



Expressive and Receptive Language in Russian Primary-School-Aged Children with Autism Spectrum Disorder

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ARTICLE INFO

Keywords:

Autism Spectrum Disorder
Expressive language
Receptive language
Language assessment
Russian

ABSTRACT

Background: Abnormal language development in both expressive and receptive domains occurs in most children with Autism Spectrum Disorder (ASD), although the language deficit is not a core symptom of ASD. However, previous studies disagree on the difference in the degree of impairment between expressive and receptive language in ASD. Existing research has concentrated on vocabulary and ‘global expressive and receptive language’, often using parental reports for language assessment. Moreover, most of these studies have focused on toddlers and preschoolers with ASD, whereas data from school-aged children with ASD are very limited. At the same time, the age of children might account for the inconsistencies across publications on expressive-receptive language difference in children with ASD.

Aims: The goal of the study was to directly compare the expressive and receptive language abilities of Russian primary-school-aged children with ASD (7–11 years old) at the levels of vocabulary, morphosyntax, and discourse.

Methods: 82 children with ASD participated in language testing. We used tests from the Russian Child Language Assessment Battery in order to assess vocabulary, morphosyntax, and discourse in expressive and receptive domains.

Results: Our results revealed different expressive and receptive patterns, depending on the linguistic level and tests complexity. Importantly, we showed that children’s non-verbal IQ partly accounted for the difference between production and comprehension abilities.

Conclusions: The expressive-better-than-receptive pattern in language has been considered by some authors as the unique hallmark of ASD. However, several studies, including our own, show that this is not a universal characteristic of ASD. We also revealed that expressive and receptive language patterns differed depending on the linguistic level, children’s non-verbal IQ, and assessment tools.

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What this paper adds?

- The present study directly compares the expressive and receptive language abilities of a large group ($N = 82$) of less-studied Russian primary-school-aged children with Autism Spectrum Disorder (ASD).
- The study revealed the different expressive and receptive patterns depending on the linguistic levels and tests complexity.
- The study showed that non-verbal IQ accounted for the difference between production and comprehension abilities.

1. Introduction

Abnormal language development in both expressive and receptive domains occurs in most children with Autism Spectrum Disorder (ASD), although the language deficit is not a core symptom of ASD (American Psychiatric Association, 2013; Eberhardt & Nadig, 2018; Kjelgaard & Tager-Flusberg, 2001; Kjellmer et al., 2012; Kover, McDuffie, Hagerman, & Abbeduto, 2013; Lindgren, Folstein, Tomblin, & Tager-Flusberg, 2009; Luyster et al., 2007). Furthermore, previous studies disagree on the difference in the degree of impairment between expressive and receptive language in autism.

Some research has supported the presence of more impaired receptive in comparison to expressive language (e.g., Charman et al., 2003; Kover et al., 2013; Maljaars, Noens, Scholte, & van Berckelaer-Onnes, 2012). For example, in Kover et al. (2013) study, 49 boys with ASD ($M_{age} = 7.6$) were assessed in receptive vocabulary relative to expressive vocabulary. Using the *Peabody Picture Vocabulary Test* (PPVT-III) and the *Expressive Vocabulary Test* (EVT), the authors showed that receptive vocabulary was significantly more impaired in these children. Charman et al. (2003) reported the same pattern in a group of 134 children with ASD ($M_{age} = 3.2$), using the *MacArthur Communicative Developmental Inventory* (MCDI). They concluded that word comprehension was more delayed than word production. In Maljaars et al. (2012) study, the *Reynell test for Dutch language comprehension* and *Dutch Communicative Development Inventories* for receptive language assessment as well as the *Schlichting test for Dutch language production* and *Dutch Communicative Development Inventories* for expressive language assessment were used to investigate language abilities in 36 low-functioning children with ASD ($M_{age} = 7.1$). Both expressive and receptive tests included tasks assessing production and comprehension, from single words to complex sentences. The results showed that expressive language exceeded receptive language abilities in children with autism.

By contrast, other studies have revealed the opposite pattern, i.e. more impaired expressive than receptive language. For example, Weismer, Lord, and Esler (2010) used the *Vineland Adaptive Behavior Scale* (VABS), the *Sequenced inventory of communication development* (SICD), and the *Mullen Scales of Early Learning* (MSEL) to investigate expressive and receptive language in 257 toddlers with ASD ($M_{age} = 2.5$). They showed that, according to the VABS, children with autism had more severe expressive than receptive language delay. However, the SICD and MSEL assessments showed the opposite pattern for the same group of children: more impaired receptive than expressive language. In Luyster, Kadlec, Carter, and Tager-Flusberg (2008) study, a similar pattern was found: receptive language was stronger than expressive, as measured by the VABS. But the results were opposite for the same group as measured by the MSEL and MCDI.

Importantly, some studies have reported an absence of any difference between expressive and receptive language in autism. Jarrold et al. (1997), using APT and WFT for assessing production and BPVS for assessing comprehension in 120 children with ASD (age range 5.6–19.7), demonstrated an equal delay of expressive and receptive language. Similar results were reported by Kjelgaard and Tager-Flusberg (2001) for 89 children with ASD ($M_{age} = 7.3$), using PPVT-III and EVT. Finally, a meta-analysis examined 74 studies of expressive and receptive language in ASD and showed no significant difference between expressive and receptive language domains (Kwok et al., 2015).

The contrasting results (more impaired production or comprehension, or equal expressive and receptive abilities) cannot be explained solely by the difference of language assessment tools or diagnostic criteria because some studies that have reported opposite results used the same instruments. For example, Kover et al. (2013) and Kjelgaard and Tager-Flusberg (2001) have used the EVT and PPVT-III for expressive and receptive language assessment and the ADOS-Generic as a gold-standard diagnostic tool. However, Kover et al. (2013) showed that receptive vocabulary is significantly more impaired than expressive vocabulary, but Kjelgaard and Tager-Flusberg's (2001) study did not find this pattern.

Note that children's age might account for differences in the expressive and receptive abilities in ASD because of the known developmental changes in language production and comprehension during childhood. For example, Bornstein and Hendricks (2012) provided a comprehensive assessment of language production and comprehension in a large group of 101,250 children aged from 2 to 9. They showed that in a subgroup of 2-to-4-year-old children, comprehension exceeded production whereas in a subgroup of 5-to-9-year-olds there was no difference between expressive and receptive domains. These results for young children were also supported by Reinhartsen et al. (2019) in the groups of both typical and atypical 2-to-5-year-old children: expressive-dominant profiles were the least frequent.

The goal of the present study was to directly compare expressive and receptive language abilities in a representative group of Russian primary-school-aged children with ASD. The novelties of the study are the following: first of all, our ASD group consisted of only primary-school-aged children whereas most other studies that compared expressive and receptive language domains focused on toddlers and preschoolers. Thus, our knowledge of expressive and receptive language in school-aged children with ASD is limited. Second, we assessed language abilities using formal testing, and did not rely on parental reports as many previous studies did. Third, we separately compared expressive and receptive vocabulary, morphosyntax, and discourse abilities. To the best of our knowledge, this is the first study which has aimed to directly investigate expressive and receptive language in children with ASD at three different linguistic levels. The previous studies usually focused on vocabulary (expressive vs. receptive), or compared the general 'global

expressive and receptive language' which might include both vocabulary and 'structural language' (Kwok et al., 2015). However, the measures of 'global expressive and receptive language' were sometimes vague, so a more structural comparison is needed. Our study compared expressive and receptive language domains separately at the levels of vocabulary (word production vs. comprehension), morphosyntax (sentence production vs. comprehension), and discourse (text production vs. comprehension). Fourth, we investigated the possible role of children's non-verbal IQ in the difference between expressive and receptive language domains. Finally, this is the first study which has examined expressive and receptive language abilities in a large group of Russian primary-school-aged children with ASD.

In a previous study with the same group of participants (Arutiunian et al., 2021), we described the language profiles of Russian primary-school-aged children with ASD at different linguistic levels, comparing them to a group of age-matched typically developing children. Also, we assessed the influence of such non-language factors as age, non-verbal IQ, and the severity of autistic traits on the language abilities of children with autism. Finally, we grouped children with ASD according to their language abilities and provided subgroup comparisons. The present study aimed to reanalyze the data from the previous language assessment and to compare expressive vs. receptive abilities of children with ASD.

2. Methods

2.1. Participants

The group of participants included 82 children with ASD (17 girls, age range 7.01–11.10, $M_{age} = 9.11$, $SD = 1.5$) and had 4:1 boys to girls ratio which is consistent with recent epidemiological studies on sex differences in ASD (Maenner et al., 2020). The children were recruited from the Federal Resource Center for Organization of Comprehensive Support to Children with Autism Spectrum Disorders (Moscow, Russia). The diagnosis of ASD was based on the International Classification of Diseases, ICD-10, and 67 out of 82 children also were assessed by a licensed psychiatrist using the Autism Diagnosis Observation Schedule – Second Edition (Lord et al., 2012). Exclusion criteria were the presence of comorbid neurological disorders (e.g., epilepsy), known chromosomal syndromes (e.g., fragile X syndrome, Rett syndrome), and / or a previous history of hearing and vision problems. According to the criteria, 11 children were excluded from the analysis.

The participants' non-verbal IQ was measured with the Kaufman Assessment Battery for Children K-ABC II (Kaufman & Kaufman, 2004) and the Wechsler Intelligence Scale for Children – Third Edition (1991), performance IQ score, where possible (IQ is available in 66 out of 71 children).

The demographic information for ASD group is provided in Table 1.

This study was approved by the ethics committee of Moscow State University of Psychology and Education and was conducted following the ethics principles regarding human experimentation (Declaration of Helsinki). A written consent form was signed by a parent of each child.

2.2. Materials

The materials included tests from the Russian Child Language Assessment Battery, RuCLAB (Lopukhina et al., 2019), assessing vocabulary (word production vs. comprehension), morphosyntax (sentence production vs. comprehension), and discourse (text production vs. comprehension) in expressive and receptive domains. RuCLAB was also used in the previous study by Arutiunian et al. (2021).

All stimulus pictures and words were selected from the Verbs and Nouns Stimuli Database for Russian (Akinina et al., 2014, 2015, 2016) with name agreement for pictures above 85 %. The tests were programmed in Java SE8 and administered using a Samsung Galaxy Tab A (2016) SM-T585 model on Android 7.0 platform with a screen size 10.1", 1920 × 1200 p × . The audio stimuli were recorded by a professional female native speaker of Russian in a recording studio, and the stimuli for all tests were presented with the AutoRAT application (Ivanova et al., 2016). The properties of each test as well as description of materials are given below¹.

- **Vocabulary** assessment included *Word production* and *Word comprehension* tests. In the *Word production*, children had to name depicted objects and actions presented one at a time on the tablet. The test consisted of 48 items (24 of them are objects and another 24 are actions). In the *Word comprehension* with word-to-picture matching paradigm, each trial started with the presentation of four object / action pictures on the screen, and the name of one object / action was presented auditorily. Children had to choose the corresponding picture, pressing on the screen. In vocabulary assessment, stimuli were matched between production and comprehension tests on subjective visual complexity, familiarity, imageability, age of acquisition, and frequency, but were balanced on word length only in the comprehension tests.
- **Morphosyntax** assessment included *Sentence production* and *Sentence comprehension* tests. In the *Sentence production* with a syntactic priming paradigm, each trial started with the presentation of two pictures on the screen, and after 500 ms from trial onset the prime sentence, describing the picture on the left, was played auditorily. Children had to produce a sentence, describing the picture on the right using the syntactic construction of the prime sentence. The test contained 24 items. In the *Sentence comprehension* test

¹ Detailed information on each test with examples of stimulus items is available online: <https://osf.io/5r3md/>.

Table 1
The characteristics of ASD group ($N = 71$).

	Range	Mean	SD
Age (years)	7.01 – 11.10	9.6	1.4
Non-verbal IQ	40 – 125	83.1	20.5
ADOS (raw scores)			
Module 1	8 – 21	14.00	5.47
Module 2	8 – 22	15.38	4.66
Module 3	7 – 24	11.66	3.77

with sentence-to-picture matching paradigm, each trial started with the presentation of two pictures on the screen, and after 500 ms from trial onset, the sentence, describing one of the pictures, was played auditorily. Children had to choose the corresponding picture, pressing on the screen. The test included 24 trials. In morphosyntax assessment, stimuli were matched on the number of verb arguments and type of third argument (prepositional or instrumental) between production and comprehension tests; however, they were balanced on semantic reversibility only within the production test, and in word order and construction type only within the comprehension test. Therefore, in terms of syntactic constructions, stimuli in the comprehension test were more complex than in the production test.

- **Discourse** assessment included *Discourse production* and *Discourse comprehension* tests. In the *Discourse production*, children had to produce a story based on the presented picture with exposition, climax and resolution. All participants are shown the same picture. In the *Discourse comprehension*, participants had to listen the story, and then answer the questions, pressing *Yes* or *No* button on the tablet screen. The 16 questions varied in relation to the story (main storyline or details) and in the type of information (explicit or implicit). In discourse assessment, stimuli were balanced only within the comprehension test in the type of questions. *Discourse production* and *Discourse comprehension* tests were not matched.

2.3. Procedure

Participants were tested individually at the Federal Resource Center for Organization and Comprehensive Support to Children with Autism Spectrum Disorders in Moscow, Russia. Prior to each test, they were instructed and completed 2–3 training trials that were excluded from the analysis. The children had the opportunity to ask questions and get clarification only during training session. The order of items and tests was the same for all participants.

2.4. Scoring

In receptive tests, accuracy was registered automatically by the application as correct (coded as 1) or not (coded as 0). In expressive tests, participants' vocal responses were recorded in the application and analyzed by the examiner².

For the *Word production*, accuracy was coded as 1 for correct naming and 0 for incorrect naming. We scored the response as correct when participants gave a direct name of the object or action (e.g., word *ball* for depicted ball) or gave a subdominant nomination³, including different forms of the word (e.g., singular or plural), diminutives, phrases with using the target words, and lexical selection, finishing by the production of the target word. All other cases were scored as 0.

For the *Sentence production* test, accuracy was calculated based on four parameters (min score = 0, max score = 1): *a* – using the priming syntactic construction, *b* – morphosyntax correctness, *c* – lexical and semantic validity, and *d* – other sentence components which construct a phrase. Each correct realization of parameter was scored as 1, so that if, for example, in the participant's sentence three out of four parameters are presented, the score would be $3/4 = 0.75$.

For the *Discourse production* test, accuracy was scored relay four parameters: *a* – fluency, *b* – morphosyntax correctness, *c* – information content, and *d* – presence of semantic, phonological, and other errors. The max score for each parameter was 5 (range from 0 to 5 based upon the scale). Thus, if the total score is $5 + 3 + 4 + 3 = 15$, the final score for the test would be $15/20 = 0.75$.

2.5. Analysis

In order to estimate the difference between expressive and receptive vocabulary, we fitted a generalized linear mixed-effects model with the main effect of domain (expressive vs. receptive, intercept corresponding to expressive) and random intercepts for participants and items. For the analysis of morphosyntax and discourse production and comprehension, we fitted linear mixed-effects models with the main effects of domain (expressive vs. receptive, intercept corresponding to expressive) and random intercepts for participants. We applied a Bonferroni correction for the total number of fitted models ($n = 3$) and reported uncorrected *p*-values; thus, the predictors are significant at the $\alpha = 0.01$ level.

For assessing the influence of non-verbal IQ on expressive-receptive abilities, we divided children with ASD into two groups (with

² Detailed information about scoring is available online: <https://osf.io/scq83/>.

³ All dominant and subdominant nominations also were taken from the Verbs and Nouns Stimuli Database for Russian (<http://en.stim-database.ru>).

and without intellectual disability; ID) and provided analyses for these groups separately. In order to estimate the difference between expressive and receptive vocabulary, we fitted another generalized linear mixed-effects model with the main effect of group (ASD with ID vs. ASD without ID, intercept corresponding to ASD with ID) and the effect of domain (expressive vs. receptive) each nested within the groups of children separately; also, the model included random intercepts for participants and items. For the analysis of morphosyntax and discourse production and comprehension, we fitted linear mixed-effects models with the main effects of groups (ASD with ID vs. ASD without ID, intercept corresponding to ASD with ID) and the effects of domain (expressive vs. receptive) each nested within the groups of children separately and random intercepts for participants. For this analysis we also applied a Bonferroni correction ($n = 3$) with the predictors being significant at the $\alpha = 0.01$ level.

All models were estimated in R (R Core Team, 2019) with the *lme4* package (Bates et al., 2015). The tables for model outcomes (Tables 2–7) were created with the *sjPlot* package (Lüdtke, 2020), and the data were plotted with *ggplot2* (Wickham, 2016).

3. Results

At the level of vocabulary, the results showed that there was a significant difference between word production and comprehension, $M_{\text{expressive}} = 0.75$ ($SD = 0.43$) vs. $M_{\text{receptive}} = 0.87$ ($SD = 0.33$), $\beta = 1.07$, $SE = 0.08$, $z = 14.01$, $p < 0.001$: word comprehension was more accurate than word production in primary-school-aged children with ASD (see Table 2 for statistical comparisons).

At the level of morphosyntax, we did not find a significant effect of domain: there was no difference between sentence production and comprehension, $M_{\text{expressive}} = 0.59$ ($SD = 0.40$) vs. $M_{\text{receptive}} = 0.65$ ($SD = 0.30$), $\beta = 0.06$, $SE = 0.03$, $t = 1.68$, $p = 0.09$ (see Table 3), indicating a similar level of expressive and receptive morphosyntactic abilities in ASD.

Finally, at the discourse level, the main effect of domain was significant, $M_{\text{expressive}} = 0.63$ ($SD = 0.32$) vs. $M_{\text{receptive}} = 0.55$ ($SD = 0.36$), $\beta = -0.08$, $SE = 0.03$, $t = -2.63$, $p = 0.01$ (see Table 4), showing that discourse comprehension was more impaired than discourse production in children with ASD.

Therefore, a discrepancy between expressive and receptive language domains in primary-school-aged children with autism was found at the levels of vocabulary and discourse (Fig. 1).

3.1. The influence of non-verbal IQ on expressive-receptive language abilities

In order to estimate the possible role of non-verbal IQ in children with ASD in the difference between their expressive and receptive language domains, we divided our participants into two groups: ASD children without intellectual disability (ASD without ID, $N = 33$, non-verbal IQ ≥ 80) and ASD children with intellectual disability (ASD with ID, $N = 33$, non-verbal IQ < 80). A sample *t*-test showed that there was no difference between the groups of children in age, $t(63.9) = 0.88$, $p = 0.37$.

The results demonstrated that at the level of vocabulary there was a significant main effect of group, $M_{\text{ASD,with ID}} = 0.76$ ($SD = 0.42$) vs. $M_{\text{ASD,without ID}} = 0.89$ ($SD = 0.30$), $\beta = 0.98$, $SE = 0.30$, $z = 3.23$, $p = 0.001$, indicating that ASD children with ID had lower accuracy scores in general. At the same time, the nested contrast revealed higher accuracy in the receptive domain in both groups of children: ASD with ID, $M_{\text{expressive}} = 0.69$ ($SD = 0.45$) vs. $M_{\text{receptive}} = 0.84$ ($SD = 0.36$), $\beta = 1.10$, $SE = 0.10$, $z = 10.78$, $p < 0.001$; ASD without ID, $M_{\text{expressive}} = 0.85$ ($SD = 0.35$) vs. $M_{\text{receptive}} = 0.93$ ($SD = 0.25$), $\beta = 0.93$, $SE = 0.12$, $z = 7.38$, $p < 0.001$ (see Table 5). Therefore, in both ASD groups of children, word comprehension exceeded word production, indicating that non-verbal IQ did not influence the expressive-receptive pattern.

At the morphosyntactic level, we found a significant main effect of group, $M_{\text{ASD,with ID}} = 0.51$ ($SD = 0.38$) vs. $M_{\text{ASD,without ID}} = 0.80$ ($SD = 0.17$), $\beta = 0.37$, $SE = 0.07$, $t = 5.09$, $p < 0.001$, indicating that ASD children with ID had lower accuracy scores. Interestingly, we showed that ASD children with ID comprehended sentences more accurately than they produced them: ASD with ID, $M_{\text{expressive}} = 0.45$ ($SD = 0.42$) vs. $M_{\text{receptive}} = 0.56$ ($SD = 0.32$), $\beta = 0.11$, $SE = 0.05$, $t = 2.48$, $p = 0.01$. At the same time, we found that ASD children without ID did not show any difference between sentence production and comprehension: $M_{\text{expressive}} = 0.82$ ($SD = 0.17$) vs. $M_{\text{receptive}} = 0.78$ ($SD = 0.17$), $\beta = -0.04$, $SE = 0.05$, $t = -0.91$, $p = 0.36$ (see Table 6). Thus, non-verbal IQ accounted for the expressive-receptive pattern at the morphosyntactic level.

Table 2
Expressive vs. receptive vocabulary in children with ASD.

	Accuracy			
	Estimate	Standard error	z	p
(Intercept)	1.43	0.20	7.26	<0.001*
Domain_Receptive	1.07	0.08	14.01	<0.001*
Random Effects				
σ^2	3.29			
τ_{00ID}	2.23			
τ_{00Item}	0.12			
ICC	0.42			
N_{ID}	71			
N_{Item}	24			
Observations	6816			
Marginal R^2 / Conditional R^2	0.049 / 0.445			

Table 3
Morphosyntax production vs. comprehension in children with ASD.

	Accuracy			
	Estimate	Standard error	t	p
(Intercept)	0.60	0.04	14.35	<0.001*
Domain_Receptive	0.06	0.03	1.68	0.093
Random Effects				
σ^2	0.04			
τ_{00ID}	0.08			
ICC	0.67			
N _{ID}	71			
Observations	142			
Marginal R ² / Conditional R ²	0.007 / 0.674			

Table 4
Discourse production vs. comprehension in children with ASD.

	Accuracy			
	Estimate	Standard error	t	p
(Intercept)	0.63	0.04	15.57	<0.001*
Domain_Receptive	-0.08	0.03	-2.63	0.010*
Random Effects				
σ^2	0.03			
τ_{00ID}	0.08			
ICC	0.71			
N _{ID}	71			
Observations	142			
Marginal R ² / Conditional R ²	0.014 / 0.710			

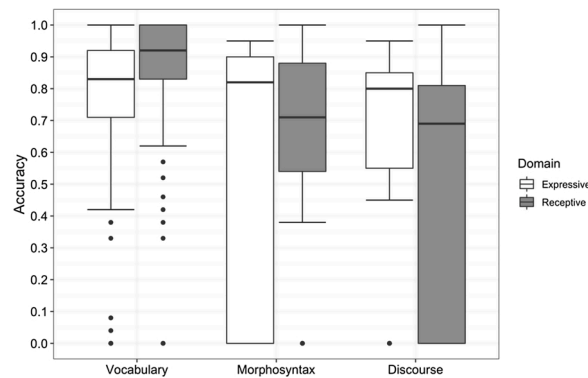


Fig. 1. Expressive and receptive language abilities of children with ASD (data from the experiment).

Finally, at the discourse level, there was also a significant main effect of group, $M_{ASD_with_ID} = 0.47$ ($SD = 0.36$) vs. $M_{ASD_without_ID} = 0.76$ ($SD = 0.21$), $\beta = 0.25$, $SE = 0.07$, $t = 3.35$, $p = 0.001$, indicating that ASD children with ID had lower accuracy scores compared to ASD children without ID. Importantly, we showed that ASD children with ID produced a story more accurately than they comprehended a story: $M_{expressive} = 0.53$ ($SD = 0.36$) vs. $M_{receptive} = 0.41$ ($SD = 0.36$), $\beta = -0.12$, $SE = 0.04$, $t = -2.66$, $p = 0.009$. By contrast, ASD children without ID did not show any difference between story production and comprehension: $M_{expressive} = 0.78$ ($SD = 0.17$) vs. $M_{receptive} = 0.74$ ($SD = 0.24$), $\beta = -0.04$, $SE = 0.04$, $t = -0.89$, $p = 0.37$ (see Table 7). This means that non-verbal IQ accounted for the expressive-receptive pattern at the level of discourse.

To conclude, we found significant main effects of groups, showing that ASD children with ID had lower accuracy scores than ASD children without ID in all language assessment tests used in the study. Importantly, we showed that non-verbal IQ accounted for the expressive-receptive patterns at the levels of morphosyntax and discourse. In morphosyntax, ASD children without ID showed no difference between production and comprehension, whereas ASD children with ID displayed the receptive-better-than-expressive pattern. In discourse, ASD children without ID also showed no difference between production and comprehension, whereas ASD children with ID demonstrated the expressive-better-than-receptive pattern. In vocabulary, both groups demonstrated the receptive-better-than-expressive pattern.

Table 5
Expressive vs. receptive vocabulary in different ASD groups.

	Accuracy			
	Estimate	Standard error	z	p
(Intercept)	1.09	0.23	4.86	<0.001*
Group	0.98	0.30	3.23	0.001*
Group_ASD_with_ID:DomainReceptive	1.10	0.10	10.78	<0.001*
Group_ASD_without_ID:DomainReceptive	0.93	0.13	7.39	<0.001*
Random Effects				
σ^2	3.29			
τ_{00ID}	1.34			
τ_{00Item}	0.13			
ICC	0.31			
N _{ID}	66			
N _{Item}	24			
Observations	6336			
Marginal R ² / Conditional R ²	0.089 / 0.371			

Table 6
Morphosyntax production vs. comprehension in different ASD groups.

	Accuracy			
	Estimate	Standard error	t	p
(Intercept)	0.45	0.05	8.83	<0.001*
Group	0.37	0.07	5.09	<0.001*
Group_ASD_with_ID:DomainReceptive	0.11	0.05	2.48	0.013*
Group_ASD_without_ID:DomainReceptive	-0.04	0.05	-0.91	0.363
Random Effects				
σ^2	0.03			
τ_{00ID}	0.05			
ICC	0.60			
N _{ID}	66			
Observations	132			
Marginal R ² / Conditional R ²	0.211 / 0.686			

Table 7
Discourse production vs. comprehension in different ASD groups.

	Accuracy			
	Estimate	Standard error	t	p
(Intercept)	0.54	0.05	10.32	<0.001*
Group	0.25	0.07	3.35	0.001*
Group_ASD_with_ID:DomainReceptive	-0.12	0.04	-2.66	0.009*
Group_ASD_without_ID:DomainReceptive	-0.04	0.04	-0.89	0.371
Random Effects				
σ^2	0.03			
τ_{00ID}	0.06			
ICC	0.63			
N _{ID}	66			
Observations	132			
Marginal R ² / Conditional R ²	0.202 / 0.706			

4. Discussion

The present study aimed to directly compare expressive and receptive language domains of Russian primary-school-aged children with ASD at the levels of vocabulary, morphosyntax, and discourse, using tests from the RuCLAB. We assessed the expressive and receptive language abilities of less-studied school-aged Russian children with ASD using formal testing at three different linguistic levels.

We found a significant difference between domains (expressive vs. receptive) at the level of vocabulary, revealing the receptive-better-than-expressive pattern in children with ASD. The same pattern was shown in only two previous studies (Luyster et al., 2008; Weismer et al., 2010) that used parental reports (*Vineland Adaptive Behavior Scale*, VABS) for language assessment and investigated language abilities in toddlers with ASD. However, VABS provides a global measure of expressive and receptive language whereas our tests assess the single-word production and comprehension. Our results showed that word production is more impaired

than word comprehension in direct testing of primary-school-aged children with ASD. Interestingly, the receptive-better-than-expressive pattern in language functioning is known as the general cross-language pattern in typically developing young children (Bornstein & Hendricks, 2012). Possibly, this pattern remains the same in children with ASD as they grow older.

At the level of morphosyntax, in sentence production and comprehension we did not find a significant difference between expressive and receptive language abilities. Children with ASD produced and recognized Russian simple sentences of different structures with comparable accuracy. This result is in line with the studies of Jarrold et al. (1997) and the comprehensive meta-analysis of Kwok et al. (2015), showing an absence of discrepancy in sentence production and comprehension in autism.

At the discourse level, we found a significant difference between expressive and receptive domains. Children with ASD produced a story based on the presented picture more accurately than they comprehended a story. There is a different possible explanations of such pattern. It is well-known that the echolalic speech is widely spread among children with ASD, and some studies have shown that autistic kids with impaired receptive language produced more echolalic utterances than children whose receptive language was more intact (Roberts, 1989). It is possible that during story-telling children were repeating the excerpts of story or single-words they are familiar with, and this could help them to earn a higher score on the expressive task but not in the receptive one. Additionally, the difference between domains may be explained not only by the expressive-receptive language pattern itself but also by the tasks. In production, children were asked to tell a story based on a picture, and they may earn some points even while using simple vocabulary and grammar. By contrast, in comprehension children were asked to listen to a story (it lasted ~ 2 min), memorize the whole story, and then answer questions targeting explicit and implicit information. Therefore, the comprehension test might be more challenging than the production test. We suppose that the difference between the two tasks might account for the difference between domains that we observed in the study.

Importantly, we showed that non-verbal IQ partly accounted for the difference between expressive and receptive language: we found different patterns for the children with and without intellectual disability in morphosyntax and discourse. At the level of morphosyntax, ASD children without ID showed no difference between expressive and receptive domains, whereas ASD children with ID demonstrated the receptive-better-than-expressive pattern. Perhaps, for children with low non-verbal IQ, it was more difficult to produce a sentence because they had to follow the priming, and to use correct grammatical markers and lexical items, whereas in comprehension with the sentence-to-picture matching paradigm they only had to choose the correct one out of two pictures. It is also possible that observed pattern may be explained by the difference between the production and comprehension tests, since they were not completely matched.

At the level of discourse, ASD children without ID also showed no difference between production and comprehension, whereas ASD children with ID demonstrated the expressive-better-than-receptive pattern. There are many different explanations for this pattern. First, this can be explained by the fact that the discourse comprehension task requires memorization, because the story lasted about 2 min, and, as different studies have shown, working memory in ASD children with ID is usually impaired (e.g., Habib et al., 2019). Second, we suppose that the pattern can also be related to the difference between the production and comprehension tests in terms of scoring as we discussed previously. Third, the questions in the comprehension task may also influence the children's ability to answer correctly, because they consisted of questions about the main storyline / details of the story as well as explicit / implicit question types. Our previous study showed that children with ASD struggled more with implicit questions (Arutiunian et al., 2021). Moreover, in order to answer correctly, children had to accurately parse the questions. In Russian, the questions are syntactically more complex than declarative sentences (e.g., Dunn & Khairov, 2009), and as children with ASD have impairments in morphosyntactic processing, their ability to answer the questions can also be influenced by morphosyntactic knowledge.

Contrary to the previous findings, at the level of vocabulary there was no difference between the two groups of children: both ASD children with and without ID demonstrated the receptive-better-than-expressive pattern. We also showed that non-verbal IQ influences the language abilities of children with ASD in general: ASD children with intellectual disability had lower accuracy scores in all tests compared to ASD children without intellectual disability, which is in line with previous works (e.g., Kjelgaard & Tager-Flusberg, 2001; Nevill et al., 2019).

Therefore, the present study makes a contribution to our understanding of the expressive and receptive language abilities of primary-school-aged children with ASD. The direct testing of children showed that the difference between production and comprehension appeared at the level of vocabulary (comprehension was more accurate than production) and discourse (production was more accurate than production), and also demonstrated that children's non-verbal IQ accounted for the difference between language domains.

The present study has some limitations which should be highlighted. First of all, in morphosyntax and especially in discourse assessments, the production and comprehension tasks were not matched on psycholinguistic variables and general complexity. In the morphosyntax assessment, stimuli were matched on the number of verb arguments and the type of the third argument between production and comprehension tests. However, they were not matched on semantic reversibility, word order, and construction type. In general, the sentence production task, where the children were asked to describe a picture relying on the provided spoken model, was more complicated than the sentence comprehension task, where they were asked to select one of the two pictures. Perhaps, that is why ASD children with intellectual disability showed the receptive-better-than-expressive pattern. In discourse assessment, the stimuli were not matched, and the production task was less demanding than the comprehension task. Possibly, because of the complexity of the comprehension task, we found the expressive-better-than-receptive pattern at the discourse level both in the whole group of ASD children and specifically in the group of ASD children with ID. Therefore, the language tests for morphosyntax and discourse production and comprehension in our study might to some extent influence the patterns. In order to reveal the patterns in expressive and receptive domains more precisely, one should develop tests that would be matched on the same variables in production and comprehension. Secondly, our sample included only children with ASD and not typically developing children, so, we do not know

exactly whether these expressive-receptive patterns are specific for ASD or they are also occurred in neurotypical population. Future research would benefit from comparing specific expressive-receptive patterns of typically developing children to children with developmental disabilities such as ASD.

5. Conclusion

The expressive-better-than-receptive pattern in language has been considered by some authors as the unique hallmark of ASD which differentiates these children from children with other developmental disabilities (e.g., Hudry et al., 2010; Mitchell, Cardy, & Zwaigenbaum, 2011). However, several studies, including our own, demonstrate that this is not a universal characteristic of ASD. Moreover, we have revealed that expressive and receptive language patterns differ depending on the linguistic level, children's non-verbal IQ, and assessment tools.

Authors contribution

All authors read and approved the final manuscript.

CRedit authorship contribution statement

Vardan Arutiunian: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing - original draft, Writing - review & editing, Project administration. **Anastasiya Lopukhina:** Conceptualization, Methodology, Formal analysis, Writing - review & editing. **Alina Minnigulova:** Investigation, Data curation. **Anastasia Shlyakhova:** Investigation. **Elizaveta Davydova:** Investigation. **Darya Pereverzeva:** Investigation. **Alexander Sorokin:** Investigation. **Svetlana Tyushkevich:** Investigation. **Uliana Mamokhina:** Investigation. **Kamilla Danilina:** Investigation. **Olga Dragoy:** Conceptualization, Methodology, Writing - review & editing, Resources.

Declaration of Competing Interest

The authors report no declarations of interest.

Acknowledgments

The study has been funded by the Center for Language and Brain NRU Higher School of Economics, RF Government Grant ag. № 14.641.31.0004. Special thanks go to all of the children who participated in the study.

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