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Sex/gender differences in the language profiles of Italian children with Autism Spectrum Disorder

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Abstract: Sex/gender (S/G) differences in ASD language profiles have been poorly investigated. The present study aims to explore whether male (M) and female (F) children with ASD and with normal non-verbal cognitive abilities differ in their linguistic profiles. A sample of 76 Italian children with ASD (range: 4.9 – 8 years), including 50 M and 26 F, was retrospectively recruited. Language profiles were analyzed using standardized tests for the evaluation of receptive and expressive vocabulary as well as grammar. Grammatical comprehension was the most impaired domain compared to the other language measures in both M and F children. Comparing language profiles between S/G, F showed significantly better scores than M in grammatical production (p=.002), and M showed better active negative sentences comprehension (p=.035). Moreover, comparing the language profiles between M and F with receptive disorder, F had significantly worse grammatical comprehension and better grammatical production than M. Even among children without receptive disorder, F had significantly higher grammatical production scores. The S/G differences in language profile, particularly better expressive language in F than M, can partially contribute to the delayed ASD diagnosis or underdiagnosis of F without intellectual disability. Finally, our results document the importance of accurately investigating both expressive and receptive abilities in children with ASD.

Keywords: Language and communication; sex/gender; Autism Spectrum Disorder; children

1. Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by persistent deficits in reciprocal social interaction, communication, and the presence of restricted, repetitive behaviour and interests [1]. Prevalence data from the most recent study conducted by the American Centers for Disease Control and Prevention reported that ASD occurs in approximately one in every 36 children aged 8 years [2]. In Italy the prevalence resulting from a cross-sectional epidemiological study conducted in the metropolitan area of Pisa (Tuscany, Central Italy) was of 1 out of 87 among children aged 7 to 9 years [3].

According to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders [1], language impairment is no longer a core symptom of ASD but an ASD 'specifier', used for a more detailed description of the patient' characteristics. Indeed, the level of language skills is highly heterogeneous in ASD, ranging from individuals who never develop spoken language (approximately one third of subjects, according to Koegel et al., [4]) to individuals with preserved expressive language abilities, but with deficits in the pragmatic use of language [5]. Moreover, most toddlers show a delay in standard early language milestones that in some children can be recovered around three or four years of

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age, while others may show a regression of language after the acquisition of first words at 12-15 months [6].

The over-representation of boys with respect to girls is one of the most replicated findings in the ASD literature [7-9]. Indeed, the sex imbalance prevalence in the ASD, with an approximately a 4:1 male (M) to female (F) ratio [10], that shifted to-ward a 3:1 ratio in epidemiological screening surveys on the general population [11], has historically impacted on the scientific knowledge (clinical, genetic and neuroanatomical) of ASD in F [12]. This topic has been poorly investigated, and only recently a growing number of studies have focused on it [11].

To note, that given the difficulties to disentangle the effects of sex and gender on ASD features, the term "sex/gender" (S/G) will be used throughout this article to acknowledge the overlap between these two concepts [13].

In toddlerhood, language delay is a major cause for concern among parents of infants who go on to receive an ASD diagnosis [14], and this symptom is more prominent in autistic M compared to F [15]. Moreover, the production of first words and sentences occurs earlier in ASD F than in ASD M [16]. Indeed, S/G differences in language delay may contribute to the delayed ASD diagnosis in some F compared to M [17, 18], since earlier ASD diagnoses are associated with parent-reported expressive language delays [19]. According to this view, findings from a retrospective investigation reported that ASD F who received a diagnosis of autism after the age of 5 years displayed more advanced social communication skills, including vocabulary [20]. Vice-versa, autistic F receiving a diagnosis during toddlerhood often displayed co-occurring language delays and/or intellectual disability [21].

Controversial findings regarding S/G differences in language and communication domains were reported. Some studies did not find any statistically significant differences on basic vocabulary, on grammar skills and on narrative abilities between F and M [22, 23], whereas others showed S/G differences in pragmatic and narrative abilities [23-29]. Regarding semantic abilities, Sturrock et al. [23] and Goddard et al. [30] found that ASD F performed better than ASD M using similar word-generation/fluency tasks.

Moreover, ASD F performed better than ASD M on narrative skills (including salient storytelling, rich narrative details, use of internal state language) [27], and on clinical observations of pragmatic abilities [29].

The abovementioned studies focused more on social and pragmatic domains rather than on basic structural language, and identified pragmatic and associated higher-level structural language skills as areas of difference between the M and F phenotype of ASD [23, 24, 27]. Indeed, S/G differences appear to exist mainly in domains where meaning of structural language is mediated by social context, inference, language of emotion and internal state, and pragmatic behaviours in discourse and narratives [31].

To address the abovementioned knowledge gap, in the present study we aimed to investigate S/G differences in basic structural language profiles in a cohort of children with ASD. Specifically, we directly compared expressive and receptive language abilities between M and F Italian children with ASD, using both naturalistic and a standardized assessment performed by speech-language therapists with expertise in communication disorders. Since a significant association between non-verbal IQ and language abilities was previously detected [32, 33], we decided to focus our investigation on a homogeneous group of children without intellectual disability.

2. Materials and Methods

2.1. Sample

The study was conducted on a sample of 76 children with ASD (50 males and 26 females) aged 4.9 – 8 years (mean age: 6.4 years; SD: 12.1 months) retrospectively recruited in a tertiary care University hospital from February 2009 to November 2020.

Inclusion criteria were as follows: (1) Diagnosis of either Autistic Disorder according to DSM-IV-TR criteria [34] or Autism Spectrum Disorder according to DSM-5 criteria [1];

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(2) Non-verbal IQ or developmental quotient ≥ 70, as assessed through standardized psychometric tests (i.e. Wechsler scales; Griffiths scales); (3) Expressive language at the level of multi-words production.

Informed written consent was obtained from the parents of all participants. This study was approved by the Paediatric Ethical Committee of the Tuscany Region (approval number: 178/2016), and was conducted according to the Helsinki Declaration.

2.2. Instruments

The language profile was evaluated by the following struments:

- Grammatical Comprehension Test for Children (TCGB) [35] is standardized on Italian children aged 3.6 – 8 years. The TCGB is a picture multiple-choice language test composed by 76 sentences pertaining to eight main blocks of grammatical structures (locatives, inflectionals, both affirmative and negative actives and passives, relatives and datives).
- Peabody Picture Vocabulary Test – Revised (PPVT-R) [36] is a multiple-choice language test for receptive vocabulary, for 3.9-11.6 years old children.
- One-Word Picture Vocabulary Test [37] is an expressive picture-naming test for high and low-frequency words), for 4.6-10.8 years old children.
- The 'Grid of Analysis of Spontaneous speech' (GASS) [38, 39] is a grid for the analysis of spontaneous language performed according to six levels rating system based on syntactical and morphological criteria.

For all language tests, (with the exception of the GASS), z scores below –1.5 SD of the mean were considered as clinically significant. For a detailed description of TCGB and GASS, see Table S1 and Table S2 in Supplementary Material.

WPPSI-III [40] performance IQ or Perceptual Reasoning Index at WISC-IV [41] or Griffiths [42] developmental quotient of the performance scale were used as measures of the non-verbal intellectual functioning level.

ADOS-G [43] or ADOS-2 [44] was performed with ASD children for the evaluation of the autistic severity.

2.3. Statistical Analysis

Skewness and Kurtosis statistics did not demonstrate a normal distribution for language-related variables, thus non-parametric tests were used.

The Mann–Whitney U test was used to compare age, language scores (z scores for TCGB and One-Word Picture Vocabulary, Lexical Quotient for PPVT-R and GASS level), non-verbal, verbal and total cognitive scores and ADOS severity scores:

1. between S/G (50 ASD M and 26 ASD F);
2. between S/G (50 ASD M and 26 ASD F);
3. between ASD M and ASD F without receptive disorder.

Statistical analyses were performed using SPSS 21 software (IBM SPSS Statistics, Chicago, IL, USA).

3. Results

Considering the mean z scores of the whole sample (see Table 1), grammatical comprehension (TCGB) was the most impaired domain compared to the other language measures (receptive and expressive vocabulary) in both M and F groups. The TCGB mean total z score and the mean z score of the different language structures (except for active negative sentences in the M group) fell below -1,5 SD of the mean (see Table 1). The expressive vocabulary (One-Word Picture Vocabulary Test) was the better linguistic area in both groups (mean z score > 1.5).

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Table 1. Male and female sample characteristics (N= 76) and Mann–Whitney U test.

	Males (N=50)			Females (N=26)			
	Mean	SD	Mean z score	Mean	SD	Mean z score	p
Age	76.08	12.54	-	79.58	12.67	-	ns
Grammatical Comprehension score (TCGB)	20.41	12.14	-2.93	21.08	9.59	-4.77	ns
Locative	2.60	2.27	-1.67	2.87	2.07	-1.90	ns
Inflectional	3.45	2.65	-2.36	3.15	2.01	-4.27	ns
Affirmative Active	2.14	2.04	-2.60	2.02	1.43	-4.06	ns
Negative Active*	1.94	1.78	-0.79	2.25	1.45	-1.70	.035
Affirmative Passive	3.25	2.29	-2.11	3.79	2.54	-4.57	ns
Negative Passive	2.54	1.82	-2.58	3.09	1.69	-3.45	ns
Relative	2.44	1.93	-2.53	2.35	1.32	-3.59	ns
Dative	2.08	1.37	-5.47	1.44	1.35	-4.23	ns
Receptive Vocabulary (LQ PPVT-R)	82.15	10.74	-1.19	81.39	16.61	-1.24	ns
Grammatical production level (GASS)*	4.16	0.61	-	4.62	0.56	-	.002
Expressive Vocabulary for high-frequency words (One-Word Picture Vocabulary Test)	14.04	5.84	-0.47	12.42	3.73	-0.52	ns
Expressive Vocabulary for low-frequency words (One-Word Picture Vocabulary Test)	32.11	6.76	-0.72	32.69	4.56	-1.21	ns
NVIQ	101.35	14.83	-	100.38	16.63	-	ns
VIQ	89.36	26.55	-	90.21	20.18	-	ns
TIQ	94.18	13.52	-	90.33	20.59	-	ns
ADOS Comparison Score	5.36	1.38	-	5.20	1.35	-	ns

*p<.05. Abbreviations: SD: standard deviation; LQ: Lexical Quotient; NVIQ: Non-verbal Intelligence Quotient; VIQ: Verbal Intelligence Quotient; TIQ: Total Intelligence Quotient.

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Table 2. Comparison between males and females with receptive disorder and between males and females without receptive disorder.

	Males with receptive disorder (N=31)	Females with receptive disorder (N=17)	p	Males without receptive disorder (N=19)	Females without receptive disorder (N=9)	p
Age	80.71 (11.43)	84.59 (8.52)	ns	68.53 (10.65)	70.11 (14.23)	ns
Grammatical Comprehension (TCGB, z score)*	-4.4 (2.43)	-7.02 (3.57)	.014	-0.54 (0.61)	-0.52 (0.66)	ns
Receptive Vocabulary (PPVT-R. LQ)	80.09 (10.77)	76.22 (11.43)	ns	84.67 (10.45)	86.56 (19.89)	ns
Grammatical production (GASS level)*	4.00 (0.63)	4.47 (0.62)	.019	4.39 (0.52)	4.89 (0.33)	.028
Expressive Vocabulary for high-frequency words (One-Word Picture Vocabulary Test, z score)	-1.02 (1.46)	-0.99 (1.23)	ns	0.41 (0.86)	0.36 (0.88)	ns
Expressive Vocabulary for low-frequency words (One-Word Picture Vocabulary Test, z score)	-1.06 (1.2)	-1.64 (0.82)	ns	-0.16 (1.14)	-0.40 (0.47)	ns
NVIQ	98.77 (15.43)	93.59 (15.15)	ns	105.42 (13.22)	113.22 (11.01)	ns
ADOS Comparison Score	5.44 (1.42)	5.38 (1.31)	ns	5.24 (1.35)	4.89 (1.45)	ns

*p<.05. Abbreviations: LQ: Lexical Quotient; NVIQ: Non-verbal Intelligence Quotient.

The analysis of the number of children who presented deficient expressive grammatical abilities (GASS) showed that there was a higher percentage of M (15%) than F (4%) with impaired performance. Moreover, receptive vocabulary and grammar were the most deficient areas in a high percentage of children in both the M and the F groups (receptive vocabulary: M=42%, F=56%; grammatical comprehension: M=62%, F=65%).

Statistical analysis with Mann–Whitney U test did not show any significant differences in age, cognitive abilities and severity of autistic symptoms between M and F (Table 1). Instead, the two groups showed significant differences in expressive grammatical abilities and in active negative sentences comprehension. In particular, F showed significantly better scores than M in grammatical production (p=.002), whereas M had better active negative sentences comprehension (p=.035). Moreover, M showed a better grammatical comprehension total score than F, though this finding did not reach statistical significance.

Given the importance of receptive difficulties, Mann–Whitney U tests have been conducted to compare the functional profiles of M and F with and without receptive disorder. Both analyses (comparisons between M and F with and without receptive disorder) did not show any significant differences in non-verbal cognitive scores and severity of autistic symptoms between the groups. Both receptive (p=.014) and expressive (p=.019) grammatical abilities differed significantly between M and F in children with receptive deficits. In particular, F had significantly worse grammatical comprehension, but significantly better grammatical production than M.

Statistical comparison between M and F without receptive disorders confirmed also in this group that F had significantly better expressive grammatical abilities (p=.028) than M.

4. Discussion

The present study aims to explore whether male (M) and female (F) children with ASD and without intellectual disability (at the non-verbal level) differ in their linguistic profiles.

An extensive literature on typical development reported that M and F differ in the rates of communication and language development. In particular, F demonstrate an

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earlier acquisition of first words [45], a better and earlier integration of language with gesture [46], and an earlier use of the social-emotional words, and of more complex linguistic forms during spontaneous speech [47]. Regarding conversational skills, F use more collaborative and negotiated discourse [48] and focus on person-centered topics and emotions [49]. These profiles are crucial for social-linguistic interaction and integration with female social groups [49, 50]. Conversely, S/G differences in language profiles of children with ASD are still poorly investigated.

In the present study we found that both M and F groups displayed a deficit in grammatical comprehension, and this weakness was more evident in ASD F than in ASD M. Moreover, in our sample F presented significantly better grammatical production skills than M.

These results thus confirm not only the presence of a marked impairment of receptive skills in children with ASD [51-56], but also, especially in the F group, a strong discrepancy between language comprehension and production already documented in the literature [56-58]. This discrepancy between grammatical production and comprehension may make it difficult to identify the receptive disorder. In fact, the better production skills may mask the comprehension deficits, thus not allowing the access to specific rehabilitation interventions.

The above data should be interpreted with caution, as the few papers that addressed this issue report conflicting results. For example, Sturrock et al. [23] compared ASD M and F with PIQ ≥ 70 and proposed them a battery of direct assessments targeting expressive and receptive language at multiple levels: word, simple and complex sentences, narratives, word knowledge (semantics), inference and vocabulary of emotion. These Authors did not find any statistical differences in grammar skills (and basic vocabulary) between M and F. Moreover, in a recent paper, Sturrock et al. [31] provides a synthesis of recent studies investigating language and communication difficulties in autistic F without intellectual disability. The Authors found that autistic F appeared to perform below typically developing F on measures of pragmatics, semantics, and above sentence-level structural language; however, vocabulary and basic grammar (receptive and expressive) appeared to be unaffected. These data are consistent with the review of McFayden and colleagues [59] in which S/G differences are most evident when social communication is evaluated in a naturalistic context rather than based on a standardized assessment. In fact, parents of F described greater difficulties than those detected through direct standardized measurement [60, 61].

Conversely, our results are in line with some works detecting better performance of F than M in some expressive language tasks. In this context, Sturrock et al. [23] and Goddard et al. [30] found that autistic F performed better than autistic M using similar word-generation/fluency tasks.

Other studies demonstrated S/G differences in pragmatic elements of narratives, with autistic F generating richer character depictions and descriptions of internal states, cognition, perception and judgment [24, 26, 27] and overall better skills in retelling salient story elements [27]. For instance, autistic girls used significantly more social words than autistic boys during the conversation section of the ADOS-2 Module 3 [62].

All these data, documenting the best expressive language and pragmatic abilities, including social words used and grammatical production (as found in our study), can partially contribute to the undiagnosed or late-diagnosed ASD in F. Moreover, the specific linguistic profile of high-functioning F with ASD has been related to the "camouflage" abilities of these individuals (for a recent review, see Tubío-Fungueiriño et al., [63]). Indeed, the term "camouflaging" is used to describe the strategies, either voluntarily or involuntarily, adopted by ASD subjects for masking or compensating the social impairment experienced during the social interactions [25]. Even if the majority of the investigations on social camouflaging to date focused on F adolescents and adults with ASD, this feature is also present in children with ASD [64-66]. Recent research suggests that girls with ASD may "camouflage" real struggles with social communication by engaging in verbal and social communication, social mimicry and behaving in ways that are superficially typical,

and these factors, combined with male-referenced diagnostic criteria and unequal societal expectations for boys' and girls' social interaction skills across development, may complicate ASD diagnosis [11, 59, 67-70]. Accordingly, a late or inaccurate diagnosis for females with ASD, may result in a difficulty of accessing to evidence-based interventions and in a lack of social supports. In this way there is a high risk of experiencing social rejection, and poor mental health outcomes [59, 71, 72].

The results of the present study suggest the presence of distinct linguistic profiles in M and F with ASD. They also provide evidence of the importance of accurately investigating both expressive and receptive language abilities for the choice of effective and personalized interventions aimed at promoting language development on the basis of the specific language profile.

The present study has certain limitations that must be acknowledged. First, the rather low sample size and the retrospective nature of this single center investigation make the study susceptible to bias: therefore, the results obtained need to be further validated on a larger sample of ASD children. Second, only ASD subjects without intellectual disability were included. This selection criterion was justified by the need to homogenize the sample of children with ASD, but it does not allow to generalize results to the rest of the ASD population. Third, the lack of a matched control group of typically developing children was a limitation of the study, but was mitigated by the use of standardized tests.

Future studies should integrate clinical assessment performed by trained professionals with parent-report measures of communication abilities in order to obtain a more comprehensive picture of S/G ASD differences in the use of language in daily living situations.

Supplementary Materials: The detailed description of TCGB and GASS can be downloaded at: Preprints.org, Table S1: The Test of Grammatical Comprehension for Children TCGB; Table S2: Grid of Analysis of Spontaneous Speech GASS.

Author Contributions: J.B. and S.C. conceived the idea for this original research and all other authors contributed to the conception and the design of the study. J.B., G.M., R.N., and L.P. carried out the enrollment of all children for the study. A.M, A.C., and R.T. performed the neuropsychiatric assessment and data curation. J.B. and A.N. carried out the statistical analysis. J.B., G.M. and S.C. conceived and prepared the manuscript. A.N., A.M.C. and P.C. were responsible for the writing, reviewing and editing. S.C.: funding acquisition. All authors have read and agreed to the final version of the manuscript.

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Institutional Review Board Statement: This study was approved by the Paediatric Ethical Committee of the Tuscany Region (approval number: 178/2016), and was conducted according to the Helsinki Declaration.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data created or analyzed during this study is available upon request from the corresponding author.

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