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Childhood language skills as predictors of social, adaptive and behavior outcomes of adolescents with autism spectrum disorder[☆]

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ABSTRACT

Background: Children with autism, including those without intellectual disability (ASD-ID), experience poor social and adaptive development in adolescence. Although language difficulties are commonly identified in children ASD-ID, there has been little empirical research that has analyzed the influence of these difficulties in social, adaptive and behavioural outcomes in adolescence.

Methods and procedure: Structural and pragmatic language of 45 children with ASD-ID were assessed at childhood (aged 7–11) through The Children Communication Checklist (CCC-2) completed by parents. More than four-years later, in the follow-up, prosocial behaviour and peer relationships, daily living and socialization skills and behavioural difficulties were evaluated.

Results: Multiple regression analysis exploring the relationships between structural and pragmatic language and the different developmental outcomes, showed that pragmatic language significantly predicted all three domains, especially stereotyped language and use of context. However, structural language (semantics in particular) only accounted for a significant proportion in the variance in prosocial behaviour and socialization skills.

Conclusions and implications: Taken together, these findings indicate that structural language and, particularly pragmatic language, are relevant predictors of ASD social and behavioural outcomes in adolescence. Therefore, a detailed language assessment might be an important target of ASD diagnostic practice for improving the development of children with ASD-ID.

What this paper adds

The paper is the first to investigate the impact of childhood language on functional outcomes of adolescents with ASD-ID. The findings suggested that semantics and pragmatic language were early markers for social and adaptive development of individuals with ASD. Moreover, only pragmatic language of children with ASD predicted behaviour and emotional problems in adolescence. Therefore, multi-disciplinary assessment of the communication profile of children with ASD is an essential target for designing individualized and adapted interventions.

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1. Introduction

Autism Spectrum Disorders (ASD) is a complex neurodevelopmental disorder characterized by heterogeneous impairments in reciprocal social interaction and communication, and stereotyped, restricted and repetitive patterns of interests and behaviour (American Psychiatric Association (APA), 2013). It is a chronic disorder whose diagnosis has experienced a significant increase in the last decade. Epidemiological data collected in 37 countries reported a mean prevalence of 0.97 % in primary school children (Fombonne et al., 2021) of which approximately two thirds of the total are not intellectually disabled (intelligence quotient, IQ > 70) (Maenner et al., 2020).

A diagnosis of ASD includes specification of any accompanying language and/or intellectual impairment (APA, 2013). The typical IQ may be protective against the poorest profile, but it does not guarantee a normotypical development (Pickles et al., 2020, pp. 13180). Despite having an average or above IQ, many children and adolescents with autism show a marked lack of social interest, and their interactions are more impaired in daily life situations relative to their typically developing peers (Barendse et al., 2018). Youth with ASD-ID exhibit many behaviour problems and low social acceptance (Baker & Blacher, 2020). Moreover, the rates of comorbidities with mental health problems seem to be higher even in children with ASD without ID than in children with low-functioning autism (Kurzius-Spencer et al., 2018).

A question to be raised refers to the possible influence of language, another specifier of the disorder in DSM-5 (APA, 2013), in the evolution of children with ASD-ID.

1.1. Language in ASD: structural and pragmatic domains

The language of individuals with ASD is characterized by a wide heterogeneity, even when cognitive abilities are not compromised. In general, it has been noted that pragmatic language abilities are invariably impaired in children and adolescents with ASD, although impaired structural language abilities also have been recognized in many of them (Gorman et al., 2016). Anyway, cognitively able children with ASD may experience greater impairments in pragmatics, even when the components of structural language are unimpaired (McKernan & Kim, 2022). Concerning the structural language variables, research has mainly focused on syntax and to a much lesser extent, on the phonological domain. Nevertheless, phonological disturbances like atypical processes, dysprosody, and limited consonant inventories have been identified in a subgroup of persons with ASD (see the review by Wolk et al., 2016). As regards syntactic deficits, these seem to be mild and localized, although residual syntactic errors have also been found in individuals with a history of autism that have lost this diagnosis (Larson et al., 2022).

Considering the wide variability in language functioning in ASD, several investigations have attempted to establish language profiles across the disorder. Among them, a subgroup of children with structural language difficulties stood out, who also showed difficulties on a nonword repetition task, which is a clinical marker of Specific Language Impairment (SLI) (Kjelgaard & Tager-Flusberg, 2001). This profile has been named with the term *Autism Spectrum Disorder with Language Impairment (ASD-LI)*, a subtype of ASD that presents formal language deficits (Boucher, 2012). This profile may be more vulnerable to exhibit communication problems, as structural language abilities seem to have a considerable influence in social communication. In fact, they have been able to predict pragmatic functioning in children with ASD without ID (Volden et al., 2009) and, when using parent report, they have been associated with children's pragmatic competence (Baixauli-Fortea et al., 2019; Reindal et al., 2021).

Pragmatics is considered a universally impaired area in ASD (Volden et al., 2009). Data on the pragmatic profile of this condition has been obtained through standardized tests (Volden & Philips, 2010), semistructured, dynamic assessments (Schoen Simmons et al., 2014) and parent rating scales, mainly *The Children's Communication Checklist (CCC-2)* (Bishop, 2004), used in the studies by Baixauli-Fortea et al. (2019), Geurts and Embrechts (2008), and Helland et al. (2012), among others. These investigations have revealed impairments in conversational skills, like topic perseverations and difficulties to initiate and respond during communicative interactions, and to provide novel and relevant information (see the review by Ying Sng et al., 2018). Furthermore, the use of pedantic and stereotyped language has been reported (Paul et al., 2009a, 2009b) as well as problems to comprehend the non-literal language involved in metaphors, irony, sarcasm or idioms (Kalandadze et al., 2018; Morsanyi & Stamenković, 2021). In addition, deficits in non-verbal communication through gaze, facial expression or gestures, have also been noticed (Silverman et al., 2017).

1.2. ASD language skills and social, adaptive and behaviour problems

The scientific literature accredits that language development is closely linked to social functioning (Davis & Huaquing, 2020; Mulvey & Jenkins, 2021). Mild deficits in communication skills could result in significant impairments in relationships with peers, leading to negative developmental effects (see review by Van der Wilt et al., 2019). Given the high incidence of language problems in autism, it makes sense to proceed to examine the impact that these have on social skills, adaptive behaviours and behaviour problems of children and adolescents with ASD.

Social skills comprise behaviours linked to major social outcomes in concrete situations (Gresham & Elliot, 1987). The specific work that has examined the association between language domains and social skills in children and adolescents with ASD has focused on pragmatics, while the role of phonological and morphosyntactic differences has received scant attention. There is some evidence that pragmatic language in children with ASD, as well as in children with language impairment (LI), is closely associated with emotional and behavioural needs (Helland & Helland, 2017). Moreover, the percentage of variance explained by the Pragmatic Composite (PC) of the CCC-2 (Bishop, 2004) in the total score of emotional and behavioural problems is higher in the group with ASD than in the group with LI (58 % versus 43 %, respectively).

The number of works that have jointly evaluated the contribution of structural and pragmatic language in explaining the severity of social impairments in autistic children is very limited. There are findings indicating that pragmatic difficulties, but not structural difficulties, are significantly linked to higher levels of social impairments in a multiple regression model (Dolata et al., 2022). Nevertheless, as previously was stated, structural and pragmatic deficits are interrelated, so that the relationship between structural language deficits and social skills in ASD is mediated by low pragmatic competence (Volden et al., 2009).

Context is likely to determine the importance that different language domains (structural and pragmatic) have in social skills. In a six-month follow-up longitudinal investigation with children with ASD, the associations across three language skills (semantics, syntax, and pragmatics) and their relations to parent- and teacher-rating of social skills (cooperation, assertion, responsibility and self control) was examined (Levinson et al., 2020). According to parent report, only semantics significantly predicted children's social skills. As regards teacher report, a combined predictive effect of semantic, syntactic and pragmatic language skills was observed, but none of them made unique contributions above and beyond one another. Therefore, language globally was a stronger determinant of children's social adjustment at school, while semantics proved to be a powerful tool for coping with the variety of problems and social situations that arise in everyday life outside the school context.

The association between communication difficulties and social and personal development has not only been identified through parent and teacher ratings. Other methods, such as interviews, have also been used, although to a lesser extent. In a recent investigation, children and adolescents with ASD reported in interviews that significant language and communication difficulties impacted on functionality, socialization and well-being (Sturrock et al., 2022). Despite the use of different methodologies, the association between communication skills and social functioning is quite consistent.

Adaptive behaviour is defined as the effectiveness and degree to which an individual meets social/cultural standards of personal independence and social responsibility (Gresham & Elliot, 1987). Children and adolescents with ASD, even without intellectual disability, show deficits in adaptive functioning, especially in the domains of socialization, communication and daily living skills (Roselló et al., 2021).

The scientific literature points out the weight of pragmatic skills in the adaptive competence of children and adolescents with high functioning autism. A study with a cross-sectional design identified a significant association between pragmatic skills and the three subdomains of the Vineland Socialization Scale: Relationships, Play and Leisure Time and Coping skills (Berenguer et al., 2018). In addition, multiple mediation analyses showed that the Pragmatic Composite Index (PCI) of the CCC-2 (Bishop, 2004), together with Applied Theory of Mind skills, mediated the relationships between autism symptoms and social functioning as measured by the Vineland Socialization Scale. The results of a follow-up study of children with ASD, who were assessed at kindergarten-entry and exit, follow a similar trend (McKernan & Kim, 2022). Both syntactic/semantic skills significantly predicted simultaneous and kindergarten-exit peer play. Pragmatic language significantly predicted simultaneous adaptive daily living, socialization skills as well as kindergarten-exit socialization skills and peer play.

Children and adolescents with ASD, compared to their peers, also display high levels of co-occurring problem symptoms (Roselló et al., 2021) that negatively affect their quality of life (Lawson et al., 2020). The association between pragmatic skill scores and emotional/behavioural problems was explored by two investigations with children with ASD. In the first one, pragmatic language deficits together with negative controlling parental behaviour, were the most significant predictors of externalizing behaviors in 6- to 12-year-old children with ASD (Boonen et al., 2014). On the contrary, structural language difficulties did not account for significant variance in behaviour problems. The second study examined the longitudinal association between structural and pragmatic language with externalizing and anxiety problems in high functioning ASD preschoolers (T1 assessment in winter; T2 in spring) (Rodas et al., 2017). Initial levels of structural language were not significantly related to later externalizing behaviours, whereas pragmatic language longitudinally predicted the severity of externalizing behaviours.

1.3. Aims of the current study

In summary, as the literature review has shown, language impairments in children with ASD-ID have been commonly identified, but there are still few studies that address the impact of these impairments on social, adaptive and behavioural development. First, previous works have focused on the influence of pragmatic language, and less attention has been paid to analyze the impact of structural language problems. Second, most of the research carried out has had a cross-sectional design and in the few studies with a longitudinal design, the follow-up time has been very short (Levinson et al., 2020; McKernan & Kim, 2022; Rodas et al., 2017). To our knowledge, no study has examined the specific predictive role of structural and pragmatic language of children with ASD-ID on functional outcomes some years later, in adolescence. Precisely, adolescence is a critical period with special relevance for the development of positive social behaviours, peer friendships and acquisition of autonomy behaviours. Third, the literature does not provide us with knowledge about which language skills are important for the success in different components of overall social functioning.

The objective of the present longitudinal study was to explore the contributions of ASD childhood structural language (speech, syntax, semantics, coherence) and pragmatic language (inappropriate initiation, stereotyped, language, use of context, nonverbal communication) to the prediction of the following domains in adolescence: social (prosocial behaviour and peer relationships), adaptive (daily living and socialization skills) and behaviour problems. Based on the sparse previous literature, we expected that both structural and pragmatic language skills would predict some results of social, adaptive and behaviour years later. However, pragmatic aspects of language, which is an essential feature of the disorder, would predict these results stronger than structural language skills.

2. Materials and methods

2.1. Study design and participants

Data came from a project with a longitudinal design that was focused on the study of social cognitive and adaptive changes in children with ASD without intellectual disability (ID) from childhood to adolescence. Participants at baseline were 52 children with autism without (ID) (Mean IQ= 101.4; Standard Deviation (SD)=12.6), aged 7–11 years old (Mean= 8.56, SD = 1.38), mostly males (92.3 %), specifically 48 males and 4 females. They had received a clinical diagnosis of ASD in child and adolescent mental health and neurology services in the Valencian Community, according to DSM IV (APA, 1994) or DSM 5 (APA, 2013), ADI-R (Rutter et al., 2006), and/or the ADOS (Lord et al., 2001). ASD condition was confirmed by a clinical psychologist from the research group who administered again the ADI-R (Rutter et al., 2006) with the following results: ADI-R A (cutoff= 10) Mean 13.49, SD (2.79); ADI-R B (cutoff = 8) Mean 8.91, SD (2.42); ADI-R C (cutoff= 3) Mean 4.70, SD (1.92). Moreover, the Social Communication Questionnaire (SCQ; Rutter et al., 2003) was completed by the parents, following the recommended cut-off points for ASD diagnosis. In addition, a clinical psychologist from the research group verified that all the children also met the strict diagnostic criteria for ASD from the DSM-5 (APA, 2013), based on information reported by teachers and parents. Exclusion criteria included neurological or genetic diseases, brain lesions, sensory, auditory or motor deficits and IQ below 80. The participants' degree of ASD severity corresponded to level 1 or mild autism. Difficulties in social interactions and repetitive and restricted behaviours were not extreme, but help was needed. The parents' education level in the families of our sample corresponded mainly to a high school or university degree (average academic level of mothers and fathers).

About five years after baseline, the follow-up included 45 adolescents with ASD between 12 and 15 years (retention rate of 86.5 %). The sample loss was due to the fact that the families could not be contacted, had relocated, or declined the invitation to attend the evaluations. There were no differences between the IQ and ASD symptom severity of the 45 children who continued in the study and the seven children who did not ($t(44) = -0.18, p = .42$), based on the parents' ratings on the SCQ questionnaire (Rutter et al., 2003) and the DSM-5 diagnostic criteria (APA, 2013). Twenty adolescents (44.4 %) attended regular classrooms but received educational support for their specific needs in their high school; 15 (33.3 %) were placed in the communication and language classroom modality, and 10 (22.2 %) were attending high school in regular classrooms full time without educational support. Regarding psychiatric medication, 40 % of the adolescents with ASD were taking antipsychotic medication (mostly risperidone) and/ or methylphenidate for behavioural problems and irritability symptoms.

2.2. Measures

The selection of the measures applied was based on the relevance according to the objectives of this study, translation and adaptation to Spanish and good psychometric properties.

2.2.1. Predictor variables. Communication skills in childhood (T1)

Communication skills were assessed using The Children's Communication Checklist second edition (CCC-2; Bishop, 2004) that was completed by the parents. This checklist provides information on communication characteristics in children from 4 to 11 years old. The CCC-2 includes 70 items that are grouped in 10 subscales that measure different communicative aspects. The first block assesses aspects of language structure, vocabulary and discourse, and has four subscales (*speech, syntax, semantics, and coherence*). The second block values the pragmatic aspects of language and also has four subscales (*inappropriate initiation, stereotyped language, use of context, and non-verbal communication*). Finally, the last block contains two subscales designed to evaluate the typical features of ASD (*social relationships and interests*). The frequency of the behaviours described in each item included in the CCC-2 is rated on a 4-point scale; a high score indicates greater communication problems. In the current study, we used the scores for each of the structure, vocabulary and discourse subscales and the scores for each of the pragmatic language subscales as measures of structural and pragmatic language skills. We did not use the social relationships and interests subscales to keep independent language measures from autism symptoms. Structural and pragmatic aspects of language are tightly linked, since linguistic forms are associated with communicative functions, and they must be adjusted to better fit the interactive functions that they are intended to perform. In this sense, the organization of the CCC-2 into separate structural and pragmatic dimensions has been discussed and reevaluated when adapting the instrument to different languages. Specifically, and in contrast with the original proposal by Bishop (2003), coherence has been included in the pragmatic dimension in the Dutch (Geurts et al., 2009), Serbian (Glumbić & Brojčin, 2012) and German adaptation (Wellnitz et al., 2021). While acknowledging the reasons leading to this reorganization, the distribution in blocks described in Bishop (2003) was maintained in the present study, since it was also followed in the Spanish adaptation of the CCC (Mendoza & Garzón, 2012) and in recent research with Spanish population (Andrés-Roqueta et al., 2021). Regarding psychometric properties, the CCC-2 presents good internal consistency that ranges between 0.77 and 0.85 (Bishop, 2003). Spanish translation has obtained a Cronbach's alpha of 0.92 (Mendoza & Garzon, 2012).

2.2.2. Outcomes variables in adolescence (T2)

2.2.2.1. Social behaviour.

Peer Relationship was assessed by one of the subscales that is included in the School Social Behaviour Scales (SSBS; Merrell, 1993; Spanish adaptation by Peralta-Sánchez, 2004). Specifically, the Peer relationship subscale includes 14 items that

are rated by teachers on a 5 point Likert-type (from never to very often). The items describe the initiation, frequency and quality of interactions with peers, social skills or peer respect (“Invites other student to participate in activities”). Higher total scores indicate greater levels of peer relations.

The SSBS has adequate psychometric properties: reliability indexes (0.94) and content and criterion validity (Peralta-Sánchez, 2004). Cronbach’s alpha in our study for Peer relations scale was .87.

Prosocial behaviour was evaluated using the subscale of prosocial behaviour from The Strengths and Difficulties Questionnaire (SDQ, Goodman, 1997; adapted to Spanish by Rodríguez-Hernández et al., 2012), that was completed by the parents. It has 5 items that are rated between 0 and 2, and refers to positive socialization behaviours (i.e., “Helpful if someone is hurt, upset, or feeling ill”). This subscale of the SDQ provides a score where higher scores indicate more prosocial behaviours or strengths. In the current study Cronbach’s α for Prosocial behaviour subscale was .81.

2.2.2.2. Adaptive skills. The Vineland Adaptive Behaviour Scale (VABS-II ed; Sparrow et al., 2005) was completed by parents to evaluate the adaptive capacity of their children. It includes four fundamental domains: communication, daily living skills, socialization, and motor skills. For this study, the scores in two domains were used, daily living skills and socialization skills. Daily living skills describe personal (e.g., eating, dressing, and hygiene), domestic (e.g., household tasks performed), and community (e.g., using money, answering the phone) tasks. The socialization scale also includes three subscales that describe interpersonal relationships (e.g. “Shows interest in children of the same age, other than brothers or sisters, for example, watches them, smiles at them, etc...”), play and leisure time (e.g. “Plays with others with minimal supervision”), and coping skills (e.g. “Follows through with arrangements, for example, if promises to meet someone, meets that person”).

The Vineland-II scale has been widely used in people with ASD to evaluate social maturity. It has solid psychometric properties, with high test-retest reliability (Cronbach’s $\alpha = 0.98$, Sparrow et al., 2005).

2.2.2.3. Behavioural difficulties. Parents completed the SDQ questionnaire (SDQ, Goodman, 1997; adapted to Spanish by Rodríguez-Hernández et al., 2012). SDQ is a screening tool for measuring psychological adjustment in children and aims to detect any emotional or behavioural problems. We used the total difficulties score that is obtained adding the scores of the four subscales that assess emotional symptoms, behavioural problems, hyperactivity/attention problems and peer relationship problems. The higher scores indicate a greater likelihood of significant problems.

The SDQ has adequate psychometric properties with good reliability in Spanish population (0.76) (Rodríguez-Hernández et al., 2014) and adequate internal consistency. In the current study Cronbach’s α was .74 to .80 between subscales, and .83 for total difficulties.

2.3. Procedure

This study was part of a research project aimed to investigate the development of children with ASD and identify predictors of functional outcomes in adolescence. Participants in the baseline (T1) had a previous diagnosis of ASD assigned by a specialized childhood mental health service from Valencian Community. The diagnosis was confirmed in the enrollment using the Revised Autism Diagnostic Interview (ADI-R; Rutter et al., 2006) and DSM-5 diagnostic criteria (APA, 2013) for ASD based on parental report. At 5-year follow-up, mothers (and/or fathers) completed the battery of questionnaires in one session with the research team that had been trained in the administration of the questionnaires used. Furthermore, teachers/tutors provided additional information about their students. All the participants were informed of the study aims and written informed consent was obtained.

The study procedures were approved by the Ethics Committee of the University of Valencia, in accordance with the principles of Helsinki Declaration (World Medical Association, 2013) (protocol codes H1425284258543; and H1493972644643).

2.4. Data analysis

The statistical analyses were performed with the Statistical Package for the Social Science (SPSS) software, version 26.00 (SPSS Inc., Chicago, IL USA). The distribution of the variables was analyzed, as well as their fit to the normal distribution curve, by applying histograms and Kolmogorof-Smirnov tests.

First, correlations analyses were carried out to explore the associations between the variables included in the present study. From a longitudinal perspective, multiple linear regression analyses were conducted to study the impact of communication skills (independent variables) measured in childhood on social behaviours, adaptive skills and behavioural difficulties (dependent variables) assessed in the adolescence. Pragmatic and structural language components were modelled separately due to avoid multicollinearity problems. The assumption of independent errors was tested using the Durbin-Watson test, with multicollinearity tested, using variance inflation factor and tolerance diagnostics (Field, 2013). VIF < 7 and tolerance > 0.20 indicated the absence of multicollinearity problems. All results were considered statistically significant if $p < .05$.

3. Results

Given the general goal of examining contributions of communication skills (structural and pragmatic language) to social behaviour, adaptive skills and behavioural difficulties, we examined each variable separately (see Table 1 for descriptives).

3.1. Correlations between variables included in the study

Correlations between variables are summarized in Table 2. Structural language variables from CCC-2 were moderately correlated with prosocial behaviour, socialization, and daily living skills (between -0.31 and -0.53). There were more significant associations between Pragmatic language variables (especially inappropriate initiation and stereotyped language) and different measures of adaptive skills, prosocial behaviour, and peer relationships (between -0.30 and -0.52). SDQ total score was positively correlated with inappropriate initiation (correlation 0.42) and stereotyped language (correlation 0.38).

3.2. Prediction of social behaviour

Peer Relationships. The regressions carried out indicated that neither structural language nor pragmatic language did not collectively predict the peer relationships. (Table 3). However, inappropriate initiation ($\beta = -0.36$, $t = -2.1$, $p = .04$) and stereotyped language ($\beta = 0.54$, $t = -2.4$, $p = .02$) were significant predictors individually.

Prosocial Behaviour. The regression analyses indicated that all Structural language predictors collectively explained 26 % of the variance of prosocial behaviour, being Syntax ($\beta = 0.38$, $t = 2.3$, $p = .02$) and Semantics ($\beta = -0.50$, $t = -3.0$, $p = .02$) two significant individual predictors. Similarly, the regressions carried out showed that all Pragmatic language variables collectively explained 42 % of the variance of prosocial behaviour. Inappropriate initiation ($\beta = -0.44$, $t = -3.1$, $p = .01$), Stereotyped language ($\beta = -0.37$, $t = -2.1$, $p = .04$), Use of context ($\beta = -0.35$, $t = -2.1$, $p = .03$), and Nonverbal communication ($\beta = 0.56$, $t = 2.9$, $p = .01$) were significant predictors (Table 3).

3.3. Prediction of adaptative skills

Daily Living Skills. There was no unique individual predictor of daily living skills, but collectively, Pragmatic language explained 36 % of its variance (see Table 4). The regressions carried out indicated that structural language did not collectively predict daily living skills, but Semantics was the only structural language domain with statistical significance ($\beta = 0.28$, $t = 2.03$, $p = .04$).

Socialization. The regression analyses indicated that Structural language collectively explained 32 % of the variance of Socialization, being Semantics ($\beta = -0.51$, $t = -3.2$, $p = .01$) a significant individual predictor (Table 4).

3.4. Prediction of behavioural difficulties

The regressions carried out revealed that none of the structural language variables predicted individual or globally behavioural difficulties. Regarding pragmatic language, the regression analysis indicated that the stereotyped language ($\beta = 0.42$, $t = 2.1$, $p = .03$) and use of context ($\beta = -0.38$, $t = -2.1$, $p = .03$) were significant individual predictors of behavioural difficulties. All of the pragmatic language variables together explained 31 % of the variance (see Table 5).

4. Discussion

This is (at least that we know) the first long-term prospective study interested in examining the contribution of structural language and pragmatic language of children with ASD without ID to the prediction of social outcomes in adolescence. In this period, language increases in complexity, and demands on social skills are accentuated, adding more pressure on individuals with ASD who usually experience feelings of loneliness and isolation (Øien et al., 2019).

As expected, both language domains independently predicted aspects of ASD social and adaptive skills as well as behaviour after more than four years later. Prosocial behaviour was the model with the highest percentage of explained variance by each of the two

Table 1
Descriptive and frequency analyses for main study variables.

Measure	Mean	SD	Min	Max	% Missing
Speech	3.19	2.86	0	12	0
Syntax	2.50	2.09	0	8	0
Semantics	5.81	2.82	0	13	0
Coherence	7.46	4.50	0	19	0
Inappropriate ini	12.29	4.59	3	20	0
Stereotyped lang	8.15	3.94	1	18	0
Use of Context	12.35	3.96	4	20	0
Nonverbal comm	10.37	4.02	2	20	0
Peer Relationship	34.28	9.16	17	57	9
Prosocial behaviour	6.89	2.30	2	10	7
Daily living skills	35.84	3.25	30	44	7
Social Skills	32.60	3.22	25	42	7
SDQ Total	18.40	5.47	8	31	7

SD: Standard deviation; SDQ Total: Strengths and Difficulties Questionnaire Total score; Lang: language; Inappropriate ini: Inappropriate initiation; Nonverbal comm: Nonverbal communication.

Table 2

Pearson correlations between the variable included in the study.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Speech	1											
2. Syntax	0.49**	1										
3. Semantics	0.35*	0.46**	1									
4. Coherence	0.50**	0.36**	0.43**	1								
5. Inappropriate ini	0.17	0.28*	0.33*	0.29*	1							
6. Stereoty lang	0.24	0.09	0.25	0.47**	0.50**	1						
7. Use of Context	0.34*	0.31*	0.31*	0.31*	0.28*	0.54**	1					
8. Nonverbal com	0.34*	0.37**	0.33*	0.56**	0.48**	0.69**	0.64**	1				
9. Peer Relations	-0.13	-0.11	-0.08	0.07	-0.31*	0.34*	-0.07	-0.05	1			
10. Prosocial beha	-0.18	0.07	-0.39**	-0.16	-0.50**	-0.42**	-0.32*	-0.13	-0.36*	1		
11. Daily l skills	-0.21	-0.15	-0.37*	-0.31*	-0.48**	-0.52**	-0.34*	-0.50**	-0.05	0.25	1	
12. Socialization	-0.36*	-0.20	-0.53**	-0.24	-0.38**	-0.34*	-0.30*	-0.22	0.04	0.43**	0.47**	1
13. SDQ Total	0.09	-0.04	0.06	0.23	0.42**	0.38**	-0.03	0.20	0.30*	-0.30*	-0.22	-0.30*

SDQ Total: Strengths and Difficulties Questionnaire Total score; Lang: language; Inappropriate ini: Inappropriate initiation; Nonverbal comm: Nonverbal communication; Prosocial beha: behavior; Daily l skills: daily living skills.

* $p \leq .05$. ** $p \leq .01$.

Table 3

Multiple linear regression analyses for communication skills predicting social behaviour at 5-year follow-up in adolescents with autism.

Peer Relationships	Beta	t	p	R ²	F		Beta	t	p	R ²	F
Structural lang				0.03	0.29	Pragmatic lang				0.17	0.10
Speech	-0.12	-0.62	0.53			Inappropriate ini	-0.36	-2.1	0.04*		
Syntax	-0.06	-0.35	0.72			Stereotyped lang	0.54	2.4	0.02*		
Semantics	-0.53	-0.27	0.78			Use of Context	-0.17	-0.84	0.40		
Coherence	0.11	0.60	0.54			Nonverbal comm	-0.16	-0.69	0.49		
Prosocial behaviour				R ²	F					R ²	F
Structural lang				0.26	3.4*	Pragmatic lang				0.42	7.4**
Speech	-0.15	-0.89	0.37			Inappropriate ini	-0.44	-3.1	0.01*		
Syntax	0.38	2.3	0.02*			Stereotyped lang	-0.37	-2.1	0.04*		
Semantics	-0.50	-3.0	0.02*			Use of Context	-0.35	-2.1	0.03*		
Coherence	-0.01	-0.06	0.95			Nonverbal comm	0.56	2.9	0.01*		

Lang: language; Inappropriate ini: Inappropriate initiation; Nonverbal comm: Nonverbal communication.

* $p \leq .05$. ** $p \leq .01$.

Table 4

Multiple linear regression analyses for communication skills predicting adaptive skills (VABS) at 5-year follow-up in adolescents with Autism.

Daily living skills	Beta	t	p	R ²	F		Beta	t	p	R ²	F
Structural lang				0.18	2.1	Pragmatic lang				0.36	5.7**
Speech	-0.03	-0.15	0.88			Inappropriate ini	-0.25	-1.6	0.10		
Syntax	0.08	0.48	0.63			Stereotyped lang	-0.24	-1.2	0.20		
Semantics	-0.37	-2.1	.04*			Use of Context	0.04	0.23	0.81		
Coherence	-0.19	-1.1	0.26			Nonverbal comm	-0.25	-1.3	0.21		
Socialization				R ²	F					R ²	F
Structural lang				0.32	4.6**	Pragmatic lang				0.21	2.5
Speech	-0.21	-1.3	0.19			Inappropriate ini	-0.29	-1.7	0.08		
Syntax	0.13	0.81	0.41			Stereotyped lang	-0.18	-0.87	0.38		
Semantics	-0.51	-3.2	0.01*			Use of Context	-0.23	-1.2	0.22		
Coherence	0.03	0.21	0.83			Nonverbal comm	0.19	0.86	0.39		

Lang: language; Inappropriate ini: Inappropriate initiation; Nonverbal comm: Nonverbal communication.

* $p \leq .05$. ** $p \leq .01$.

domains of communication skills. Pragmatic language globally explained 42 % of the variance, while structural language explained 26 % of the total variance of prosocial behaviour estimated by parents. All pragmatic subscales, inappropriate initiations, stereotyped language, use of context and nonverbal communication had an important predictive weight in prosocial skills in adolescence. Syntax and semantic structural skills also proved to be a powerful media for predicting a variety of behaviours of positive socialization, aimed at responding to other people's need for physical or emotional support.

The information from teachers on the peer relationships were important for our research, because the children spent most of their day at school context interacting socially with peers. Overall, neither structural language nor pragmatic language explained a significant percentage of the variance in teacher ratings of peer relationships (3 % and 17 %, respectively). Nevertheless, on a more concrete level, and although,

Table 5

Multiple linear regression analyses for communication skills predicting behavioural difficulties at 5-year follow-up in adolescents with autism.

SDQ Total	Beta	t	p	R ²	F		Beta	t	p	R ²	F
Structural lang				0.07	0.80	Pragmatic lang				0.31	4.4*
Speech	0.05	0.26	0.79			Inappropriate ini	0.29	1.8	0.06		
Syntax	-0.17	-0.93	0.36			Stereotyped lang	0.42	2.1	0.03*		
Semantics	0.02	0.01	0.99			Use of Context	-0.38	-2.1	0.03*		
Coherence	0.26	1.4	0.14			Nonverbal comm	0.03	0.19	0.85		

SDQ Total: Strengths and Difficulties Questionnaire Total score; Lang: language; Inappropriate ini: Inappropriate initiation; Nonverbal comm: Nonverbal communication.

* $p \leq .05$. ** $p \leq .01$.

the model as a whole was non-significant, two pragmatic components such as inappropriate initiation and stereotyped language seem to play an important role in ASD adolescents' relationships with their peers. Persistence in dealing with the same topic and the excessive use of phrases without adaptation to the context, would make it difficult to generate a shared communicate space with the peers in the school. In any case, given the inherent complexity of peer relations, they would have been better explored through direct observation than through teacher ratings.

Globally, the findings relative to the social level proved that childhood ASD pragmatic language, and to a lesser extent the structural language, have influence in adolescents' prosocial behaviours and peer relationships. Individually, only syntax and semantics skills obtained significant values, while structural language skills of speech and coherence did not predict any of both constructs of social functioning. Probably, not correctly articulating a message or making syntactic errors are not as negative to peer interactions and prosocial behaviour as not understanding or using the appropriate content of the words. These results agree with those of cross-sectional and longitudinal studies with a very short follow-up (Levinson et al., 2020; Sturrock et al., 2022), but disagree with a recent paper that found no significant relationship between structural language difficulties and the severity of social impairment in children with autism (Dolata et al., 2022). The differences in the age of the participants or in the assessment instruments, for both language and social skills, may have contributed to the conflicting results.

Our findings also showed that structural language as a whole may contribute to the socialization skills of adolescents with ASD. Semantic skills play a prominent role in predicting adaptive functioning, particularly in socialization skills.

The importance of semantic skills seems to be more extensive in comparison to other structural language skills because semantics allows effectively to understand the social world, expressing oneself clearly and getting independence and confidence. Word finding difficulties, mixing up words of similar meaning, being vague in the choice of terms, may result in an impaired ability to effectively communicate with others. Moreover, when learning vocabulary, speakers must capture all the meaning variations and subtleties that depend on the context, which may change the intentions of the messages conveyed. This may be a cause of misunderstandings during social interactions with peers and a possible source of conflicts. In addition, all the components of pragmatics together, inappropriate initiative, stereotyped language, use of context and nonverbal communication explained a significant percentage of the variance of daily living skills in adolescence (36 %). These findings coincide with a previous work with a cross-sectional design that found that pragmatic language was significantly associated with socialization skills (Berenguer et al., 2018). Likewise, in a follow-up study, from kindergarden entry and exit, pragmatic language predicted adaptive daily living and socialization skills of children with ASD (McKernan & Kim, 2022).

Finally, our results, as other previous studies (Boonen et al., 2014; Rodas et al., 2017), pointed out that only childhood pragmatic language, not structural language, had the ability to predict behavioural problems in adolescents with ASD. In particular, stereotyped language and use of context were the pragmatic components that showed the highest predictive ability for behavioural problems. The finding suggests that pragmatic difficulties such as excessive use of phrases learned without adaptation to the context and poor use of the social communication rules, sarcasm, figurative language, politeness, metaphors, humor and the intentions of others could undermine children to communicate their thoughts and wishes. In turn, these pragmatic difficulties may intensify children's use of negative externalizing procedures to achieve their desires.

In summary, from a longitudinal perspective the present study shows the relationships between language skills and social behaviours in the long term. These findings are added to the body of research which corroborates that language skills in early childhood are able to predict social functioning in adults with ASD (Gillespie-Lynch et al., 2012; Magiati et al., 2014). Obviously, in human development, apart from language, numerous factors may interact that can influence a person's social behaviours, both at an intrinsic level (personality, emotional regulation abilities,...) and at an environmental level (parental styles, school context, satisfaction with school life, ...). Therefore, any explanation of a person's functioning must take these factors into account in order to provide him/her the necessary supports for reaching his/her full potential. In any case, and according to the results of the present study, promoting language and social communication skills in childhood might decrease the risk of intensifying the social difficulties that children with ASD experience due to their neurodevelopmental condition.

4.1. Limitations and future research

This study, to our knowledge, is the first to examine the associations between language skills in childhood and social behaviours, adaptive skills and behaviour problems among adolescents with ASD. Its longitudinal design allowed us to consider how structural and

pragmatic language skills are related to significant functional outcomes from childhood to adolescence.

The results, however, should be considered in the light of their limitations. First, the evaluation was based on questionnaires completed by parents and teachers that, despite having good psychometric properties, can be affected by different types of biases, such as social desirability or recall errors. Moreover, a comprehensive assessment of children communication skills should include not only parent report but also the information from clinicians, teachers, self-reports and observation of interaction with peers (Sturrock et al., 2022). These constraints may limit the scope of the results obtained and should be addressed in a future research. In addition, the small sample size may not have sufficient statistical power to detect meaningful effects. Therefore, the results should be replicated with larger samples and assessment procedures with less chance of bias such as performance tests, self-, controlled observation and clinician-reported measures. The third limitation is that the participants had a mid-range intellectual capacity, and most of them were male, which may affect the generalization of the results. The findings may not apply to females or individuals with ASD with other cognitive levels. Likewise, important risk/resilience factors of the family (e.g., parenting education strategies) or school (e.g., type of schooling) context were not taken into account. Furthermore, few low-academic level families participated in our study and a pending issue for future research is to explore whether findings generalize to children from lower-academic level families, given the link between family education and language development in ASD samples (Olson et al., 2021). Finally, the role on the outcomes of different pharmacological and psychoeducational interventions during the time between base line and follow-up could not be considered, as information on these issues was not collected systematically enough to facilitate the analysis.

4.2. Conclusions and clinical implications

In synthesis, the findings of this longitudinal study highlight the great influence of language skills in different developmental areas of children with ASD. Therefore, it is important to implement from early childhood, interventions directed to enhance this kind of communicative competences. Regarding the Primary-school period, there are different evidence-based programs addressing this goal. One of these programs is *Talkability* (Sussman, 2007), from the Hanen Centre, in which parents are trained to support their children in different pragmatic abilities, like having longer, more meaningful conversations with both adults and peers, understanding non-verbal messages according to the context or developing story-telling skills. Other types of programs are more focused on directly teaching children how to understand social context cues in interactions, improving conversation reciprocity and extending vocabulary and word knowledge (Adams & Gale, 2015), variables to be considered in pragmatic functioning, as shown in the current study. These interventions will probably minimize the negative consequences derived from pragmatic difficulties, as they maintain a bidirectional relationship with social development. Pragmatics is necessary for social development but, at the same time, pragmatic deficits may reduce the opportunities of learning, practicing, and improving pragmatics. Therefore, conditions should be set up to prevent children with ASD from entering this negative spiral.

As previously stated, in adolescence there are greater expectations to be able to use language to navigate the social world, manage conflicts and regulate behaviour.

Therefore, it is crucial to create communicatively supportive environments in order to help adolescents with ASD to perceive and understand social situations while using language in an efficient manner. In this sense, one of the most empirically supported programmes nowadays, addressed to adolescents with ASD and their families, is PEERS (Laugeson & Frankel, 2010). Among other issues, this program deals comprehensively with conversational skills, electronic communication, or the use of humour, and has obtained excellent outcomes in randomized-controlled trials in different language and cultures (Rabin et al., 2018; Yoo et al., 2014).

CRedit authorship contribution statement

Ana Miranda: Conceptualization and study design. **Carmen Berenguer:** Formal analysis and interpretation of the data. **Inmaculada Baixauli:** Assessment and supervision of data collection. **Belén Roselló:** Assessment and supervision of data collection. All authors contributed to reviewing the analysis and editing the manuscript prior to submission.

Declaration of Competing Interest

The author(s) declared no potential conflicts of interest with the research, authorship, and/or publication of this article.

Data Availability

Data will be made available on request.

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