

DYNAMICS OF AUTISM SYMPTOMS IN 3-6-YEAR-OLDS WITHIN THE FRAMEWORK OF A 4-FACTOR MODEL

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Abstract

In 2020 – 2022 we conducted a survey of 926 children (383 with ASD, 200 with DD, 343 Norm group) in order to elaborate a screening scale for the expert diagnosis of ASD in 3-4-year-olds. For the examination we used an online questionnaire developed by us to identify 436 possible symptoms of autism. The questions were answered by specialists involved in correctional work with children. The main result of the study was elaboration of Autism Scale based on 40 autism symptoms (points) representing 4 vectors of its manifestation: 1) difficulties in establishing emotional contact, expressing one's emotions and decoding the emotions of others in the context of social interaction; 2) sensory disintegration; 3) difficulties in verbal and non-verbal communication and social skills; 4) hyperactivity, including excessive movements, motor disinhibition and restless behavior. The Scale has a prediction accuracy of 88.91% (sensitivity 92.1%, specificity 87.2%) (Nasledov, Miroshnikov, Tkacheva, Miroshnik, & Semeta, 2021). The structural and measurement invariance of this model was confirmed for boys and girls, 3- and 4-year-olds (Nasledov et al., 2021). In 2023 233 5-6-year-olds with ASD were examined using an online questionnaire including 40 points of the mentioned above Scale, in order to study the suitability of the developed Scale for diagnosing children of this age and identification of possible age-related changes. A multigroup confirmatory factor analysis showed that the Autism Scale, the 4-factor version of which was developed for 3-4-year-old children, retained structural and measurement equivalence for 5-6-year-olds. The accuracy of differentiation of the group of children with ASD from other children for this age remained high (85.8%), only slightly lower than for 3-4-year-olds. Apparently, this is due to the fact that the identified 4 factors (vectors) of ASD symptoms are the areas in which children with ASD differ the most from other children, and are least susceptible to age-related changes. Further, the values of the factors were calculated for children as the average values of the points included in each factor. A multidimensional ANOVA was used to study age shifts: Gender factor (1st, 2nd), Age factor (1 – 3-4-year-olds, 2 – 5-6-year-olds), dependent variables – 4 calculated factors. Multidimensional criteria revealed statistically significant main effects of the factors Gender and Age, the effect of the interaction of these factors was not statistically significant. According to one-dimensional criteria, girls, regardless of age, have statistically significantly stronger symptoms of Communication disorders than boys. Regardless of gender, the influence of age according to one-dimensional criteria was revealed in relation to Communication disorders and Sensory disorders. These symptoms decrease with age, apparently under the influence of corrective interventions. Regarding Emotional disorders and Hyperactivity/Disinhibition age differences are far from statistically significant. These symptoms remain at a consistently high level with age, apparently as more resistant to corrective interventions.

Keywords: *ASD, 3-6-year-olds, factor structure of autism, autism vectors.*

1. Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by problems in social interactions and repetitive and restrictive behaviors and interests (American Psychiatric Association, 2013). The problem of autism timely diagnosis and optimal psychological and behavioral intervention is very relevant nowadays, due to the high prevalence of this complex neurodevelopmental disorder (Maenner et al., 2020) and the serious consequences it causes for social adaptation and quality of life for those who suffer from it and their families (Mason et al., 2021). There is a wide variety of autistic symptoms and scenarios of its manifestation; however, it is customary to distinguish a triad of core features, such as impaired social communication, limited and repetitive behavior and sensory

disintegration (Happé & Frith, 2020). The etiology of autism is heterogeneous. To date, it is believed that the etiology of ASD includes but is not limited to such parameters as genetic risks (Lord, Elsabbagh, Baird, & Veenstra-Vanderweele, 2018), atypical brain maturation (Hadders-Algra, 2022), environmental, immunological, perinatal, neuroanatomic and biochemical factors (Pennington, Cullinan, & Southern, 2014). Such heterogeneity makes differential diagnosis of autism and early intervention a complicated task (van 't Hof et al., 2021). At the same time, it is known that the earlier signs of ASD are detected, the faster rehabilitation begins and the better the expected results (Clark, Vinen, Barbaro, & Dissanayake, 2018). The structure of autism symptoms is still unclear; in addition, existing diagnostic screening tools also have known limitations (Hus, & Lord, 2013; Kim et al., 2016). It is also necessary to note the gap in the literature regarding ASD factor structure, the understanding of which is crucial for studying its mechanisms and identifying specific phenotypes of autism to choose optimal interventions.

Our previous large-scale study was devoted to the identification of ASD factor structure in early childhood and the detection of its predictors and indicators. In 2020-2022, we examined 926 children (383 with ASD, 200 with developmental delay (DD), 343 groups of norm) in order to develop a screening scale for rapid diagnosis of ASD in 3-4-year-olds. An extensive online questionnaire was used for the examination, which we elaborated to identify 436 possible symptoms of autism. The main result of the study was the creation of an autism scale based on 40 autism symptoms (points) representing 4 vectors of its manifestation: "Emotional disorders", "Sensory disintegration", "Communication disorders" and "Hyperactivity/disinhibition". The accuracy of the scale prediction is 88.91% (sensitivity 92.1%, specificity 87.2%) (Nasledov et al., 2021). A multigroup confirmatory factor analysis of structural and measurement equivalence confirmed the 4-vector structure of ASD for children with autism only. Thus, the obtained scales reflect the vectors of ASD or specific phenotypes of ASD, depending on the predominance of the one of the four domains symptoms severity over the others. The purpose of this work was a comparative empirical analysis of age-related changes in autism phenotypes, conducted on 3-4-year-olds and 5-6-year-olds with ASD to identify trends in reducing or maintaining the severity of symptoms in each of the 4 domains.

2. Method

In 2023, we examined 346 children (233 with ASD, 46 with DD, 67 of norm groups) using a modified online questionnaire similar to the one we used earlier (Nasledov et al., 2021). The questionnaire included the same 40 items that formed 4 vectors of autism for 3-4-year-olds. This survey aims to verify the structural and measurement equivalence of that 4-factor model for 5-6-year-olds with ASD. Additionally, the hypothesis of age differences in dynamics of ASD symptoms was tested. For that purpose, a multi-group confirmatory factor analysis (CFI) was used for 12 packages of items (3 packages per factor, 3-4 items per package, with a random distribution of items in packages within each factor). The CFA was conducted according to the same scheme as before (Nasledov et al., 2021). The sample consisted of 383 3-4-year-olds and 233 5-6-year-olds with ASD. Due to the equivalence of the 4-factor model for the both age groups, it appeared correct to compare these samples by the selected factors. The values of the factors were calculated as the average values of the items included in them, so the value of the factor represented the proportion of affirmative responses to the items included in it. To analyze the influence of age on the values of 4 primary factors a multidimensional ANOVA was used according to the following scheme: 4 dependent variables corresponding to the values of primary factors, factors Gender and Age. IBM SPSS Statistics 28 version (Armonk, NY: IBM Corp.) was used.

3. Results

Checking the invariance of the 4-factor model for 3-4- and 5-6-year-olds is presented in Table 1.

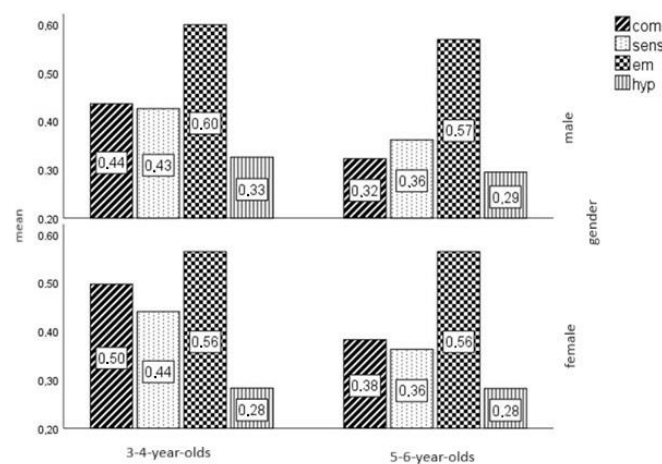
Table 1. Fit indices for 3-4 and 5-6-year-olds with ASD.

Levels of restrictions	χ^2	df	CFI	TLI	RMSEA
Unconstrained	208.555	100	0.94	0.921	0.042
Measurement weights	224.047	108	0.936	0.922	0.042
Structural weights	233.828	111	0.932	0.919	0.042
Structural covariances	241.239	112	0.929	0.916	0.043
Structural residuals	285.213	116	0.907	0.894	0.049
Measurement residuals	305.297	128	0.902	0.899	0.047

The unconstrained model corresponds well to the initial data for most of the indicators: CFI > 0.95 and TLI > 0.90; RMSEA < 0.05 (Pclose = 0.948). The ratio χ^2/df is only slightly higher than 2, which, given the total sample size is acceptable. Thus, the configuration equivalence of the model is confirmed for the following levels of limitation: a) the level of explicit variables measurements (Measurement weights); b) the level of primary factors measurements (Structural weights); c) the level of covariances between factors (Structural covariances). The strict invariance of the models with respect to the remnants of primary factors (Structural residuals) and the remnants of explicit variables (Measurement residuals) is questionable. However, the arguments in favour of the models equivalence at the previous levels of constraints are sufficient for the model to be suitable for measuring 4 factors for 5-6-year-olds with ASD.

Figure 1 shows the results of comparing the average values of the percentages of affirmative answers from specialists to the questions concerning the severity of 4 groups of ASD symptoms in children, depending on gender and age.

Figure 1. The proportion of affirmative responses to 4 groups of ASD symptoms, depending on gender and age of the child (Com – Communication disorders, Sens – Sensory disorders, Em – Emotional disorders, Hyp – Hyperactivity/Disinhibition).



The use of multivariate analysis of variance by multivariate criteria (Pillai's Trace) revealed statistically significant main effects of Gender factor ($F(4; 605) = 2.994; p = 0.018; \eta^2 = 0.019$) and Age factor ($F(4; 605) = 6.770; p < 0.001; \eta^2 = 0.043$). The effect of the interaction of these factors is not statistically significant ($F(4; 605) = 0.350; p < 0.884; \eta^2 = 0.002$). According to one-dimensional criteria, girls, regardless of age, statistically significantly show symptoms of Communication disorders more strongly than boys ($F(1; 608) = 6.605; p = 0.010; \eta^2 = 0.011$). Regardless of gender, the influence of age according to one-dimensional criteria was revealed only in relation to Communication disorders (Com) ($F(1; 608) = 23.409; p < 0.001; \eta^2 = 0.037$) and Sensory disintegration ($F(1; 608) = 7.929; p = 0.005; \eta^2 = 0.013$). Regarding Emotional disorders and Hyperactivity age differences are not statistically significant ($p > 0.390$).

4. Discussion

Checking the invariance of the 4-factor model of autism for 3-4- and 5-6-year-olds confirmed its configurational equivalence for the compared samples of children, boys and girls, which corresponds to the previously obtained results on the stability of the main symptoms of autism in childhood (Li et al., 2022), and their possible persistence throughout lifespan (Shulman et al., 2020). We found a greater severity of communication disorders symptoms for girls than for boys. The results obtained highlight the possibility of the existence of gender-specific phenotypes within the framework of ASD. Previously it was shown, that females with autism without mental impairment have a special profile associated with the presence of communication problems, which makes them prone to negative social and emotional consequences (Sturrock, Adams, & Freed, 2021). Also in our study was the tendency revealed for decrease the severity of communicative and sensory problems within the age shifts from 3-4 to 5-6 years for all children, which may be explained due to timely performed behavioral and sensory interventions well known for positive outcomes (Paul, 2008; You, Gong, Guo, & Ma, 2024). However, the limitations of these methods in maintaining and generalizing skills suggests that many children with autism will need

to supplement these methods with actions less focused on adults in order to increase communicative initiation and transfer acquired skills to new conditions and new communicative partners (Carruthers, Pickles, Slonims, Howlin, & Charman, 2020).

The most important result of our study, apparently, was the discovered tendency to preserve the symptoms of emotional disorders and hyperactivity within the framework of age shifts for children with ASD of both genders. The results obtained go in accordance with the data of other authors. It has been shown that in about 30% of cases, autism is burdened with emotional disorders such as anxiety/OCD, including phobias, generalized and social anxiety disorders; mood disorders; oppositional defiant disorder; Tourette's disorder/nervous tic; eating disorders (Fucà et al., 2023). It is also believed that 50 to 70% of people with ASD have concomitant hyperactivity and attention deficit disorder (Hours, Recasens, & Baleyte, 2022). The similar neuropsychological difficulties common to ASD and ADHD due to comparable endophenotypes were found (Ghirardi et al., 2019). It was suggested that ADHD and ASD have similar patterns, including difficulties with emotion regulation, social awareness, and externalizing behavior (Rommelse, Geurts, Franke, Buitelaar, & Hartman, 2011). Apparently, this coincidence may explain the severity and duration of hyperactivity symptoms in children with autism.

Summarizing, it was revealed that in preschoolers with autism, sensory and communication problems decrease with age, presumably due to interventions. However, emotional disintegration and hyperactivity remain at a high level. The presence of the latest makes the prognosis for the child's development less favorable.

5. Limitations

The stability of the identified 4 structural components of autism symptoms for 3-6-year-olds is probably due to the fact that these components were initially isolated from a mixed sample of children with and without ASD (DD, Norm), as the areas in which children with ASD differ from other children most strongly. At the same time, the structure of the autism symptoms is more complex; highly likely, it has a greater age dynamic, which will be the subject for the further research.

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