



Brief Report: Socioeconomic Factors Associated with Minimally Verbal Status in Individuals with ASD

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Abstract

About 30% of adults with autism are minimally verbal. Past research suggested that after age five, few gain verbal fluency, but studies have rarely investigated whether family environmental factors contribute to the acquisition of verbal fluency. The present study utilized data from the Autism Diagnostic Interview-Revised to compare changes in verbal fluency for 404 individuals with autism from childhood to adolescence and adulthood. Socioeconomic factors were examined across fluency groups (i.e., those who did/did not achieve verbal fluency). Findings indicated that fully 60% of those who were minimally verbal in early childhood acquired verbal fluency in adolescence and adulthood. Parent socioeconomic status differed across fluency groups, suggesting the importance of environmental factors for individual development.

Keywords ASD · Minimally verbal · SES · ADI-R · Lifespan development

Autism spectrum disorder (ASD) is a heterogeneous neurodevelopmental disorder characterized by social communication deficits and patterns of restricted and repetitive behavior. The average age of first words for individuals with ASD is approximately 36 months, in contrast to the expected onset at around 18 months, making expressive language delay the most common reason parents of individuals with ASD seek diagnostic and clinical services (De Giacomo and Fombonne 1998; Franchini et al. 2018). Individuals with ASD who have few to no functional words are considered *minimally verbal* (Kasari et al. 2013; Koegel et al. 2020) and an estimated 30% of individuals with ASD are classified as such during adulthood (Tager-Flusberg and Kasari 2013; Rose et al. 2016). However, despite this substantial subgroup of individuals with ASD, their inclusion in research studies is limited and currently little is known about what factors might relate to persistence versus change in limitations in functional communication in adulthood.

Most prior work regarding acquisition of verbal abilities for individuals with ASD has focused on the time period up to age five, and language skills by age five have been shown to be predictive of outcomes in adulthood (Howlin 2005;

Magiati et al. 2014). For instance, Magiati et al. (2014) systematically reviewed longitudinal studies of individuals with ASD, and noted that almost all studies reported that language abilities at five years old predicted later language gains, adaptive behavior, ASD severity, and social outcomes in adulthood. A range of individual factors may differentiate children with ASD who are minimally verbal from those who are verbally fluent. For instance, studies have observed deficits in motor skills (Bal et al. 2019), lower nonverbal IQ (Luyster et al. 2008), reduced imitation behavior (Luyster et al. 2008), and divergent patterns in visual attention to faces during social interactions (Plesa Skwerer et al. 2019) among minimally verbal individuals. There is limited knowledge, however, as to the environmental factors that may contribute to the acquisition of verbal abilities beyond childhood. Extensive literature suggests that environmental factors, including socioeconomic status, may be associated with language development in typical populations (Madigan et al. 2019) and may also contribute to variation in ASD symptom presentation (Ferguson and Vigil 2019). However, it is unclear how acquisition of verbal skills in individuals with ASD may be influenced by such factors.

This brief report examined verbal status in individuals with ASD in childhood and in adolescence and adulthood via data collected using the Autism Diagnostic Interview-Revised (ADI-R; Lord et al. 1994). The first aim of this study was to evaluate the proportion of individuals with

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ASD who were reported to be minimally verbal as children, but who subsequently became verbal, as rated in adolescence or adulthood. The second aim of the study was to examine family socioeconomic factors that may have differentiated these groups.

Methods

Sample and Procedures

The sample included 406 mothers of individuals with autism spectrum disorder (ASD) from a community-based sample who participated in a longitudinal study of adolescents and adults with ASD (Seltzer et al. 2003). Inclusion in the study was based on three criteria: (1) their child had received a prior diagnosis of ASD from an independent medical professional, psychologist, or educational professional; (2) their child was at least 10 years of age at the start of the study; (3) their child's scores on the research administered ADI-R were consistent with an ASD diagnosis.

Participants were recruited through agencies, schools, diagnostic clinics, and media announcements. Approximately half of the participants lived in Wisconsin and the other half lived in Massachusetts at the time of initial data collection. Identical study procedures were used in both states. Data collection consisted of a 2–3 h home interview, which included administration of the ADI-R (described below) and collection of data regarding demographics, daily living skills, and vocational activities. In addition, participants completed self-administered questionnaires. Data from the present study were collected at the first timepoint.

The mean age of mothers at Time 1 was 51.48 years ($SD = 10.45$). Most had completed at least some college (73.3%) and were employed either full- or part-time (65.1%). Their adolescent and adult children with ASD ranged in age from 10 to 52 years old ($M = 21.46$, $SD = 9.40$). In the adult cohort (≥ 22 years old, $n = 153$), type of employment and vocational activities varied greatly in the level of independence, with 56.2% of adults participating in sheltered settings, 18.3% in supported employment, and only 5.9% in competitive employment (Taylor and Seltzer 2012).

Measures

ADI-R

The ADI-R (Lord et al. 1994) is a standardized clinical interview that was used to compare ASD symptoms from childhood (age four to five) to adolescence/adulthood (current) in individuals with ASD based on criteria for an autism diagnosis outlined by the *Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition* (DSM-IV; APA 2000) and

the International Classification of Diseases-Ninth Edition (ICD-9). Participants were visited in their home and were interviewed using an abbreviated version of the ADI-R from a standard short form that represents items from the diagnostic algorithm (see Seltzer et al. 2003 for additional description). In preparation for the interview, participants received an information packet which prompted them to reflect on their child's skills and development between the ages of four and five. At the time of the interview, both current (i.e., adolescence/adulthood) and lifetime scores were collected, and some questions referred specifically to the time period between 4 and 5 years of age. Through the inclusion of both current and lifetime severity scores, the ADI-R captures peak ASD symptom severity for gold-standard diagnostic purposes. Therefore, the ADI-R is a powerful tool to measure symptom variability across development, regardless of the child's age or skill level at the time of the interview, and has been used extensively in research and clinical contexts to assess ASD-related symptoms for children and adolescents/adults (Hus and Lord 2013; Seltzer et al. 2003). Further, comparisons between current and past scores have been utilized as a method of assessing developmental change over time in prior work (Fecteau et al. 2003; Shattuck et al. 2007) and was the approach used in this study. The ADI-R has demonstrated good test–retest reliability, diagnostic validity, convergent validity and specificity and sensitivity in past research (Lord et al. 1994; Hill et al. 2001).

For the present study, one item (item 33) was used to characterize the functional use of language of the adolescents and adults with ASD at the time of data collection compared to their functional use of language at age four to five, consistent with prior work (Shattuck et al. 2007). Participants were asked to describe their child's typical language and communication at the time of the interview, with additional questions pertaining to their child's language and communication between the ages of four and five; examples were requested for all responses, following standard procedures. For example, participants were asked to describe their child's use of words and phrases and how well others understand him or her when they speak (both current and lifetime). Based on the answers given during the standardized interview, items were scored by trained, research reliable interviewers. Inter-rater reliability between interviewers and two supervising psychologists averaged 89%, with an average κ coefficient of 0.81 (interpreted as "very good agreement"; Dawson and Trapp 2004).

For both current (i.e., during adolescence or adulthood) and lifetime (age four to five) ratings, this item uses the following scale:

0: Functional communication used on a daily basis that involves phrases of three or more words that at

least sometimes include a verb and are comprehensible to others.

1: No functional use of three-word phrases in spontaneous, echoed, or stereotyped speech, but uses speech on a daily basis with at least five different words in the last month.

2: Fewer than five words total or speech not used on a daily basis.

Individuals with ASD were grouped according to their verbal status using both current and past ratings. If the adolescent/adult received a score of “0” for both current and past ratings, this group was determined to be *Always verbal*. Individuals who received a score of “0” for current, and either a “1” or “2” for their past rating were grouped as *Progressed to verbal*. Individuals who received a score of “1” or “2” for both current and past ratings were considered *Always minimally verbal*. Two individuals in the study received a past rating of “0”, but their current score was either “1” or “2”; these individuals were excluded from the analysis, yielding a total sample of 404 adolescents/adults with ASD.

Daily Living Skills

Current level of daily living skills for adolescents and adults with ASD was measured using the Waisman Activities of Daily Living scale (W-ADL). The W-ADL consists of 17 items measuring performance of personal hygiene (e.g., washing/bathing, grooming, toileting), housekeeping (e.g., home repairs, laundry), meal preparation (e.g., preparing simple food, drinking from a cup, washing dishes), and financial management (banking and managing daily finances) on a rating from 0 (does not perform the task at all) to 2 (performs the task independently), and summary scores were computed. The measure has excellent reliability ($\alpha = 0.91$) and criterion validity (r -values > 0.77 using the Vineland as a gold standard instrument) (Maenner et al. 2013).

Classification of Intellectual Disability

ID status of adolescents and adults with ASD was determined by standardized measures [the Wide Range Intelligence Test (WRIT); Glutting et al. 2000; Vineland Screener (VS); Sparrow et al. 1993], following diagnostic guidelines (i.e. scored 70 or below on both measures; Luckasson et al. 2002). Cases with incomplete information on these two measures or cases with either one measure falling within the marginal range (i.e. 71–75) were reviewed by psychologists on a case-by-case basis through a consensus procedure to assign ID status (see Orsmond et al. 2006; Shattuck et al. 2007 for details). Over two-thirds of adolescents/adults with ASD (281 out of 404) met criteria for intellectual disability.

Analysis Plan

All analyses were conducted in SPSS Version 26 (IBM Corp). To address the first aim, we assessed the proportion of individuals with ASD who were verbal by adolescence/adulthood by grouping them as follows: always verbal, progressed to verbal, and always minimally verbal. For the second aim of the study, we conducted χ^2 analyses and one-way analyses of covariance (ANCOVA) across a range of family demographic variables to determine the extent to which socioeconomic status (SES) differentiated groups. Those analyses with significant χ^2 statistics were followed by two-sided Fisher’s exact tests to compare individual groups. Additional follow-up ANCOVAs were conducted, which included W-ADL as covariate, to determine whether global adaptive differences in adolescents and adults with ASD may have influenced the findings.

Results

Over one third of adolescents and adults with ASD (144 out of 404) were categorized as *always verbal* (i.e., verbal both at age four to five and during adolescence/adulthood). One hundred fifty-five adolescents and adults (38.4%) were rated as minimally verbal at age four to five but were rated as verbal at the time of data collection, thus *progressed to verbal*. The remaining 105 adolescents and adults (26.0% of total sample) were rated as minimally verbal from childhood through adolescence and adulthood (i.e., *always minimally verbal* group).

To address the second aim of the study, the three verbal status groups were compared on a range of child and family factors (see Table 1).

Regarding characteristics of individuals with ASD, verbal status groups differed according to age, intellectual disability, and W-ADL scores. Follow-up tests showed that the always verbal group was significantly younger than both the progressed to verbal and always minimally verbal groups. All groups differed by intellectual disability status, with the greatest proportion with intellectual disability observed in the minimally verbal group, followed by the progressed to verbal group and always verbal group, respectively. An ANCOVA revealed that individuals in the always minimally verbal group had significantly lower W-ADL scores compared to other groups [$F(2,398) = 64.27, p < 0.001$].

Regarding family characteristics, parents differed by college education, such that a greater proportion of mothers and fathers had completed college in the always verbal and progressed to verbal groups than in the always minimally verbal group. The proportion of participants with a family income at or above the median (~\$50,000) was greater in the always verbal group compared to both the progressed to verbal and

Table 1 Group comparisons: child and family factors by verbal fluency group

	Always verbal (n = 144)	Progressed to verbal (n = 155)	Always minimally verbal (n = 105)	p-value
Child factors				
% 10–21 years	71.5 ^{a,c}	59.2 ^b	54.3 ^b	.013
% Female	26.4	29.9	22.9	.404
% ID	43.8 ^{a,c}	73.9 ^{a,b}	99.0 ^{b,c}	< .001
W-ADL <i>M (SD)</i>	22.20 (5.71) ^a	21.09 (6.08) ^a	14.33 (5.22) ^{b,c}	< .001
Family SES factors				
% Maternal education (college or above)	83.3 ^a	74.5 ^a	57.1 ^{b,c}	< .001
% Paternal education (college or above)	84.7 ^a	79.0 ^a	61.6 ^{b,c}	< .001
% Married	79.3	77.3	78.8	.887
% Family income ≥ median (\$50K)	60.4 ^{a,c}	47.8 ^b	36.2 ^b	.001
% Mothers employed (full/part time)	68.1	66.5	59.0	.306
% Fathers employed (full/part time)	84.6	82.0	72.6	.093
% White	95.1 ^a	94.9 ^a	85.7 ^{b,c}	.007

After controlling for W-ADL, all findings are the same except for % fathers employed, which becomes significant ($p = .017$)

Differing superscripts indicate significant differences ($ps < .05$) on follow-up tests:

^aSignificantly different from minimally verbal group

^bSignificantly different from always fluent group

^cSignificantly different from improved to fluent group

always minimally verbal groups. Although the sample was predominantly White, the proportion of White sample members differed across groups, with the always minimally verbal group having the lowest percentage compared to both the always verbal and progressed to verbal groups. However, parental marital status and overall employment status (any part/full time employment) did not differentiate the groups.

Follow-up ANCOVAs on all child and family factors were completed, controlling for child W-ADL score. For the child factors, all previous findings remained the same. For the family SES factors, all previous findings remained the same, with the exception of the proportion of fathers employed, which became significant ($p = 0.017$); the proportion of fathers employed was the greatest in the always verbal group and lowest for the always minimally verbal group. Further, fathers in the always verbal group had significantly higher rates of full-time employment (80.3%) than the always minimally verbal group (61.9%; $p = 0.014$).

Discussion

Past research suggests that many children with ASD who are minimally verbal will remain minimally verbal into adulthood (Tager-Flusberg and Kasari 2013). However, in this study, approximately 60% of the children who were minimally verbal at age four to five based on the lifetime ADI-R ratings had progressed to verbal status by adolescence and adulthood. This percentage signifies improvement from *no*

functional use of language or *fewer than five words* during early childhood to *functional communication used on a daily basis that involves phrases of three or more words that at least sometimes include a verb and are comprehensible to others* during adolescence and adulthood. This is a qualitative change that potentially has important clinical and quality of life implications. We further demonstrated the utility of a gold-standard ASD diagnostic and clinical interview, the ADI-R, in evaluating the extent to which verbal status changes over time, which underscores this measure as a valuable tool in tracking outcomes for individuals with ASD.

Additionally, we observed differences between verbal groups on a number of socioeconomic factors, including parent education, race, and family income. A higher proportion of parents of adolescents and adults who were always verbal went to college, were White, were employed full-time, and had incomes at or above the median (~\$50K) compared to parents of always minimally verbal adolescents and adults. Likewise, a higher proportion of parents of adolescents and adults who progressed to verbal status went to college and were White compared to the always minimally verbal group; however, the progressed to verbal and always minimally verbal groups did not differ in income.

Much past research on verbal status in ASD has primarily focused on the time period up until age five (Saul and Norbury 2020; Yoder et al. 2015). This is perhaps due to studies suggesting that verbal status at age five is highly predictive of adult outcomes (Howlin 2005; Magiati et al. 2014) and that most variability in language acquisition occurs prior

to age five, with uniform trajectories in language development beyond age six (Pickles et al. 2014). Although this time period certainly warrants consideration for language interventions, findings from this study and several others (Tager-Flusberg and Kasari 2013; Chenausky et al. 2018; Pickles et al. 2014) underscore that acquisition of verbal skills may occur beyond early childhood.

Accordingly, there remains a continued need for targeting acquisition of verbal skills for the subgroup of individuals with ASD who have not yet attained the milestone of verbal communication by age five, as well as development of alternative communication strategies for these individuals across socioeconomic strata. Prior work highlights the importance of augmentative and alternative communication (AAC) strategies for individuals with ASD, particularly those who are minimally verbal (Ganz 2015; Schlosser and Koul 2015; Sievers et al. 2018). As in the present work, there is evidence to suggest that AAC use improves into adolescence and adulthood for individuals with ASD (Holyfield et al. 2017). Continued examination of barriers to implementation of such intervention strategies across the life course will be vital in future studies.

Further investigation into environmental factors that may contribute to the developmental trajectories of individuals with ASD is of critical importance for appropriate intervention development and service accessibility. For instance, socioeconomic factors may influence age of diagnosis, access to evidence-based interventions, and adherence to such interventions (Mazurek et al. 2014). Although the present sample was largely ethnically- and racially-homogenous, racial differences between verbal status groups highlight the need to broadly represent under-served populations in research and clinical services. Therefore, it is essential that researchers and clinicians are aware of factors that may contribute to response to interventions and are able to implement added supports as needed. Future work should continue to examine environmental factors as possible targets for intervention at the community and policy level.

This study had several notable strengths, namely the inclusion of a large, community-based participant sample, and the use of a reliable, gold-standard measure to assess ASD-related symptoms. However, the study also had limitations. For example, although the ADI-R is a standardized measure to assess symptoms of ASD, the reliance on maternal report to describe childhood functioning may have introduced some error into the classification of verbal status, and thus replication is needed, ideally with longitudinal data. Future research could examine other contextual factors such as work, family relationships, and residential status that could affect the development of verbal skills; these questions are beyond the scope of this paper. Further, participants were classified based on their spoken verbal ability, and it was not possible to capture the range of alternative

communication strategies used across groups. This remains an important need in future work, particularly in longitudinal studies. The present study suggests an optimistic trajectory for some individuals with ASD who were minimally verbal in childhood and emphasizes the importance of family socioeconomic factors in predicting outcomes in adolescence and adulthood.

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Compliance with Ethical Standards

Conflict of interest The authors declare they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the Institutional and/or National Research Committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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