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RESEARCH ARTICLE

Language growth in verbal autistic children from 5 to 11 years

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Abstract

To examine predictors and growth in language for verbal autistic and non-autistic children with/without low language from 4 to 11 years. Receptive and expressive language trajectories were compared in a community sample of 1026 children at ages 5, 7, and 11 years, across four groups: two autistic groups; one with and one without low language; and two non-autistic groups; one with and one without low language. Groups were delineated on baseline assessment at 4 years. Non-autistic and autistic children with low language had lower mean expressive language scores than the non-autistic typical language group (22.26 and 38.53 units lower, respectively, $p < 0.001$), yet demonstrated faster language growth across 5 to 11 years ($p < 0.001$ and $p = 0.002$, respectively). Both groups without low language had similar mean expressive language scores ($p = 0.864$) and a comparable rate of growth ($p = 0.645$). Language at 4 years was the only consistent predictor of language at 11 years for autistic children. Results were similar for receptive language in all analyses except there was no significant difference in rate of progress (slope) for the autistic with low language group compared with the typical language group ($p = 0.272$). Findings suggest early language ability, rather than a diagnosis of autism, is key to determining language growth and outcomes at 11 years in verbal children. Furthermore, children with low language showed developmental acceleration compared with same age peers.

Lay Summary

This study compared language growth from 5 to 11 years across four groups of verbal children (autistic and non-autistic children with or without low language ability). An autism diagnosis did not influence language growth and children (autistic and non-autistic) who started with lower language showed some acceleration in some areas of language, with the gap between those with and without language delays either keeping parallel or narrowing over time. Language ability at 4 years was the only consistent factor that predicted language outcome at 11 years of age in autistic children.

KEYWORDS
autism, developmental language disorder, language, language impairment, language trajectory

INTRODUCTION

Language difficulties are common in autistic children and estimated to occur in around 78% of autistic children (Carlsson et al., 2013). Difficulty with the social use of language (pragmatic language) is consistent with a diagnosis of autism, yet there is remarkable variability in the content and form of children's language (i.e. phonology, morphology, syntax, vocabulary). Despite ongoing investigation into neural substrates (e.g., Lombardo et al., 2015), the environment (Siller & Sigman, 2008) and genetic associations (e.g., Myers et al., 2020), it remains unclear why some autistic children have better language outcomes than others (Brignell, Morgan, et al., 2018) and why their language profiles are so diverse (Tager-Flusberg, 2016).

Longitudinal studies that map trajectories of language development can shed light on variability in language, optimal periods of language growth, the need for and response to intervention and important predictors of future outcome. In autistic children, longitudinal studies have mainly focused on the preschool period and have generally shown verbal children have lower mean language scores (and abilities) compared with age expected norms, however, the mean rate of language development is comparable to peers (see Brignell, Morgan, et al., 2018 for a review). Findings on key factors that predict language outcomes in autism are mixed. Various predictors have been studied including social communication skills, joint attention, nonverbal intelligence, early language ability, motor speech impairment, imitation, socioeconomic status, and gender (Brignell, Williams, et al., 2018; Charman et al., 2003; Chenausky et al., 2019; Ellis Weismer & Kover, 2015; Smith et al., 2007; Stone & Yoder, 2001; Thurm et al., 2007; Wodka et al., 2013), however the two most consistent predictors across studies are early language ability and IQ (Bal et al., 2020; Brignell, Williams, et al., 2018).

In the current study, we expand our previously reported findings focused on language trajectories up to 7 years of age (Brignell, Williams, et al., 2018) by extending the age at language outcome to 11 years. To our knowledge no other studies have investigated language development from 7 to 11 years using comprehensive, direct, validated, standardized assessments across multiple language domains and compared development to two key reference groups (low language and typical language groups).

Extending the study to the 11-year time point adds value and new knowledge to the field in several ways. First, in Australia the intensity of intervention received once children move beyond 7 years of age typically decreases due to a range of factors including funding. Understanding how children's language progresses when intervention begins to wane is important to inform the type and intensity of supports required. Second, the average age children experience puberty has fallen over the years and puberty currently starts around 8–9 years for females/males (Parent et al., 2016). Puberty is a profound transition period in children's development with changes in areas of motivation, psychology, cognition, social life and physical, and emotional development (Blakemore et al., 2010; Goddings et al., 2012). There is evidence pubertal hormones influence the structure and function of the developing brain (Blakemore et al., 2010) and there are reports of more aggressive and hyperactive behavior and deterioration of communication and intellectual skills in autistic children (May et al., 2020) with around 30% of autistic children experiencing a marked decline in adaptive functioning (Picci & Scherf, 2015). Third, language and social interaction becomes increasingly complex and abstract and there are increased demands around competency as children move through school, alongside the academic curriculum. It is not well understood how well autistic children "keep pace" with their peers as language demands increase. Last, when observing change in language it important there are sufficient periods of time to allow change in language to occur. The 6-year period between 5 and 11 years is likely to be sufficient to monitor change.

Study aims were to compare expressive and receptive language trajectories at ages 5, 7, and 11 in four groups of verbal children: autistic with low language[1] (A+LL), autistic without low language (A−LL), not autistic with low language (LL), and not autistic with typical language (TD). We also investigated predictors of language outcome at 11 years in autistic children. Based on our previous systematic review of language trajectories in autism (Brignell, Morgan, et al., 2018) we hypothesized that A+LL and LL groups would have comparable (or flatter trajectories) than the A−LL and TD groups and that the A+LL would have the flattest trajectories of all four groups.

METHODS

Participants

Children were drawn from the Early Language in Victoria Study (ELVS), which is a unique community-based study set in Victoria (Australia), specifically designed to longitudinally examine speech and language development. Children were purposefully sampled and recruited at around 8 months of age (prior to the onset of any identified developmental difficulties) with repeated follow up into early adulthood using direct assessments and parent questionnaires (Reilly et al., 2018). For the purposes of this study, only the assessments conducted at ages 4, 5, 7, and 11 years were included. Children with known conditions and syndromes such as cerebral palsy, genetic disorders, and hearing impairment were excluded from the study at intake, see Reilly et al. (2018) for further details. Children who were unable to complete standardized assessments of IQ and language (e.g. were minimally verbal or had very low language) were excluded from the present study as standardized assessment data was required for the analyses.

[1]In this paper we use the term "low language" to refer to children being below 1.25 standard deviations (SD) below the mean for their age at 4 years of age. While the terms "language delay" and "language disorder" are helpful clinical distinctions, for our study that examines trajectories across a community sample, it was preferable to use a standardized measure that enabled comparison to same age peers at a specific time point.

Seventy-eight children aged 11 years were reported by parents to have been diagnosed with "autism spectrum disorder." (American Psychiatric Association, 2013) Most diagnoses (92%) were multidisciplinary with the remainder made by a psychiatrist or psychologist. A psychologist or speech pathologist experienced in autism diagnosis verified the diagnosis through interview with each parent. This interview was developed by the investigators of the broader ELVS study who were highly experienced in autism assessment and diagnosis and consisted of questions about the diagnosis such as type and age of diagnosis, who made the diagnosis, how the diagnosis was made, co-occurring diagnoses. If the diagnosis was uncertain, the children were not included in the study (Brignell, Williams, et al., 2018). Four groups were defined based on autism diagnosis and language scores at 4 years of age (Figure 1): A−LL ($n = 32$), A+LL (n = 23), LL ($n = 279$), and TD ($n = 1208$).

The criteria used for low language group assignment, was based on standard scores on the Clinical Evaluation of Language Fundamentals-Preschool Second Edition (CELF-P2; Wiig et al., 2006) for the receptive and expressive language indexes at 4 years. A cut point of −1.25 SD from the mean (i.e. standard score ≤ 81) was based on prior studies (Reilly et al., 2014; Tomblin et al., 1996; Tomblin et al., 2003) and ensured consistency with previous publications using the ELVS dataset.

Participants were required to have data for at least two time points for mapping generalized estimating equation trajectories and were required to have data at 4 and 11 years for the predictor analyses. Children who were unable to complete the standardized language assessment (e.g. those who were non-speaking/minimally verbal) were excluded from the analyses. This meant some of the 78 children reported by their parents to have autism were not included in the trajectory or predictor analyses. Sample sizes are reported separately for each analysis.

Measures

Predictor measures

Demographic data from the 8 months of age timepoint were used in the analyses, including: gender, socioeconomic index for areas (SEIFA) disadvantage index, which is a continuous measure that considers neighborhood disadvantage based on the Australian Bureau of Statistics reference, maternal level of education, maternal age at birth, married/de facto, English being the only language spoken at home, and number of children in the home.

Nonverbal IQ (NVIQ) was measured at 7 years using two subtests (block design and matrix reasoning) of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). Language ability at 4 years was measured using the CELF-P2 (Wiig et al., 2006). The receptive and expressive language index standard scores were used.

Social abilities were measured using the social functioning scale in the Pediatric Quality of Life Inventory (PEDS-QL; Varni et al., 2001) and pro-social behavior scale in the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997; Russell et al., 2013). In the PEDS-QL the parent rates how much of a problem each item has been over the past month with scores ranging from 0 to 4 with 4 indicating it is almost always a problem. The SDQ (Goodman, 1997) has 5 subscales (scores range from 0 to 10 for each item) including the pro-social scale used in this study. We used subtest raw scores for the analyses. A lower raw score in this subscale indicates more difficulties with pro-social behaviors. The SDQ and PEDS-QL have satisfactory validity and reliability (Russell et al., 2013; Varni et al., 2001) and have been used frequently with autistic populations (e.g., Ikeda et al., 2014; Russell et al., 2013). A review found significant correlations between measures of autism traits and functional

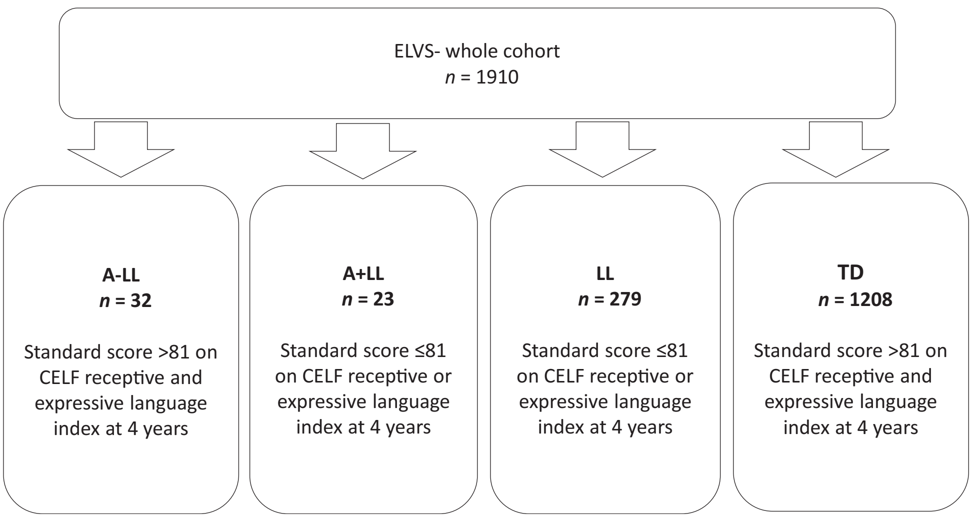

FIGURE 1 Four groups of children were formed using language score cut points at 4 years and autism diagnosis. A−LL, autistic without low language; A+LL, autistic with low language; LL, not autistic with low language; TD, not autistic with typical language development.

impairment most often in the social functioning subtest (Russell et al., 2013).

Trajectory and outcome measures

The CELF-fourth edition (CELF-4; Semel et al., 2003) was used at 5, 7, and 11 years to assess receptive and expressive language. Standard scores from receptive and expressive language indexes were used.

Statistical analyses

Data were analyzed using the generalized estimating equations (GEE) method for fitting the marginal models. An exchangeable correlation structure was used and robust standard errors. This analysis takes into account the dependence of the multiple responses across waves from each participant. We centered continuous variables around zero and used 0 as the intercept for categorical variables. The 0 intercept was the first time point in the trajectory analysis (5 years of age). We plotted trajectories of receptive and expressive language index standard scores on the CELF using GEE for each group. Analyses were adjusted for theoretically driven and evidence-based factors likely to impact language outcomes and/or had shown statistically significant differences in between group demographic comparisons. Co-variates included socioeconomic disadvantage, whether child's mother had completed high school, gender, nonverbal IQ, and whether English was the main language spoken at home. Adjusted analyses are presented in the text. The proportion of children whose receptive and expressive language index standard scores increased from 5 to 7 and 7 to 11 years was calculated.

We used linear regression to investigate the effect of predictor variables on expressive and receptive language outcomes in autistic children. We first performed univariate (unadjusted) analyses, testing all putative predictor variables (gender, socioeconomic disadvantage, English main language spoken at home, language at 4 years, NVIQ at 7 years and three social domains on the PEDS QL, and SDQ at 4 years) individually for their association with language outcome. Predictors with a strong association at the 0.01 significance level were included and were entered hierarchically into the linear regression model. Given the small sample size of autistic children who had completed all required measures, with ($n = 14$) and without ($n = 22$) low language, in the regression analyses, we collapsed the two autism groups into one. All analyses were conducted using STATA version 16. Ethical approval was obtained from the Royal Children's Hospital (#23018) and La Trobe University, Human Ethics Committee (#03-32). All parents provided written, informed consent.

RESULTS

Demographic and participant characteristics are described in Table 1. There were no significant differences between the groups for the number of children living in the home and maternal age at the child's birth. The TD group had significantly more females than the other three groups. Children with LL had a higher proportion of parents who spoke a language other than English at home (reported at 8 months of age) compared with the TD and A−LL groups. Children in the LL group also had significantly lower mean scores on the SEIFA index (i.e. greater socioeconomic disadvantage) and were less likely to have a mother who finished high school compared with the TD group. Children with LL had significantly lower NVIQ compared with the TD and A−LL groups. The A+LL group had significantly lower scores on the PEDS-QL social functioning scale compared with the other three groups.

At 4 years of age 42% of autistic children scored more than 1.25 SD below the mean on the language measure for their age, compared with 19% of the rest of the sample (i.e. without autism). This is expected given language difficulties are common in autism (Carlsson et al., 2013). In the A+LL group, 38% of participants scored within the average range for receptive language and 50% were in the average range in expressive language at 11 years of age. Most children in the LL group (70% in receptive and 65% in expressive language domains) achieved language scores within the average range by the time they reached 11 years of age, even though mean scores for both groups remained lower than the groups without low language.

For receptive language, the proportion of children with standard scores that increased (or stayed the same) from 5 to 7 years was 53% (A+LL), 35% (A−LL), 42% (LL), and 37% (TD) and between 7 and 11 years scores increased (or stayed the same) for 60% (A+LL), 59% (A−LL), 72% (LL), and 61% (TD). For expressive language, the proportion of children with scores that increased (or stayed the same) from 5 to 7 years was 50% (A+LL), 60% (A−LL), 55% (LL), and 48% (TD) and between 7 and 11 years standard scores increased (or stayed the same) for 88% (A+LL), 57% (A−LL), 75% (LL), and 57% (TD). For the mean change in standard scores for each group across the time points 5–7 and 7–11 years, see Tables S1 and S2.

Trajectories

There was individual variability in language scores and rate of growth for children in all four groups. For expressive language, children in the A−LL group had estimated mean scores that were 0.57 units lower than the TD group indicating similar ability at 5 years ($p = 0.864$). By contrast, the A+LL and LL groups both had substantially lower estimated mean scores than the TD group

TABLE 1 Participant characteristics.

	A+LL *n* = 23	A−LL *n* = 32	LL *n* = 279	TD *n* = 1208	Comparison	*p*-value
Male (%)	74	69	61	48	LL > TD A−LL > TD A+LL > TD	$p < 0.001$ $p = 0.02$ $p = 0.014$
No. children at home M (SD)	1.8	1.5	1.8	1.7	-	NS
English only language spoken at home (%)	95.7	100	85.3	97.8	LL < A−LL LL < TD	$p = 0.02$ $p < 0.001$
Married/defacto (%)	96	97	95	97	-	NS
Socio-economic index (SEIFA) M (SD)	1022 (55.5)	1043 (58.7)	1017 (70.5)	1044 (53.7)	LL < TD	$p < 0.001$
Maternal age at birth M (SD)	33.7 (5.0)	33.1 (4.6)	31.6 (4.8)	32.1 (4.2)	-	NS
Mother completed high school (%)	68	78	72	81	LL < TD	$p < 0.001$
Nonverbal IQ M (SD)	99 (14.3) (*n* = 18)	106.1 (20.0) (*n* = 30)	96.9 (11.9) (*n* = 157)	106.5 (14.4) (*n* = 916)	LL < TD LL < A−LL	$p < 0.001$ $p < 0.007$
PEDS-QL-social M (SD)	74.7 (21.1) (*n* = 15)	86.5 (13.6) (*n* = 27)	86.3 (15.1) (*n* = 97)	88.8 (11.4) (*n* = 839)	A+LL < TD A+LL < LL A+LL < A−LL	$p < 0.001$ $p = 0.003$ $p = 0.013$

Note: All participant characteristics were collected at 8 months except for nonverbal IQ which was taken at 7 years.
Abbreviations: A−LL, autistic without low language; A+LL, autistic with low language; LL, not autistic with low language; M, mean; NS, not significant at p < 0.05 level; PEDS-QL-social, Pediatric Quality of Life Inventory-social functioning scale; SD, standard deviation; SEIFA, socio-economic index for areas; TD, not autistic with typical language development.

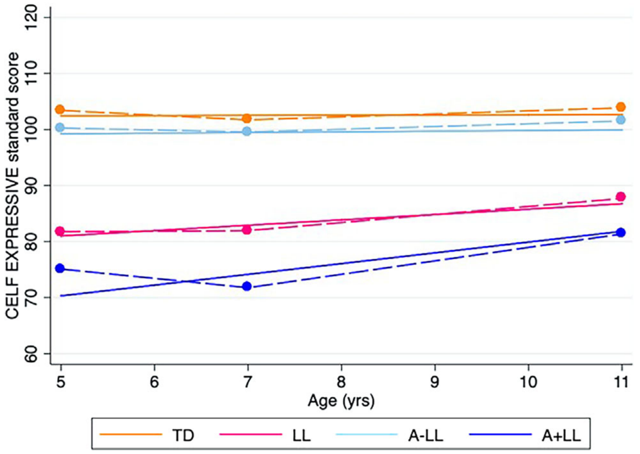

FIGURE 2 Generalized estimating equation estimates from 5 to 11 years for expressive language standard scores for LL, A+LL, A−LL, and TD. The dotted lines represent standard scores at each time point and solid lines represent GEE trajectories. A−LL, autistic without low language; A+LL, autistic with low language; LL, not autistic with low language; TD, not autistic with typical language development.

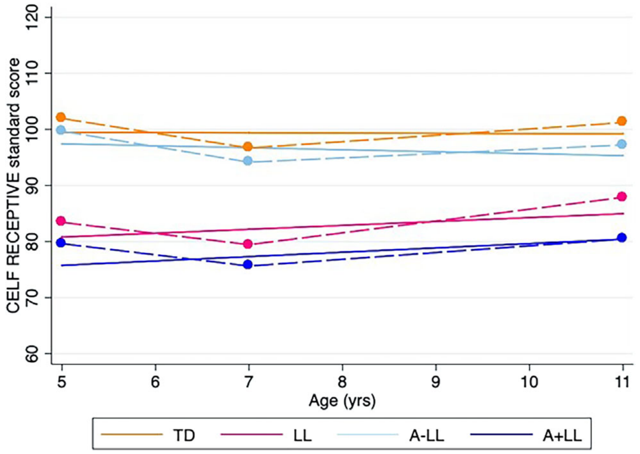

FIGURE 3 Generalized estimating equation estimates from 5 to 11 years for receptive language standard scores for LL, A+LL, A−LL, and TD. The dotted lines represent standard scores at each time point and solid lines represent GEE trajectories. A−LL, autistic without low language; A+LL, autistic with low language; LL, not autistic with low language; TD, not autistic with typical language development.

(38.53 and 22.26 units lower, respectively; $p < 0.0001$ for both). The estimated mean difference in slopes was similar for the A−LL and TD groups ($p = 0.645$) indicating comparable rate of growth in language from 5 to 11 years. There was, however, a significant difference between the LL and A+LL groups compared with the TD group ($p < 0.0001$ and $p = 0.002$, respectively) indicating mean standard scores increased more quickly for the LL and A+LL groups relative to the TD group from 5 to 11 years. This increased rate of growth was particularly evident for the A+LL group (Figure 2).

For receptive language, children in the A−LL group had estimated mean scores that were 2.63 units lower than the TD group indicating similar ability ($p = 0.467$). The A+LL and LL groups both had substantially lower estimated mean scores than the TD group (23.60 and 19.83 units lower; $p = 0.001$ and $p < 0.0001$, respectively). The estimated mean difference in slopes was similar for the A−LL and TD groups ($p = 0.452$) and the A+LL and TD groups ($p = 0.272$) indicating comparable rate of growth in language from 5 to 11 years. There was a significant difference between the LL group compared with the TD group ($p < 0.0001$) indicating mean standard scores increased more quickly for the LL group relative to the TD group from 5 to 11 years (Figure 3).

All analyses for receptive and expressive language were repeated with co-variates in the model (socioeconomic disadvantage, parent had completed high school, gender, nonverbal IQ, and whether English was the main language spoken at home). The findings were very similar. Unadjusted analyses are presented in Figures 2 and 3.

Predictors of language outcomes in autistic children

Of the variables tested, language at 4 years and NVIQ at 7 years were the only univariate predictors for receptive and expressive language outcomes in autistic children at age 11 ($n = 35$). Therefore, only these two predictors were included in the final regression model. In the model, a higher expressive language score at 4 years was the only significant predictor of higher expressive language score at 11 years (co-efficient = 0.48; $p = 0.001$). NVIQ was not a significant predictor of expressive language outcome in the model (co-efficient = 0.15; $p = 0.268$). Expressive language CELF-P2 scores at 4 years explained 33% of the variance in expressive language outcome. Higher receptive language score at 4 years (co-efficient = 0.49; $p = 0.001$) and higher NVIQ score at 7 years (co-efficient 0.28; $p = 0.039$) were the only two significant predictors of higher receptive language score at 11 years. These predictors explained 35% of the variance in receptive language outcome.

DISCUSSION

For overall language ability and rate of growth, autistic children with typical language (A−LL) had similar language profiles to non-autistic children with typical language (TD). Autistic children with low language (A+LL) had similar profiles to those who were not autistic with low language (LL). Despite variation in mean language scores between the four groups, the predictors of language scores at 11 years of age and mean language trajectories appeared relatively independent of whether the child was autistic or not. Furthermore, although mean language scores were slightly lower for those in the autism groups compared with the other two groups with equivalent language status, the differences in scores were not statistically significant.

Whilst there was individual variation in language growth, the mean rate of growth followed a predictable pattern for the TD and A−LL groups; those with LL and A+LL demonstrated some developmental acceleration between 5 and 11 years in expressive language and the LL group showed accelerated growth in receptive language. Reassuringly, our findings confirm that rather than falling further behind typically developing peers, most verbal children with early language impairment, whether autistic or not, are likely to either track in parallel to the children without low language or make up some ground. Further, the gap between groups shows some narrowing over time.

The findings regarding acceleration in language development for the LL and A+LL groups are consistent with other studies of autistic children (Brignell, Morgan, et al., 2018) but not for studies of children with language impairment without autism (Conti-Ramsden et al., 2001; Law et al., 2008). In general, studies of children with language impairment do not show a dominant pattern of acceleration over time but rather a predictable, consistent increase in growth in language which tracks in parallel to children with typical development, thus supporting the "tracking hypothesis" (Law et al., 2008). Conti-Ramsden et al. (2001) and Law et al. (2008) followed children attending language units from 7 to 11 years ($n = 242$ and $n = 184$, respectively). Conti-Ramsden et al. (2001) found that 89% of children scored within one standard deviation of the mean on at least one previous language assessment, indicating language ability relative to norms was relatively stable over time (Conti-Ramsden et al., 2001). Similarly, Law et al. (2008) found consistent increases in language growth, with comparable rates of development for those with and without language difficulty and outcomes predicted by initial severity of language difficulties. Two further studies (Rice & Hoffman, 2015; Tomblin et al., 2014) of children with language impairment found, despite consistent patterns of growth for most children, the majority remained within their language classification, that is, language impaired/not language impaired. Tomblin et al. (2014) for example, reported the probability of a diagnosis of language impairment at the 4th and 8th grades from kindergarten was around 56%. While these findings were comparable for the A+LL group in our study (38% of participants in receptive and 50% in expressive language), the majority of children in the LL group (70% in receptive and 65% in expressive language domains) achieved language scores within the average range by 11 years of age. One possible explanation for the discrepancy in findings is that in previous studies children were identified at a later age with ongoing language impairments, predetermining a more severe and complex presentation relative to those in our community sample who were recruited in infancy prior to the onset of any identifiable difficulties (Reilly et al., 2018). Comparing study outcomes is complicated by changing definitions, ascertainment, and different measures; for example, earlier studies adopted more stringent criteria dependent on a discrepancy between language ability and nonverbal IQ (Rice & Hoffman, 2015). Furthermore, "language impairment" may be classified in a range of ways such as "below average language at two or more time points," age-equivalent cut points, attendance at a language unit, standard scores, or standard deviation cut points.

Prior research in children with language impairment with and without autism (Law et al., 2008; Pickles et al., 2014; and see Brignell, Morgan, et al., 2018 for review) has found the preschool years had the fastest rate of language growth compared to middle school years or adolescence across all groups, especially for the LL and A+LL groups. It could be hypothesized that early intensive intervention contributed to faster growth for the children with A+LL and LL, however, interestingly we observed a similar increased rate of language growth from 7 to 11 years which is not typically a time of intensive intervention. The expressive and receptive language trajectories hint there may be different rates of development between each time point (i.e. 5,7, and 11 years) for the four groups and therefore present opportunities to capitalize on developmental periods where intervention may be optimally effective, supporting the case for intervention during these periods (Pickles et al., 2014). Of interest, a substantial number of children who had low language at 4 years scored within the average range by 11 years. This may reflect a proportion of children who were "late bloomers" or may also indicate that our threshold for diagnosing LL at 4 years should be modified (e.g. reducing the threshold) to more accurately capture the children who are less likely to catch up and have more severe and persisting language difficulties. This key prognostic information can assist in building our knowledge around key priorities and optimal timing for intervention. Larger samples of children and reporting on language trajectories and ability outcomes at additional time points, along with investigations into help seeking behaviors by parents and type, timing, and duration of interventions accessed, will be required in future studies to better explore individual differences over time, investigate potential subgroups, and better tailor interventions. While some information was collected on interventions accessed in the current study (such as through government funding data and parent report), consistent and detailed data was not available to allow reliable conclusions to be drawn about the effect of these on language outcomes.

Our study did not identify any novel predictors for later language outcome for verbal autistic children. The only significant predictor of expressive language outcome at 11 years was the expressive language score at 4 years. Whereas, receptive language at 11 years was predicted by both receptive language ability at 4 years and NVIQ at 7 years. Social communication (measured using SDQ or PEDS-QL), socio-economic status, gender, and language other than English spoken at home did not predict language outcome, despite there being more males in the A+LL groups. We did not find severity of difficulties in social skills (Charman et al., 2003; Ellis Weismer & Kover, 2015; Wodka et al., 2013) and nonverbal IQ/cognition (Bal et al., 2020; Ellis Weismer & Kover, 2015; Smith et al., 2007; Wodka et al., 2013) to be key predictors of expressive language. This may be partly explained by differences in how samples were ascertained and the resulting sample characteristics. The characteristics of clinically ascertained samples will differ from those of a community study (May et al., 2020). Other factors of relevance include the study's inclusion criteria such as the range of verbal ability (but no children who were minimally verbal), age range, the way in which predictors and language domains were measured and the variation in the follow up period. Furthermore, while correlations between the social measures and autism have been reported in the literature (Ikeda et al., 2014) some of the social measures used in the study were relatively blunt compared to detailed autism-specific assessments and hence may have missed some subtle differences in social ability. Of interest, some studies have not found social communication to be a significant predictor once nonverbal IQ was added as a co-variate in their analyses (Brignell, Williams, et al., 2018; Thurm et al., 2007), which is consistent with the current study findings.

To our knowledge this is the only study of a community sample of children to enable the detailed examination of language growth in autistic children and comparison with a large sample of children without autism. We addressed some of the limitations of previous research by completing the same consistent assessments using well validated standardized language tools across three time periods and we included comparison groups. Another strength of our study is that we included key covariates that may impact language ability at 11 years in the statistical models to consider the contribution of these to the outcomes. To date, most research has focused on intervention studies during the preschool period, however, our findings around developmental acceleration, at least until 11 years, suggests there is scope for further language improvement.

A limitation of our study was the initial parent-reported diagnosis of autism resulting from a diagnostic assessment conducted in the community via a range of tools, professionals, and processes. We verified each diagnosis through diagnostic interviews with each parent conducted by our team's experts in autism diagnosis. In addition, findings from our study can only be applied to verbal children who have the capacity to complete formal language assessments. Regression to the mean can inflate the number of children with lower scores making more rapid progress (see Zhang and Tomblin (2003) for further description) and may have had an impact on our findings for the slopes of the trajectories. With this in mind, we grouped the children at 4 years and mapped trajectories from 5 years. It is common in longitudinal community cohort studies to have a proportion of participants who are lost to follow up and the representativeness in the current study has decreased over time, with a higher proportion lost to follow up having greater socioeconomic disadvantage (Reilly et al., 2018). This may limit the generalization of our findings. Our study focused only on verbal children and the findings should not be applied to children who are minimally verbal or do not have sufficient language to complete a CELF. Mean scores for language and/or IQ therefore may be higher in our sample than if all autistic children (regardless of language ability) were included. Finally, our sample size of autistic children was relatively small which may have impacted statistical power to identify between group differences.

The predictors of social communication in this study were selected for the community study rather than a study of autism. The tools used (SDQ and PEDS-QL) have not been designed to measure social communication and are not as comprehensive compared with other tools used to assess social communication in autism. However, they have good measurement properties and have been used widely in large population-based studies and in studies of autistic children. Furthermore, parent report is a valid way to concurrently measure a range of childhood domains including early social and behavioral development as it considers a range of natural interactions across different contexts. Ellis Weismer & Kover (2015) found that while autism spectrum disorder symptom severity (measured with the autism diagnostic observation schedule) was a significant predictor of receptive and expressive language growth, social communication (measured by the “socialization” domain of the Vineland Adaptive Behavior Scales) was not. It is likely that refined predictors may be more sensitive than broader constructs. There is some data to suggest that rate of development may slow in adolescence in autistic and non-autistic children (Pickles et al., 2014; Rice & Hoffman, 2015). Rice and Hoffman (2015) reported that vocabulary acquisition slowed in all children regardless of diagnosis. However, few studies have followed language longitudinally, so comparisons to prior research is limited.

To our knowledge two studies have followed autistic children into early adulthood using standardized assessments of language (Bal et al., 2020; Pickles et al., 2014). Both used parent interviews to assess language rather than direct assessments and neither included a typical language cohort for comparison (Bal et al., 2020; Pickles et al., 2014). Pickles et al. (2014) followed 192 participants from 2 until 19 years; substantial variability in adaptive language progress was identified between 2 and 6 years, becoming largely uniform beyond 6 years. The second study (Bal et al., 2020) focused on children who were minimally verbal/non-speaking (use minimal functional language), did not analyze trajectories and focused on predictors of language outcome. Additional studies that track the language growth of autistic children through adolescence and adulthood using direct, standardized comprehensive language assessments are needed.

There is strong evidence that language ability at 5 years sets the course for language development for verbal children regardless of language impairment (Rice & Hoffman, 2015; Tomblin et al., 2014) and autism (Ellis Weismer & Kover, 2015; Pickles et al., 2014) diagnosis. Thus, highlighting the importance of more reliable early detection that aligns with more sensitive predictors of language outcome to identify children who are at greatest risk of slow progress, at critical time periods for growth and development. Law et al. (2008) suggested that subgroups of children with language impairment may display different patterns of development, driven by different etiologies. Whilst beyond the scope of this study, detailed description of speech and language growth together with neurobiological and genetic information in larger samples may clarify the existence of subgroups (Lombardo et al., 2015). These data can inform language interventions to prevent some of the longer-term adverse outcomes associated with low language ability and will assist parents and clinicians to better understand children’s language prognosis and inform intervention and service planning.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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