4. Discussion

The novelty of our study is the revealed age-related changes in the structure of autism symptoms in preschoolers: in older children 8 factors form 3 groups of symptoms similar to the ones in 3-4-year-olds however there is a significant overlap of factors which form a complex interdependent system. Thus, sensory disintegration hinders motor skills development in auitistic 5-7-year-olds. The result is correspondent with the previous research as it was shown that there is a pronounced impairment of sensorimotor abilities in autistic children which is decreases with age (Coll, Foster, Meilleur, Brambati, & Hyde, 2020) and affects not just motor skills development but also body function and activity participation (Wuang, Huang, & Tsai, 2020). In turn, as expected, praxis impairment includes symptoms of hyperactivity and this goes along with previous findings (Zhong & Porter, 2024), but also is related with emotional dysregulation and lack of empathy. Similar connection was obtained in research of Kilroy et al. (2022) as it was revealed, that praxis impairments are linked with cognitive empathy, and Theory of Mind ability. It was also shown that adaptive functioning among preschoolers with ASD and, in particular, motor skills development are hugely dependant on emotional regulation (Davico et al., 2022). According to our model, sufficient verbal abilities and proper emotional control are the main contributors to empathy manifestation, which is correspondent to the research of Li, Blijd-Hoogewys, Stockmann, Vergari, & Rieffe (2023) where the positive tendency of empathy mastering in autistic children was connected with children's developmental trajectories, specifically with intact or slightly impaired verbal abilities. At the same time it appears that communication disorders group increases symptoms of sensory disintegration which also goes in accordance with the results in the field. It was shown that sensory difficulties in ASD children are

significantly associated with communication skills and this connection is mediated by anxiety (Khaledi, Aghaz, Mohammadi, Dadgar, & Meftahi, 2022). Finally, it is noteworthy, that persistence on sameness, known as a key autistic symptom, is linked with motor skills development in older preschoolers with ASD which is a novelty of our study. Earlier in the research of Bhat (2021) it was revealed that the risk of motor impairment is closely associated with pronounced symptoms of repetitive behavior patterns, and also with social communication, cognitive, and functional impairments but not vice versa.

Thus, sensory desintegration in autistic 5-7-year-olds affects praxis impairment which includes symptoms of hyperactivity/disinhibition and motor delay, and in its turn praxis impairment begins to increase emotional dysregulation and lack of empathy, which are closely related to speech understanding. Apparently, for older autistic preschoolers, the symptoms of speech and motor impairments are key ones and determine the trajectory of further cognitive development and educational route.

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References

Bhat, A. N. (2021). Motor impairment increases in children with autism spectrum disorder as a function of social communication, cognitive and functional impairment, repetitive behavior severity, and comorbid diagnoses: A SPARK study report. *Autism research: Official journal of the International Society for Autism Research, 14*(1), 202-219. https://doi.org/10.1002/aur.2453

Coll, S.-M., Foster, N. E. V., Meilleur, A., Brambati, S. M., & Hyde, K. L. (2020). Sensorimotor skills in autism spectrum disorder: A meta-analysis. *Research in Autism Spectrum Disorders, 76*, 101570. https://doi.org/10.1016/j.rasd.2020.101570

Davico, C., Marcotulli, D., Cudia, V. F., Arletti, L., Ghiggia, A., Svevi, B., Faraoni, C., Amianto, F., Ricci, F., & Vitiello, B. (2022). Emotional Dysregulation and Adaptive Functioning in Preschoolers with Autism Spectrum Disorder or Other Neurodevelopmental Disorders. *Frontiers in psychiatry, 13*, 846146. https://doi.org/10.3389/fpsyt.2022.846146

Khaledi, H., Aghaz, A., Mohammadi, A., Dadgar, H., & Meftahi, G.H. (2022). The relationship between communication skills, sensory difficulties, and anxiety in children with autism spectrum disorder. *Middle East Current Psychiatry 29*, 69. https://doi.org/10.1186/s43045-022-00236-7

Kilroy, E., Ring, P., Hossain, A., Nalbach, A., Butera, C., Harrison, L., Jayashankar, A., Vigen, C., Aziz-Zadeh, L., & Cermak, S. A. (2022). Motor performance, praxis, and social skills in autism spectrum disorder and developmental coordination disorder. *Autism research: Official journal of the International Society for Autism Research, 15*(9), 1649–1664. https://doi.org/10.1002/aur.2774

Li, B., Blijd-Hoogewys, E., Stockmann, L., Vergari, I., & Rieffe, C. (2023). Toward feeling, understanding, and caring: The development of empathy in young autistic children. *Autism: the international journal of research and practice, 27*(5), 1204-1218. https://doi.org/10.1177/13623613221117955

Nasledov, A., Miroshnikov, S., Tkacheva, L., & Fedorov, S. (2023). Factor structure of ASD symptoms in Russian 3-4-year-olds. *OBM Neurobiology, 7*(4), 190. https://dx.doi.org/10.21926/obm.neurobiol.2304190

Nasledov, A., Tkacheva, L., & Miroshnikov, S. (2024a). Factor structure of autism symptoms in 5-6-year-old children: Age perspective. *OBM Neurobiology, 8*(4), 259. https://dx.doi.org/10.21926/obm.neurobiol.2404259

Nasledov, A., Tkacheva, L., & Miroshnikov, S. (2024b). 7-factor model of autism symptoms in 3-6-year-olds: Age-related changes. *Terapia psicológica, 42*(3), 379-414. https://dx.doi.org/10.4067/s0718-48082024000300379

Wuang, Y. P., Huang, C. L., & Tsai, H. Y. (2020). Sensory integration and perceptual-motor profiles in school-aged children with autistic spectrum disorder. *Neuropsychiatric disease and treatment, 16*, 1661-1673. https://doi.org/10.2147/NDT.S253337

Zhong, Q., & Porter, M. (2024). Autism Spectrum Disorder Symptoms in Individuals with a Primary Diagnosis of Attention-Deficit/Hyperactivity Disorder: A Systematic Review. *Review Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/s40489-024-00443-4