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Is language impaired in Spanish-speaking children with autism spectrum disorder level 1?

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Abstract

The current diagnostic criteria for the autism spectrum disorder (ASD) include the possibility to specify concomitant language difficulties.

Purpose: Our main aim was to explore whether children with ASD-Level 1 (ASD-L1) present difficulties in the acquisition of structural language, as little work has been done in this regard so far. As a secondary aim we evaluated the degree to which the potential language impairment in ASD is directly associated with their social communication deficits or it represents a distinct deficit.

Methods: To further clarify the nature and characteristics of putative language difficulties in ASD-L1, we evaluated language skills in 89 children and preadolescents diagnosed with ASD-L1, and a group of typically developing participants (TD). All of them were between 8 and 13 years old and had similar socioeconomic backgrounds.

Results: Children with ASD-L1 obtained lower scores than those in TD group in repeating sentences, in finding the semantic relationships between words, and in applying word structure rules (morphology). Congruently, the core language standard score was lower in the ASD-L1 group, and the proportion of language delay was significantly higher in the ASD-L1 group than in the control group.

Conclusion: Language scores were associated with autistic traits; thus, language performance in ASD-L1 is closely related to autistic symptoms. These results are discussed according to the literature on linguistic deficits in ASD-L1 and their relations with phonological working memory.

Keywords
ASD-L1, structural language, delay, phonological working memory

Introduction

According to the *Diagnostic and Statistical Manual of Mental Disorders-5* (*DSM-5*; American Psychiatric Association [APA], 2013), autism spectrum disorders (ASDs) can be defined as a broad continuum of neurodevelopmental disorders that manifest from an early age with a qualitative deficit in social communication and social interaction, along with inflexible and stereotyped patterns in everyday

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behaviors. These disorders have a considerable biological basis and affect from 1% to 2% of the general population (Christensen et al., 2016). ASDs refer to a heterogeneous group of neurodevelopmental disorders where different symptoms lead to clinically significant alterations in the social, communicative, cognitive, and behavioral aspects that represent the core areas of human functioning. These alterations are not better explained by the presence of an intellectual disability or by a global developmental delay. The *DSM-5* specifies three different levels for ASD: Level 1 implies that the person affected "requires support" (ASD-L1); Level 2 involves the need of "substantial support"; and Level 3 indicates the need of "a lot of substantial support." Moreover, the *DSM-5* specifies that ASD can or cannot be accompanied by a language delay. Previously, in the *DSM-4TR* (American Psychiatric Association [APA], 2003) most of these levels corresponded with different disorders, being different categories instead of a spectrum. In this sense, most of the children who are now diagnosed with an ASD-L1 were considered previously as Asperger disorder.

With respect to ASD-L1, diagnostic criteria include deficits in initiating social interactions and in social openness (Constantino & Charman, 2016). Qualitative communication difficulties are also detected in this group, including atypical answers given in social situations and diminished interest in social interaction (Happé & Frith, 2014). This communicative pattern is accompanied by difficulties in alternating activities and a lack of flexibility in one or more developmental contexts, including school.

Deficits in communication skills are in the core definition of ASD and ASD-L1 in the *DSM-5*, but language skills and their possible difficulties are not still clearly depicted in this population, as ASD-L1 can be accompanied or not with a linguistic deficit. Both language and communication refer to distinct but interrelated aspects of an individual's language and social functioning (Charman et al., 2003). Although they may overlap in some respects, it is important to distinguish between them to better understand the needs and characteristics of individuals with ASD. On one hand, linguistic difficulties refer to the challenges an individual may experience specifically with the acquisition, comprehension, or use of a language system and their structure, considering all their components (phonology, morphosyntax, semantics, and pragmatics; Paul et al., 2009). Differently, communication difficulties refer to the broader challenges that affect an individual's social interaction and communication with language and or other communication systems (Law et al., 2000). These last skills have been extensively studied in children with ASD and are supposed a core difficulty in this population. In contrast, language skills have been less explored in ASD even less in ASD-L1.

Accordingly, few studies have explored the language skills in ASD. One of the most recent is that of Larson et al. (2022) who explored whether language was impaired in children with ASD and evaluated whether the nature of their language impairment was related to social and communication deficits. The authors confirmed that language—assessed with the Clinical Evaluation of Language Fundamentals-4 (CELF-4) (Semel et al., 2006)—was structurally impaired in children with ASD aged 13. More in detail, the average Core Language Score (CLS) in Larson et al.'s study was approximately 18 units lower than their normative peers. The CLS is a measure with a mean of 100 and standard deviation of 15 in the general population and has been widely used in clinical and research settings to determine whether a language disorder exists and is extracted from the participant's performance on subtests that measure syntax, morphology, and the semantics. Furthermore, data using the criterion of the CLS ≤ 82 (Nitido & Plante, 2020) showed that 11.4% of participants in their ASD group were classified as having a language impairment. Interestingly, the authors chose the subtest recalling sentences (RS) with a ≤ 7 criterion (mean in general population of subtest of 10 and SD of 3) because of its greater specificity in probing morphosyntactic skills and assessing phonological working memory and showed that 22.9% of participants in the ASD group were classified as language impaired. Thus, the proportion of structural language impairment in ASD using this subtest doubled the odds of ASD participants being classified as language impaired. Other studies have also shown that children with ASD could present difficulties in producing complex structures (Eigsti et al., 2011), semantic-based reading difficulties (with a tendency to make more semantic substitutions), and syntactic difficulties when having to correctly place adjectives within a sentence (Gernsbacher et al., 2016).

Concerning the language skills of ASD-L1, there are only studies conducted with the former Asperger syndrome (AS; which shall partially correspond to the actual ASD-L1) before the change from DSM-4TR to *DSM-5*. In this sense, different studies have reported that language comprehension may be affected in persons with Asperger's disorder, showing lower scores in receptive language, although other language skills may develop typically (Eigsti et al., 2011; Jolliffe & Baron-Cohen, 1999; Saalasti et al., 2008). Moreover, in the intersection between language and communication, Martín Borreguero (2005) highlights that people with AS present scarce linguistic compensation strategies, poor understanding of discursive norms, little modulation of the suprasegmental characteristics of the language, and an absence of rhetorical figures.

Nevertheless, some previous studies suggested some differences in the characteristics between AS and the present ASD-L1. In this sense, de Giambattista et al. (2019) showed that persons with AS showed higher cognitive functioning, language skills, perceptual reasoning, working memory, processing speed, and long-term memory than persons with ASD-L1. Concerning language characteristics, persons with AS show a less literal interpretation, more excessively precise speech (characterized by excessively monotonous speech and with prosodic difficulties), and less delay in the first language acquisition than persons with ASD-L1. Therefore, results in previous studies on language skills in AS cannot be translated directly to the actual ASD-L1 diagnostic.

To our knowledge, there is only one study that has explored the linguistic difficulties in children with ASD-L1 following the present *DSM-5* criteria. Georgiou and Spanoudis (2021) reported that there is a subgroup inside children with ASD-L1 who also show language difficulties, similar to children with developmental language disorder (DLD), evidencing that a subgroup of individuals with ASD-L1 may present a structural language impairment with a deficit in morpho-syntax (see Kjelgaard & Tager-Flusberg, 2001; Riches et al., 2010; Wittke et al., 2017) beyond their communication deficit.

Due to the scarce studies describing language abilities beyond communication difficulties in children with ASD-L1, there is still little consensus on their linguistic profiles and the relation between language and communication skills with other impairments observed in this population (Law et al., 2000; Martín Borreguero, 2005). In this sense, it seems that not all people with ASD will experience the same challenges in these areas. Some may have a good command of formal language but may struggle in social situations, while others may have significant difficulties in both language and communication.

Besides, different studies support the relevance of examining language development in children with ASD and how this may influence their diagnosis and clinical management (Charman et al., 2003; Eigsti et al., 2011; Paul et al., 2008). Even though pragmatic language impairments are common in ASD, identifying whether there are specific difficulties in structural language or in language comprehension in this population is of interest, as it might help understand the diversity of ASD profiles, their relationship with communication skills and cognitive functioning.

Regarding the associations of language skills with other impairments in ASD, Larson et al. (2022) showed that a poorer language skill measured by the CLS was associated with higher social communication difficulties and repetitive behavior. Likewise, Reindal et al. (2023) recently found that structural language deficits were common in children with ASD and were associated with reduced pragmatic competence. Similarly, Tager-Flusberg (1999) highlights the importance of understanding social and linguistic deficits in ASD from an integrative perspective, which underlines the need to address language in the context of the social difficulties characteristic of this disorder for although language and communication difficulties are closely related and can influence each other.

Following the above-mentioned literature, the main objective of this study is to explore language skills in a wide sample of children and preadolescents diagnosed with ASD-L1 to ascertain whether language deficits are inherent to ASD-L1 or there is a subgroup of participants with a significant language delay (Goal 1, G1). Also, we aimed to elucidate which of the CLS subtests would reveal more differences between the ASD-L1 group and children with typical development (Goal 2, G2). Thus, we wanted to explore what percentage of children in each group would fall within the category of language delay (G1) and which of the CLS subtests would show more significant differences compared with the children in the control group (G2). Additionally, we aimed to explore the associations between CLS subtests and symptoms of ASD (Goal 3, G3). We expected that children with ASD-L1 would present poorer language skills overall than the TD group (H1) and a higher proneness to language delay (H2). As there is no previous research in ASD-L1 with the CELF, we cannot hypothesize which subtests would show more significant differences with typical development. Finally, we expected that lower language scores would be associated with higher scores on autistic traits (H3).

Method

Participants

We started with an initial sample of 94 Spanish-speaking children aged 10 years on average from Colombia (Bogotá and the central region) and the Balearic Islands (Spain). All children in the ASD-L1 group presented a previous clinical diagnosis by their pediatric neurologist following standard guidelines (de Giambattista et al., 2019). Thus, the ASD sample was composed of participants with ASD-L1 (requiring support), according to the *DSM-5* (American Psychiatric Association [APA], 2013). All participants in the ASD-L1 group developed oral language and did not present echolalia or excessively repetitive language, according to the neurologists. All these aspects were verified in the initial interview with the families and the subsequent clinical reports. Clinical reports from a pediatric neurologist, psychologist, and speech therapist in the Colombian population, as well as a report from a child and adolescent psychiatrist in the Team for the socialization and communication difficulties assessment (EADISOC) for the Spanish population, confirmed that all persons with ASD-L1 did not have a language disorder (APA, 2013) at the moment of diagnosis.

Specifically, the clinical protocol for the diagnosis, treatment, and comprehensive care route of children with ASD established by the Ministry of Health of the Colombian government was followed (Ministerio de Salud y Protección Social, 2015) for the Colombian sample. In the Colombian protocol, it is recommended to take a complete clinical history, which addresses prenatal, perinatal, family history, and current conditions. In addition, it requires following the *DSM-5* criteria and carrying out interdisciplinary work by different professionals such as neuropediatric or child psychiatry. Also, an assessment by a clinical psychologist and a speech therapist is conducted.

For the Spanish sample, the clinical protocol established by the (EADISOC; https://www.caib.es/sites/diversitat/ca/eoep_eadisoc/) of the Regional Government of the Balearic Islands was followed. In the Spanish clinical circuit, in addition to including the recommendations cited above, it is required to administer a minimum of four screening tests such as the Modified Checklist for Autism in Toddlers (M-CHAT; Robins et al., 2009), Social Communication Questionnaire (SCQ; Rutter, Bailey et al., 2003), and Autism Mental Status Exam (AMSE; Lord et al., 2012). Once the screening has been administered, the two gold standard tests Autism Diagnostic Observational Schedule (ADOS-2; Lord et al., 2015), and Autism Diagnostic Interview Revised (ADIR; Rutter, Le Couteur et al., 2003) must be applied to each of the participants to confirm the diagnosis.

Children with ASD-L1 were paired with control children of the same age, sharing the same classroom, and having as maximum similarities as possible about sex, socioeconomic status (SES), and family language (see Table 1). Additionally, they were exposed to a linguistic environment that did not differ significantly and did not present difficulties to understand test instructions.

To ascertain whether participants presented traits associated with ASD-L1 after their respective neuropsychiatric reports by clinicians, we used *The Autism Spectrum Screening Questionnaire* (ASSQ; Ehlers et al., 1999), and the *Autism Spectrum Quotient* (AQ; Baron-Cohen et al., 2006) described later in materials subsection. Besides the Raven's Progressive Matrices test (Raven et al., 1995) was administered to the entire sample to determine the nonverbal IQ and to verify that both groups presented a normative cognitive level. A minimum IQ of 85 was considered as the cut-off criterion, together with no history of cognitive, auditory, or neurological damage. Of the initial sample, two participants were excluded from ASD-L1 group because they did not reach the score to accomplish ASD criteria according to their scores in the ASSQ and AQ. Following Table 1, average scores in the ASD-L1 closely resemble those of the validation sample of the ASSQ. Similarly, three participants in the control group were discarded from the sample, as two of them exceeded the clinical threshold of ASD behaviors according to the ASSQ and AQ tests, and the other had a low IQ ($IQ < 85$), which was not compatible with typical development. Accordingly, all participants in the ASD-L1 group and control group presented an average cognitive level, as is the case in previous reports (Mazurek et al., 2019).

Therefore, after applying the screening tests described later and the cognitive test, we obtained a definitive sample of 89 participants: 45 with ASD L1 (31 from Colombia and 14 from Spain) and 44 with typical development (31 from Colombia and 13 from Spain). None of the demographic variables differed between groups (see Table 1). All children had completed the two previous years of primary education before the study. In the final sample, there were only three female participants (6.7%) in the ASD-L1 group ($n = 45$), which is reflective of the gender disparity in diagnosis (Nevison & Zahorodny, 2019). For the control group ($n = 44$) there were eight females (18.2%). Groups did not differ significantly with regards to sex [$\chi^2(1) = 2.72$; $p = .1$], and the age range of the participants was 8–13 years old (see Table 1).

Participants from Colombia were monolingual (Spanish) and those from the Spanish region were bilingual (Spanish and Catalan). Catalan is a co-official language in the Balearic Islands, along with Spanish, and schools use Catalan as the main language of instruction; however, Spanish has a great presence in the mass media and social relations (Govern de les Illes Balears, 2022), which makes that students are competent in both languages. However, to ensure statistical rigor, we controlled for bilingualism and demographic residency (Spain and Colombia), maintaining an equal number of participants from each demographic region within the clinical group. Besides, an independent sample test conducted between both samples (Colombia $M = 99.7$, $SD = 15.0$; and Spain $M = 101.3$, $SD = 18.4$) revealed non-significant differences ($t[87] = -0.459$; $p = .647$) in the CLS standard score.

Materials

The Autism Spectrum Screening Questionnaire (ASSQ)

As mentioned previously, two tests were administered to confirm the diagnosis of ASD-L1. The first one, ASSQ (Ehlers et al., 1999), was answered by the parents of participants with ASD. The ASSQ is designed exclusively to assess the characteristic symptoms of AS and other high-functioning ASD in children and adolescents with normative intelligence. The ASSQ has been used to differentiate children with AS and high-functioning autism from those with attention-deficit/hyperactivity disorder, behavioral, and learning disorders (Norris & Lecavalier, 2010). Despite that, it is important to note that AS symptoms do not represent an exact equivalence to those of ASD-L1. The main difference is that people with AS tend to have normative intelligence values and do not usually present a significant language delay (Morales et al., 2014). However, it is likely that people with AS would currently be diagnosed as having ASD-L1 due to their relatively low need of support (Sagarzazu Sacristán, 2017).

Table 1. Descriptive and inferential statistics of the confirmation tests administered after initial diagnosis for the ASD-L1 ($n = 45$) and the control group ($n = 44$).

	ASD-L1 mean (*SD*)	Control mean (*SD*)	*t* (*p*)	*U* (*p*)	*d*	*n* (ASD L1)		*n* (Control)	
						Col.	Spa.	Col.	Spa.
Age	9.89 (1.79)	9.98 (1.93)	970 (.87)	–	0.05	31 (34.8%)	14 (15.7%)	31 (34.8%)	13 (14.6%)
Raven (total)	113.45 (11.91)	108.83 (13.02)	506 (.18)	–	0.37	31 (34.8%)	14 (15.7%)	31 (34.8%)	13 (14.6%)
SES	3.11 (.83)	3.38 (.84)	822 (.14)	–	0.17	31 (34.8%)	14 (15.7%)	31 (34.8%)	13 (14.6%)
ASSQ	34.31 (10.04)	7.22 (4.62)	**1505.5** (<.001)	–	3.38	30 (33.7%)	13 (14.6%)	30 (33.7%)	12 (13.4%)
ASSQ-girl	9.67 (3.05)	4.5 (3.96)	–	2.02 (.074)	1.37	1 (1.1%)	1 (1.1%)	1 (1.1%)	1 (1.1%)
AQ-child	94.84 (13.92)	46.31 (14)	**1248** (<.001)	**–**	3.48	25 (28.1%)	14 (15.7%)	19 (21.3%)	13 14.6%)
AQ-Adolescent	38.50 (4.93)	19.50 (5.42)	**–**	**7.21** (<.001)	3.60	6 (6.7%)	0 (0%)	12 (13.4%)	0 (0%)

Note: Bold depicts significant group differences. ASD-L1: autism spectrum disorder-level 1; SES: socioeconomic status [1: lowest level; 6: highest level]; ASSQ: Autism Spectrum Screening Questionnaire; AQ: Autism Spectrum Quotient; *SD*: standard deviation; *t*: Student's *t* (in a sample of over 30 participants) test; *U*: Mann–Whitney's *U* (in a sample of fewer than 30 participants) test; *p*: significance level; *d*: effect size with Cohen's *d*; Col.: Colombian sample; Spa.: Spanish sample.

The ASSQ presents 27 items that are scored by choosing between "No" (absence of an alteration), "Something" (indicates some level of impairment), and "Yes" (there is an impairment), which correspond to the numerical values of 0, 1, and 2, respectively.

For female participants, we applied the ASSQ-Girl (Kopp & Gillberg, 2011), which includes 18 items. Some examples of ASSQ items are: "*Lives somewhat in a world of his/her own with restricted idiosyncratic intellectual interests*"; "*Has a deviant style of communication with a formal, fussy, old-fashioned or 'robot-like' language*" (Ehlers et al., 1999). All items were adapted to Spanish and had been formerly validated (Freire et al., 2007).

In the version for boys, the total score ranges from 0 to 54. According to the authors (Ehlers et al., 1999), a score of 22 or higher would indicate signs and traits of ASD. In the version for girls, the total score ranges from 0 to 36. A score higher than the average (14.4 points) (Ehlers et al., 1999; Kopp & Gillberg, 2011) is indicative of ASD. The mean parent and teacher scores in the AS validation sample were 25.1 ($SD = 7.3$) and 26.4 ($SD = 11.7$), respectively. A correlation analysis demonstrated that ASSQ-girl had a good convergent validity with the previously well-validated ASSQ (Ehlers et al., 1999; Kopp & Gillberg, 2011). The ASSQ-girl screening tool was used in our research to provide a more specific and sensitive assessment for detecting autistic spectrum characteristics in girls, despite their small numbers in the sample, as it has been specifically designed to address gender differences and capture autistic characteristics that may be more common in girls.

Autism Spectrum Quotient-Child version (AQ-Child) and Adolescent Version (AQ-Adolescent)

Both versions of the AQ (child and adolescent; Auyeung et al., 2008; Baron-Cohen et al., 2006) quantify autistic traits and are designed to be answered by parents or caregivers. The AQ-Child (Auyeung et al., 2008) is intended for children between 4 and 11 years of age, and the AQ-Adolescent is designed for children and adolescents between the ages of 12 and 16. Both versions consist of 50 questions answered using a 4-point Likert-type response in which the participants answer from "totally disagree" to "totally agree." The AQ-Adolescent (Baron-Cohen et al., 2006) is very similar to the AQ-Child. In the child version, the authors establish the result of 76 as a cut-off scale score to indicate behaviors associated with ASD that would justify carrying out a diagnostic assessment by a health professional. For the Adolescent version, a scale score of 30 and higher is established as the cut-off. Some examples of the test items are: "*S/he prefers to do things with others rather than on her/his own*"; "*When s/he is reading a story, s/he finds it difficult to work out the characters' intentions or feelings*" (Auyeung et al., 2008). This screening test has been reviewed and adapted to Spanish by the Autism Research Center website (University of Cambridge, Department of Psychiatry, 2021).

Clinical Evaluation of Language Fundamentals, Versions 4 and 5

The Spanish version of the CELF-4 (Semel et al., 2006), adapted and approved to be applied in American populations, was used to measure linguistic skills in the subsample from Bogotá (Colombia). Specifically, we used the subtests that form the CLS, which serves as a global approximation of the participants' linguistic profile for a given age. We calculated the scores of the different subtests following the test's instructions and used the standard score in our data. The following subtests were administered depending on the age of the participant: concepts and following directions (CF), which involves identifying stimuli in the correct order following the administrator's directions as participants must point to remember the order and then pictured objects in response to oral; RS, which consists in repeating oral sentences of increasing length and morpho-syntactic complexity without altering any element; formulated sentences (FS), in which the participant has to produce adequate and correct oral sentences with a target word and a visual stimulus as a reference; word classes (WC), consisting in choosing the related pair of words between four possible choices and explaining why these words are related, thus making a receptive and an expressive score; word structure (WS), which demands completing oral sentences with a visual stimulus as a reference, marking the necessary inflections derivations and comparisons; and word definition (WD), consisting in defining several words within a linguistic context. The CLS for children aged 5–8 (13 participants in our sample) is computed as the sum of CF, RS, FS, and WS. For participants aged children 9+ (45 participants in our sample) the CLS included the sum of CF, RS, FS, and WC. A total of 58 participants were assessed using the CELF-4.

The CLS of the CELF-5 (Semel et al., 2018) was used to quantify general linguistic performance for the Spanish sample, as it is the only version adapted to this context. As in the case of the CELF-4, test's instructions were followed to apply and score the test. For participants aged 5–8 (10 participants in our sample): we used the subtests FS, RS, paragraph comprehension (PC), which evaluates the capacity to interpret spoken sentences of increasing length and complexity and consists in selecting the pictures that illustrate referential meaning of the sentences, and WS. For participants aged 9+ (21 participants in our sample) the CLS is computed as the sum of WC, FS, RS, and semantic relationships, which involves the ability to interpret sentences make comparisons, identify location or direction, specify time relationships, include serial order, or are expressed in passive voice. A total of 31 participants were assessed using the CELF-5. Both versions of CELF are equivalent and have similar subtests. Besides, as we used two different control groups for each subsample with ASD, the possible test differences were experimentally controlled and, as reported above, non-significant differences were found between both samples (Colombian and Spanish) in the CLS.

Socioeconomic Status

Participants were classified according to their families' SES. SES in Colombia is used to identify families which can obtain a subsidy. Each stratum is created based on two principles (Gallego et al., 2014): to 'classify' citizens according to their income or ability to pay, and according to the characteristics of the environment where they live. Specifically for Bogotá, it essentially consists of the following procedure: (a) cartographic update, taking into account the appearance of new blocks, (b) zoning, which according to Gallego et al. (2014) allows different zones to be established taking into account land use, settlement planning, construction materials, real estate density, state of completion of development, immediate environment of the dwelling, quality of space public, degree of deterioration of the building and urban landscape, and (c) collection of information by block side. It is worth mentioning that in Bogotá income is not included directly, since it is a variable difficult to collect, with low levels of reliability. Thus, SES 1 corresponds to the lowest level and SES 6 corresponds to the highest.

To calculate the SES for Spanish participants, we adopted the criteria established in 2023 by the Organization for Economic Cooperation and Development (OECD) (https://www.oecd.org/economy/panorama-economico-espana ; Organization for Economic Cooperation and Development (OECD), 2023). The following variables were considered: the number of persons in the family unit, the income of the family unit (monthly and yearly), and the area of residence. Families with incomes below 1.645€/month are considered as low class (equivalent to Colombian Strata 1 and 2). The middle class (Colombian Strata 3 and 4) comprise those families with incomes between 1.645€/month and 4.386 €/month, and the upper class (Colombian Strata 5 and 6) corresponds to familiar incomes above 4.386€/month. Most of participants in both subsamples were classified as having a middle stratum (3 or 4). The ASD-L1 and the control group did not differ in SES distribution ($\chi^2[4] = 3.18$; $p = .53$). See also Table 1 for independent group comparison of SES using discrete data.

Procedure

The research ethics committee of both Universities in Spain and Colombia approved the study and provided full consent. Interested parties contacted the evaluators through their educational counsellors after the research project was presented to all schools. All participants provided explicit oral consent at the beginning of the tests, and their parents or legal guardians also gave their written consent, following the data protection laws of each country. In the Colombian sample, all the tests were carried out in two 45-min sessions at the Cognitive neurosciences and communication laboratory of the Universidad Nacional de Colombia (UNAL) or the guidance department of the participating schools (participants from Colombia). Regarding the Spanish sample, the tests were applied with the same criteria and duration at the University of the Balearic Islands, and in the support classrooms in the educational centers of the participants. All instruments were administered in Spanish by trained team members, accomplishing the required conditions for each test. Parents of participants with ASD-L1 answered the screening tests at the same time as their children in a different room, guaranteeing the optimal conditions for test administration.

Data analyses

JASP v.0.17 (JASP Team, 2023) was used for data analysis. Parametric and nonparametric group comparisons (Student's *t* test or Mann–Whitney's *U* test) were used to conduct all analyses given that some of the tests did not follow a normal distribution and the fact that for several subtests there were few participants per group. To explore the percentage of participants with a language delay, the χ^2 statistic was used. Finally, to analyze the associations between symptoms of autism and language subcomponents, Spearman's *rho* was calculated.

Results

Percentage of a Language Delay in Each Group (Goal 1)

According to the interpretation manual, a standard score of 85 or less in the CLS (1 or more SD below the mean; or equal to or less than a 16th percentile rank, which corresponds to a scaled score of 7) can be considered a language delay. This criterion is similar to that of previous studies examining structural language impairment in ASD, drawing on criteria for general language impairment (Kjelgaard & Tager-Flusberg, 2001). This criterion has also been used for the different subtests that have been applied. Both groups differed in terms of the percentage of children with a language delay with a higher proportion in the ASD-L1 group ($n_{\text{ASD}-1} = 14$, 31.1%; $n_{\text{TD}} = 3$, 6.8%) ($\chi^2[1] = 8.5$; $p = .004$) (see Figure 1). The percentage of language delay in the control group according to the CLS is comparable with that in the general population (Norbury et al., 2016).

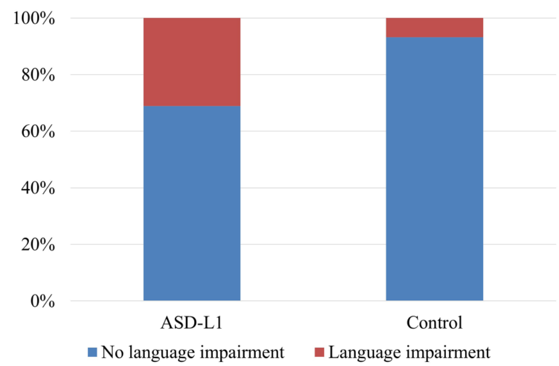

Figure 1. Language delay by group according to the *Core Language Score*.
Note. ASD-L1: autism spectrum disorder level-1.

Table 2. Percentage of delay according to each CELF subtest and the standard score.

	N	ASD-L1, *n* (%)	Control, *n* (%)
Concepts and following directions	47	4 (16%)	4 (18.2%)
Recalling sentences	89	**15 (33.3%)****	3 (6.8%)
Formulated sentences	89	6 (13.3%)	4 (9.1%)
Word classes-RE	67	11 (32.3%)	7 (21.2%)
Word classes-EX	46	5 (21.7%)	4 (17.4%)
Word definitions	12	1 (25%)	1 (14.3%)
Word structure	22	**4 (36.4%)***	0 (0%)
Semantic relations	21	6 (54.5%)	2 (20%)
Paragraph comprehension	10	2(40%)	1(25%)
CLS (standard)	89	**14 (31.1%)**	3 (6.8%)

CELF: Clinical Evaluation of Language Fundamentals; ASD-L1: autism spectrum disorder-level 1; RE: receptive; EX: expressive; CLS: core language standard score. Bold depicts significant differences between groups *$p < .05$; **$p < .01$.

In terms of the CLS subtests, a significantly larger proportion of children in the ASD-L1 group showed a significant delay in RS ($\chi^2[1] = 9.69$; $p = .002$) and WS ($\chi^2[1] = 4.89$; $p = .027$) (see Table 2). In contrast, neither the subtests CF ($\chi^2[1] = .34$; $p = .084$), FS ($\chi^2[1] = .40$; $p = .53$), WC receptive ($\chi^2[1] = 1.06$; $p = .30$), WC expressive ($\chi^2[1] = .14$; $p = .71$), WD ($\chi^2[1] = 0.196$; $p = .66$)], semantic relations ($\chi^2[1] = 2.65$; $p = 10$) nor PC ($\chi^2[1] = 0.225$; $p = .63$) showed a differential percentage of delay between groups.

Between-Group Differences in Specific Language Outcomes (Goal 2)

To compare linguistic capacities between the ASD-L1 and the control group (G2), all scaled scores of the subtests of the CLS, together with the CLS score were compared. Table 3 shows descriptive statistics, contrasts, and effect sizes for the group comparisons on all CELF subtests that constitute the CLS for each version.

Following Table 2, the ASD-L1 group obtained significantly lower scores than the control group in the CLS (standard score). Breaking down the CLS into its subscales, the ASD-L1 group scored lower than the control group in RS, WC (receptive), and WS, with medium effect sizes (Cohen, 1988).

Associations Between Autistic Traits and Language Scores (Goal 3)

Bivariate Spearman's correlations showed that autistic traits were inversely related to both the CLS and the subtests RS, FS, WC (expressive), and WS (see Table 4). Thus, we found moderate inverse associations between symptoms of ASD as measured with the ASSQ and AQ scores and several key linguistic components.

Discussion

The main objective (G1) of this study was to explore the linguistic skills of children and adolescents with ASD-L1, comparing them with TD peers, and to elucidate whether a sub-group of children with ASD-L1 would exhibit a significant delay in their language abilities. Secondarily (G2), we explored which core language components would reveal differences between ASD-L1 and TD peers and to investigate which language components were associated with autistic traits using ASD screening measures (G3).

Structural Language Delay in ASD-L1

The present results confirm our primary hypothesis (H1) that children and adolescents with ASD-L1 show language difficulties and obtain lower CLS scores than their peers without difficulties, following previous studies (Georgiou & Spanoudis, 2021; Larson et al., 2022). However, these results contrast with other works which show that intellectually able participants with ASD compare favorably with their TD peers in sentence-level linguistic structure and complexity (Volden et al., 2017). In this vein, the CELF-4 has been already used in other studies assessing children with Asperger's before the definition change of ASD in the *DSM-5* (Lewis et al., 2007), revealing that Asperger constituted a heterogeneous group. Our results are compatible with Larson et al. (2022), although they found that the CLS score was higher than in our study in both TD and ASD participants, scoring 117 and 99, respectively (18 units of difference), while in our sample, TD and ASD scored 105 and 95 in the CLS, respectively (10 units of difference). In this sense, our score resembles more that of the typical population in CELF-4 and 5 where a mean of

Table 3. Group comparisons of CELF-4 and CELF-5 scaled scores.

		ASD-L1		Control				
	n	*M*	*SD*	*M*	*SD*	*t* (*p*)	*U* (*p*)	*d*
Concepts and following directions	47	9.48	3.23	10	2.54	–	263 (.80)	.18
Recalling sentences	89	8.82	2.68	10.65	1.90	–	**579** (<.001)	.41
Formulated sentences	89	11.89	3.96	13.23	3.26	1.74 (.08)	–	.37
Word classes-Re	67	8.32	2.70	9.85	2.80	–	**389** (.03)	.31
Word classes-Ex	46	10.22	3.03	10.87	3.17	–	236 (.53)	.11
Word definitions	12	9.75	2.5	12.00	3.96	1.02 (.33)	–	.63
Word structure	22	8.27	3.52	11.09	2.15	–	**29** (.037)	.52
Semantic relations	21	8.00	2.68	9.90	3.07	1.51 (.15)	–	.66
Paragraph comprehension	10	8.00	3.00	7.60	1.82	.25 (.81)	–	.16
CLS (standard)	89	95.51	15.88	105.29	15.55	**2.94** (.004)	–	.62

CELF: Clinical Evaluation of Language Fundamentals; Re: receptive; Ex: expressive; CLS: Core Language Standard Score; *M*: mean; *SD*: standard deviation; *t*: Student's *t* test; *U*: Mann–Whitney's *U* test; *p*: significance level; *d*: effect size with Cohen's *d*. Bold depicts significant differences between groups with $p < .05$.

Table 4. Spearman correlations (Rho) between the autistic traits and language scores.

CELF subtests	*N*	ASSQ	AQ
Concepts and following directions	47	–0.10	–0.20
Recalling sentences	89	**–0.22***	**–0.25***
Formulated sentences	89	**–0.22***	**–0.22***
Word classes-RE	67	**–0.25***	–0.06
Word classes-EX	46	–0.10	0.01
Word structure	22	–0.10	**–0.45***
Semantic relations	21	–0.35	–0.33
CLS (standard)	89	**–0.29****	**–0.31****

ASSQ: Autism Spectrum Screening Questionnaire; AQ: Autism Spectrum Quotient; CELF: Clinical Evaluation of Language Fundamentals; RE: receptive; EX: expressive; CLS: Core Language Score; *M*: mean; *SD*: standard deviation. Bold depicts significant correlations: *$p < .05$; **$p < .01$. Displayed only tests with > 20 participants.

100 (and $SD = 15$) is expected. Moreover, these differences in departing CLS can be attributed to our finding that 7% of children in the control group showed a language delay, and might partially explain the higher percentage in the ASD-L1 group in our study (31.1%) versus Larson et al. (2022), which reported 22.9%.

It is worth noting that their cut-offs and those in the present study were very similar (≤7 scaled score for RS or a standard CLS score ≤82 in their study, as compared to ≤7 scaled score corresponding to a CLS standard score of 85 in the present study). Thus, discrepancies between studies while considering very similar cut-offs might arise from differences not in the CLS thresholds used, but in the clinical characteristics and grade of the departing samples, yielding slightly different although comparable samples of ASD. Whereas a neurologist diagnosed participants in the present study as ASD-L1, and their autistic status was further confirmed using the ASSQ and the AQ, the participants with ASD in Larson et al. (2022) were not limited to ASD-L1, and the diagnoses were done using the ADOS and clinical judgment of ASD. Thus, although with certain nuances, we align with Larson et al. (2022) and provide additional support to the suggestion that a subset of individuals with ASD-L1 may exhibit language delays. This suggests that structural language impairment should be evaluated in ASD, although not being a core feature (see also, Blume et al., 2021; Wittke et al., 2017). In conclusion, we found that a subgroup of participants with ASD-L1 exhibited a limitation in CLS and, as a group, they show a lower language score in contrast to normative peers. However, the majority of participants (approximately 70%) with ASD-L1 demonstrated equivalent language skills to the control group, as has been observed in other studies (Ellis Weismer & Kover, 2015).

Differences in Specific Language Components Between ASD-L1 and TD

As a secondary goal, we aimed to evaluate which of the CELF subtests would exhibit differences between the ASD-L1 and the control group by comparing their CELF subscales. We found that participants with ASD-L1 obtained lower scores than the control group in RS (memory and morphosyntax production), WC (semantics, receptive language), and WS (morphological production). Lloyd et al. (2006) also found that participants with ASD presented difficulties in listening to paragraphs and RS, which involves difficulties in abstracting and remembering information from two short texts and a limited capacity for the repetition of sentences of increasing length and syntactic complexity. In this vein, previous studies have found that the sentence recall subtest is a good psycholinguistic marker of language impairment (Conti-Ramsden et al., 2001), which supports the finding of a language impairment in a subtest of participants with ASD-L1 and can be used to evaluate phonological working memory.

The lower scores in RS may be also due to difficulties in verbal working memory and attention, since participants must recall increasingly complex sentences, which may denote difficulty as sentences become longer. Although these two variables (memory and attention) were not directly measured in the present work, different studies have described relationships between failures in verbal working memory and attention in children with ASD (Andersen et al., 2013; Harper-Hill et al., 2013; Yerys et al., 2009). However, it is worth noting that other language subtests also potentially tapping on working memory, such as CF, did not show differences between both groups. A speculative explanatory hypothesis for this result is that the visual support of the task helps to promote task responding, as described in previous research showing that children with ASD improve their verbal responding when the task is accompanied by visual aid (Harper-Hill et al., 2013).

Our findings also align with Saalasti et al. (2008) and Riches et al. (2010), who reported that tasks having considerable load in working memory (e.g., comprehension of instructions) were compromised in participants with ASD who, contrary to our results, did not differ with TD in RS. Although they acknowledged that a well-preserved working memory is necessary for selecting, maintaining, and manipulating information for goal-directed behavior (Russell et al., 1999), a lower score in comprehension of instructions in ASD was related to a diminished capacity in short-term memory. However, as children with ASD scored similarly to the controls in RS, deficits in short-term memory alone in their study could not explain the poorer performance in the comprehension of instructions test. Consequently, the authors interpreted that this deficit was related to an executive dysfunction which, in persons with autism, might be associated to a deficient use of inner speech to guide goal-directed behavior (Joseph et al., 2005).

We also found that participants with ASD-L1 obtained lower scores than their pairs in WC, which evaluates the ability to understand relationships between words that are related by semantic class features and to express those relationships. Children with ASD, including those at level 1, often exhibit semantic difficulties and may struggle with understanding WC due to problems in grasping the subtleties of word meaning and usage within different contexts (Bishop, 2014). As previously mentioned, children with ASD-L1 often exhibit difficulties in executive functioning and cognitive flexibility, which are crucial for organizing and categorizing linguistic information, including WC (Hill, 2004; Kenworthy et al., 2008). A similar explanation may also be provided for the lower scores observed in WS in our sample of ASD-L1 participants. Previous work has revealed that tasks involving understanding and applying WS rules (e.g., adding suffixes, blending sounds) may be particularly challenging for children with ASD due to their executive functioning difficulties (Whitehouse & Bishop, 2008).

In summary, the diminished performance of participants with ASD-L1 on specific subtests of the CELF indicates that their linguistic challenges pertain to tasks requiring the integration of executive functioning abilities, working memory, and grammatical proficiency. Notably, tasks involving sentence recall, WS, and word comprehension emerged as particularly linguistically demanding for this group. In this vein, it is worth mentioning that persons with ASD present repetitive behaviors and a lack of flexibility, aspects related to executive functions. In this sense, prior studies have found deficits in ASD in several cognitive functions, such as working memory (Habib et al., 2019), inhibitory control, and planning (Joseph et al., 2005). In the case of working memory, it has been extensively associated with language skills (Deldar et al., 2020) and is regarded as a marker for language difficulties (Alt, 2011; Conti-Ramsden et al., 2001). Baddeley (2003) considered working memory as a short-term storage crucial for cognitive processes, one of which is language. Although much of language processing operates automatically, deficiencies in the phonological working memory and other components of working memory can greatly hinder language comprehension, but also language production. Consequently, children with ASD are at risk of having language difficulties due to their phonological working memory difficulties (Habib et al., 2019).

Association of Language Scores with Autistic Traits

Our third hypothesis (H3) was confirmed since we found an inverse association between the CLS subtests and autistic traits, as measured with the ASSQ and the AQ. Previous reports have explained that improvement in ASD symptoms is closely related to improvements in language function (Suh et al., 2016). However, a recent study (Larson et al., 2022) has not found evidence of a relationship between RS and social-communication deficits as measured with the SCQ. On the contrary, we found an inverse association between RS, FS, and WC (receptive) and the autistic traits as measured with the ASSQ; and between the subtests RS, FS, and WS and the autistic traits as measured with the AQ. Thus, we report a relationship between autistic traits evaluated by parents and/or caregivers and several structural language tests in terms of phonological working memory, syntax, semantics, grammar, and morphology. In consequence, symptoms of autism in children and adolescents with ASD-L1 are moderately related to their language skills (Ellis Weismer & Kover, 2015). More specifically, the present results are partially in line with a study conducted with young children aged 1–3 with ASD that used the Mullen and Preschool language scales and evaluated their association with the ADOS scores (Nevill et al., 2019). Whereas parent-reported language measures were uncorrelated with any ADOS-2 variable, receptive and expressive language were negatively associated with their scores on social affect and restricted and repetitive behaviors. The findings of Nevill et al. (2019) indicate that children with more severe ASD symptoms could have more significant language difficulties. Congruent with Nevill et al. (2019), we found that parent-reported autistic traits using the ASSQ and AQ were associated with worse language scores. The negative association between sentence repetition and autistic traits was also reported by Volden et al. (2017); thus, we extend prior research by highlighting that language tasks tapping on working memory might be particularly difficult for persons with ASD-L1.

Our findings align with the existing literature, indicating a connection between oral language difficulties, social communication deficits, and autistic traits in individuals with ASD-L1. Moreover, the present study underscores that oral language challenges extend beyond mere comprehension issues. Children with ASD are likely to encounter difficulties related to grammatical complexity and verbal working memory, which may exacerbate the social behaviors reported by their parents. This emphasizes the critical importance of incorporating language tasks into both assessment and intervention strategies for this population.

Limitations

Despite having tested a relatively large sample, it is arguable that the heterogeneous cultural and even geographical variation of the present sample might have influenced our results. In this context, the presence of bilingualism in one of the tested regions (Spain) may add to the sample's heterogeneity. Additionally, differences in the diagnostic protocols for ASD diagnosis employed in each region could serve as another source of distinction between the Colombian and Spanish populations. However, ASD diagnostic protocols in both countries are adequate and effective, and in both Spanish-speaking contexts, clinical history-taking is applied through an anamnesis, application of screening and standardized tests through an interdisciplinary work carried out by professionals from education and health settings.

Also, further research might want to look at the specific association between the CELF-4 and CELF-5 language subcomponents and executive control tasks in ASD-L1 and to extend the exploration of language and its associations with higher-order cognitive functions with literacy and narrative tasks. Also, to confirm the hypothesis that a deficit in inner speech might be at the basis of a poor goal-directed behavior leading to lower language outcomes in participants with ASD-L1, a concurrent task of articulatory suppression shall incorporate novel findings. Similarly, future research might benefit from exploring what type of specific symptomatology associated with ASD is related to structural language deficits by using not only parent or caregiver ratings of autistic traits, but well validated diagnostic tools of ASD, such the ADOS-2 or the ADOS-3.

Although the observed correlation between language difficulties and autistic traits might have an association with working memory and attention demands, our findings cannot establish this relationship. Further research is necessary to corroborate this hypothesis, emphasizing the need for direct assessments of these cognitive abilities to provide conclusive evidence.

Clinical implications

From the clinical implications of our study derives the recommendation to administer language assessments that include language comprehension, semantics, and morphosyntax. Accordingly, the use of the CELF-4 and -5 as tools for identifying language difficulties in children and adolescents with ASD has been proven useful to this end. Since the acquisition of spoken language is a crucial hallmark in long-term adaptation for individuals with ASD (Mukaddes et al., 2014) and may be more resistant to typical behavioral treatment of ASD, language stimulation in ASD becomes a particularly relevant clinical target. Our study also supports the results of the CATALISE project (Bishop et al., 2016, 2017), which concludes that some—but not all—children and adolescents with ASD can experience a language disorder. In this regard, CATALISE advocates differentiating between DLD and ASD by using two distinct labels: ASD-associated language delay for those children with ASD, and DLD for those with only language.

Conclusions

Children and adolescents with ASD-L1 make up a group susceptible to linguistic difficulties in structural language, as they present a higher proportion of participants with significant language delay than the normative population. Specifically, children and adolescents with ASD-L1 present more difficulties in sentence repetition, semantic relations, and morphosyntax. We show that language deficits in participants with ASD-L1 appear most evident in tasks that require the deployment of working memory, grammar, and semantics. We also report that autism symptoms in children and adolescents with ASD are moderately related to their linguistic development.

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