Brief Report: Associations between Autism Characteristics, Written and Spoken Communication Skills, and Social Interaction Skills in Preschool-Age Children on the Autism Spectrum

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Abstract

We used parent-report data from a prospective longitudinal study to better understand the early strengths in written skills often observed in preschoolers on the spectrum. Consistent with previous research, children demonstrated relative strengths in standardized written communication compared to spoken communication scores on the VABS-II. We found no significant links between children's performance on the written communication subdomain and their autism characteristics or the Social Interaction Deviance Composite score on the CCC-2. Our results emphasize the need for further research into the early strengths in written skills of preschoolers on the spectrum. From a clinical viewpoint, we highlight the need for a comprehensive emergent literacy assessment in this group of children who are at high risk of persistent literacy difficulties.

Keywords: Emergent Literacy; Autism Spectrum Disorder; VABS-II; CCC-2; SCQ

The ability to read is one of the most important academic skills children acquire at school, with early reading success predictive of long-term reading volume and reading achievement in typically developing children (i.e., those without developmental disorders; Sparks et al. 2014). Many children develop important precursor skills to reading during the preschool years, including *meaning*-related (i.e., spoken language skills, such as vocabulary) and *print*-related (e.g., alphabet knowledge, emergent name writing) skills (National Early Literacy Panel 2008). These precursor reading skills, also referred to as emergent literacy skills, are often fostered in the home environment, for example through shared book reading with parents or caregivers (Sénéchal et al. 1998). Research suggests that preschool-age children diagnosed with autism spectrum disorder (ASD) show relative strengths in print-related emergent literacy skills compared to their meaning-related literacy skills (Lanter et al. 2012; Westerveld et al. 2017). Potential explanations include (a) a higher prevalence of challenges in spoken language in children on the spectrum (Kwok et al. 2015); (b) social communication challenges as per diagnostic criteria, lowering children's interest in engaging in shared book reading (Westerveld and van Bysterveldt 2017), and consequently impacting spoken language development; and (c) higher levels of social communication challenges associated with more restricted interests, leading to a fascination with letters (Davidson and Ellis Weismer 2014). Despite reported strengths in early print-related literacy skills, children on the spectrum are at increased risk of reading failure (Henderson et al. 2014; Westerveld et al. 2018), highlighting the need for a better understanding of the early print-related emergent literacy strengths often observed in preschool-age children on the spectrum.

Most previous studies have purposively recruited families to participate in research focusing on early literacy development, which may have introduced a bias towards parents who were more likely to engage in literacy-related activities at home (Davidson and Ellis Weismer 2014; Lanter et al. 2012; Westerveld et al. 2017). One exception is a study by Westerveld, Paynter, Brignell et al. (2020), in which the researchers used data from a longitudinal prospective community-based sample to compare two print-related emergent literacy skills (letter knowledge and phonological awareness) in children who did and did not have a diagnosis of ASD, and who were closely matched for age, gender, socioeconomic status, language ability, and cognitive ability. Surprisingly, no group differences were found on these precursor literacy skills. However, only children who were able to complete standardized measures were included in this report, which may have influenced the findings by possibly excluding children with significant difficulties in one or more of these emergent literacy tasks. The current study uses parent-report data from a prospective longitudinal study exploring educational and

social outcomes for children on the autism spectrum, which arguably reduces recruitment bias and avoids excluding children unable to complete standardized tasks.

The aim of the present study was to investigate the associations between preschool children's autism characteristics, their performance on the Social Interaction Deviance component of the Children's Communication Checklist (CCC-2; Bishop 2003), and parent-reported performance in written (reading and writing) and spoken language using the Vineland Adaptive Behavior Scales (VABS-II; Sparrow et al. 2005). We used the data collected at the first time point of the LASA study (Roberts et al. 2018) to answer the following research questions:

1. Do 4- and 5-year old children on the autism spectrum show relative strengths or challenges across the written and spoken communication subscales of the VABS-II?
2. Is there an association between children's scores on the VABS-II communication subscales and their autism characteristics (as measured by the Social Communication Questionnaire [SCQ; Rutter et al. 2003])?
3. Is performance on the VABS-II written communication skills subdomain associated with the presence of pragmatic/social interaction difficulties based on the Social Interaction Deviance Composite score derived from the CCC-2?

Based on previous results (Dynia et al. 2014; Westerveld et al. 2017), it is hypothesized that parents will report significantly better written versus spoken communication skills on the VABS-II. Although some research suggests there may be a link between a higher number of autism characteristics and better performance in specific written communication skills such as alphabet knowledge (Davidson and Ellis Weismer 2014), based on the most recent research (Westerveld, Paynter, Brignell et al. (2020), we hypothesize that there will be no significant association between the number of autism characteristics (SCQ) and written communication skills on the VABS-II. Finally, if, as suggested, social interaction challenges observed in children on the spectrum are linked to a higher interest in letters (Davidson and Ellis Weismer 2014), we may find a significant association between children's written communication skills and the Social Interaction Deviance Composite score on the CCC-2.

Method

Participants

Ethical approval for the Longitudinal Study of Australian Students with Autism (LASA) study was obtained from all participating institutions and health authorities and all parents provided written, informed consent. Participants included 125 children (105 males; 20 females) with a diagnosis of ASD recruited into the 4-5- year-old cohort from the LASA study. Parents received recruitment information through clinics, national and state autism associations, parent support groups, as well as through websites and mailing lists. Interested participants were asked to register through an internet link (see Roberts et al. 2018), for the full protocol) and completed each annual questionnaire online. The only inclusion criteria was child age (4-5 or 9-10 at recruitment) and a clinical diagnosis of autism by a health professional. Evidence for children's ASD diagnosis was obtained via diagnostic reports provided by parents and verified by completion of the SCQ (Rutter et al. 2003). A cut-off score of 11 was used as support for an ASD diagnosis as recommended by Eaves, Wingert, Ho, and Mickelson (2006). If SCQ scores fell between 11-15, community diagnostic reports were checked to verify they were based on gold-standard assessment methods. Of the original cohort, one child's scores were excluded for the current study as a significant outlier (VABS receptive AE of 11 years).

Parents completed a range of online questionnaires and checklists. For the purposes of this study, Time 1 data (collected in 2015) were extracted for analyses. At Time 1, children were aged between 4;0 and 5;11 (mean age 5;0 years). Most parents reported tertiary education as their highest completed level of education (81.7%), with remaining parents completing secondary education. All parents reported English as their primary language spoken at home.

Measures

Autism Characteristics

The SCQ (Rutter et al. 2003) is a behavioural checklist containing 40 dichotomous (yes/no) items. A higher score on this checklist indicates a higher number of behaviours. Therefore, in this study, the raw score on the SCQ was used as a proxy for autism characteristics, as per previous research (Adams et al. 2019; Westerveld et al. 2017). The manual reports internal consistency (α) = 0.93 and test-retest reliability = 0.81

Communication Skills

The Communication Domain of the VABS-II (Sparrow et al. 2005) was used to determine the participants' communication skills across three subdomains: Receptive (listening and understanding), Expressive (talking), and Written (reading and writing). Communication Domain standard scores are reported for descriptive purposes (see Table 1). V-Scale and age equivalent (AE) scores were calculated for each

subdomain and chosen for analysis based on recommendations for this age group (Yang, Paynter, and Gilmore 2016). As reported in the manual, internal consistency (α) for the Communication Domain is 0.84–0.93.

Communication Skills and Pragmatic/Social Interaction Skills

The Social Interaction Deviance Composite of the CCC-2 (Bishop 2003) was used as a screener for pragmatic communication difficulties. All parents who reported their child speaking in multiword phrases were asked to complete this 70-item questionnaire across ten scales seven subscales (A-J). The SIDC is calculated by subtracting the sum of scales E, H, I, and J, from the sum of scales A, B, C, D and identifies children with "disproportionate pragmatic and social difficulties in relation to their structural language skills" (Norbury et al. 2004, p.345). SIDC scores of zero or below (as suggested by Norbury et al. 2004) indicate the presence of pragmatic and/orsocial interaction difficulties on the CCC-2. Table 1 shows the children's performance. The manual reports internal consistency (α): 0.73–0.88, and inter-rater reliability 0.61–0.83.

Results

Data Screening

Missing value analysis of each variable showed < 5% missing with analysis, and data were missing completely at random, Little's MCAR test $\chi 2$ (46) = 52.60, p = .234. Thus, data were deleted listwise by analysis as per recommendations under these conditions (Tabachnick and Fidell 1996). Data were screened for outliers and assumptions of repeated measures ANOVA. Violations of normality were shown for all VABS subdomain AE scores and CCC-2 SIDC scores (Shapiro-Wilk statistics < .048). However, as distributions showed no severe deviations from normality, these violations can be tolerated due to the robust nature of the analyses (Allen and Bennett 2007) and no corrective action was taken for ANOVA analysis. Spearman's Rho was reported for correlation analysis. Alpha was set to .05 throughout. Due to potential floor effects in AE scores on the VABS with the minimum AE being 22 months on the written subscale score compared to 1 month on the other two communication domain subscales, to screen for possible floor effects, analyses were repeated with those scoring at the floor on the written subtest removed, and also repeated with the V-scale scores instead of AEs. As no substantive differences (effect size or significance) were found with one exception, AEs are presented as planned *a priori.* For the exception of the correlation between written communication and autism characteristics, this is also presented below.

The Profile of Written and Spoken Subscales from the Communication Domain of the VABS-II

A significant difference was shown between parent-reported VABS-II Written, Receptive, and Expressive subdomain AE scores, $F(1.90, 231.31) = 166.56$, $p < .001$, $\eta p^2 = .58$). Pairwise comparisons indicated higher age-equivalent parent-reported written skills compared to both receptive ($M_{diff} = 22.43$; $p < .001$; $d = 1.29$) and expressive communication skills ($M_{diff} = 19.49$; $p < .001$; $d = 1.35$).

Correlations Between VABS-II Communication Skills and Autism Characteristics

When VABS-II AE scores were used in analysis, the association between children's written communication skills and their autism characteristics as measured by the SCQ was small and non-significant ($r = -.15$; $p = .091$). However, this association, while remaining small, was significant for the association between children's written communication V-scale score and their autism characteristics as measured by the SCQ ($r = -.22$; $p = .016$). Significant, moderate negative associations were shown between children's autism characteristics and their receptive ($r = -.45$; $p < .001$) and expressive ($r = -.33$; $p < .001$) VABS-II AE scores.

Correlations and Comparisons of Written Communication Skills and Pragmatic/Social Interaction Skills

Data for 65 of the children with parent-reported phrase speech who had complete data for the VABS-II written subdomain and CCC-2 were used to answer the final research question. Table 1 shows means, standard deviations, and ranges for CCC-2 SIDC scores. A one-way ANOVA ($F(1,6) = 2.05$, $p = .158$) did not identify any significant differences on the written communication AE scores between those who had a score which indicated the presence of disproportionate pragmatic andsocial interaction difficulties on the CCC-2 ($n = 35$) and those who did not ($n = 30$).

Discussion

The current study investigated the profile of scores and associations between 4- and 5-year-old children's communication skills, their autism characteristics, and their social-interaction deviance composite (SIDC) derived from the CCC-2. All measures were based on parent-report and drawn from a longitudinal cohort recruited to explore educational and social outcomes over a 6-year period (<removed for blind review>). Consistent with previous research (Westerveld et al. 2017), children's performance on the written communication subdomain of the VABS-II (which measures writing and reading skills, such as alphabet knowledge, name writing, and word reading) was significantly better than their spoken communication scores (both expressive and receptive). These findings support a profile of relative strength in written communication skills over spoken communication skills as measured by the VABS-II that may be characteristic of preschool-

age children on the autism spectrum. This may be an age-specific finding, as the VABS-II manual (Sparrow et al. 2005) suggests similar performance (V-scores) across the three communication subdomains from their sample of 128 nonverbal and verbal children on the autism spectrum spanning a wider age range (3-16 years).

The relative strengths of written communication skills within this sample are based upon within-subject comparisons, and due to the lack of IQ scores available, is not clear from our results if these results are in line with, or indeed driven by, the children's cognitive skills. Previous research by Perry et al. (2009) showed that children on the spectrum who score in the borderline (IQ 70-85) or average (IQ ≥ 85) range for cognition generally scored better on the communication subdomain than their peers with lower cognition, which the authors suggested could be due to their performance on the written subdomain inflating their overall communication score. However, the study by Perry et al. was a retrospective file review of children on the autism spectrum aged 6 years and under, using the VABS first edition (published in 1984), and no specific details regarding the children's performance on the communication subdomains were provided, which makes direct comparisons between these studies difficult.

The correlation between children's V-scale (but not age-equivalent) scores on the written communication subdomain and their autism characteristics as measured using the SCQ was significant, but small (r = -.22), and much weaker than the correlations found between autism characteristics and the spoken communication subdomains (-.35 to -.45). These results indicate that autism characteristics may differentially impact upon spoken and written communication skills, with higher autism characteristics more strongly correlated with lower spoken communication skills than with written communication skills. These results seem inconsistent with previous research showing no differences on code-related measures of alphabet knowledge between preschool children with a diagnosis of autism and their carefully matched (cognition, age, gender, language ability) peers without a diagnosis of autism (Westerveld, Paynter, Brignell et al. (2020). However, the latter study used direct child assessment rather than parent-report and previous research has shown a strong, but not perfect correlation between the written communication subdomain score on the VABS-II and direct assessment of alphabet knowledge (r =.76) in young children on the autism spectrum (Davidson and Ellis Weismer 2014). The most likely explanation of the relative strengths in alphabet knowledge frequently observed in children on the autism spectrum (Davidson and Ellis Weismer 2014; Dynia et al. 2014) may well be related to environmental factors (rather than autism-specific traits), including the home literacy environment and the child's interest in shared book reading, and mediated by children's spoken language ability (see also Simpson et al. 2020). Future research should more carefully consider both environmental and child factors to help

disentangle this complex relationship and how it is similar to or different from the relationship with spoken communication skills.

The final research question investigated the links between written communication and children's SIDC on the CCC-2. Contrary to expectations, we found no significant group differences on the VABS-II written communication scores between children with and without disproportionate pragmatic and social impairments based on the SIDC. Davidson and Ellis Weismer (2014) found that lower social abilities (measured on the VABS-II) predicted better alphabet knowledge in their sample of 89 children on the autism spectrum (mean age 5 years, 6 months) and suggested this could be explained by children's higher interest in letters (this was not measured), coupled with a detail-focused cognitive processing style associated with autism (Happé and Frith 2006). The current study provides further support for Davidson and Ellis Weismer's (2014) suggestion that further research is needed to better understand the relationship between social interaction abilities and alphabet knowledge in preschool children on the autism spectrum, as more recent studies have found no evidence of a specific focus on print (i.e., letters and written words) during shared book reading activities (Westerveld, Paynter, and Wicks 2020).

One limitation of the current study is that it used parent-report measures obtained via an online survey, which could potentially influence the results by recruiting families who had access to the internet, possessed the necessary literacy skills to complete the surveys independently, and were interested in participating in research. This may be reflected in the demographics of the participants, with all parents completing at least secondary education and speaking English in the home. Considering the significant links between socio-economic status (parental education) and children's literacy development, combined with the evidence of genetic influences on children's literacy achievement (see Buckingham, Beaman, and Wheldall, 2013, for a review), future research should consider recruiting families from different cultural, linguistic, and socioeconomic backgrounds to confirm our generalisability of our findings regarding the children's profile on the communication domain of the VABS-II that differs from the profile for typical development.

Conclusion

As a group, young children on the autism spectrum are at increased risk of persistent literacy difficulties, highlighting the importance of research into the early literacy trajectories of this vulnerable group of children. The results from the current study indicate that preschool-age children on the spectrum show a specific communication profile on the VABS-II, with relative strengths in written over spoken communication skills.

However, we advise against interpreting these strengths in written communication skills as an indicator of future literacy success and recommend a full assessment across meaning-related and print-related emergent literacy skills that are known to predict future reading skills in this population, including letter knowledge, receptive vocabulary, emergent name writing and phonological awareness (Dynia et al. 2017; Westerveld et al. 2018) Although further research is clearly needed to better understand what underpins these observed early strengths in print-related skills during the preschool years, a comprehensive emergent literacy assessment may provide a profile of strengths and weaknesses to help guide early targeted intervention to those who are at risk of literacy failure.

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Conflict of Interest: The authors declare they have no other conflicts of interest.

Table 1. Child performance on VABS-II and CCC-2 subdomains

	N	*M*	*SD*	Range
Age (in months)	125	59.93	6.17	48-71
SCQ	125	20.31	7.25	2-39
VABS-II Comm SS	123	76.29	16.0	38-110
VABS-II Receptive AE	124	29.83	17.29	1-78
VABS-II Receptive V score	124	10.12	3.18	2-17
VABS-II Expressive AE	123	32.96	10.68	4-43
VABS-II Expressive V score	123	10.10	2.63	4-14
VABS-II Written AE	123	52.45	17.48	22-83
VABS-II Written V score	123	13.43	3.44	8-21
SIDC	65	-3.78	10.45	-27-13

Note: SCQ: Social Communication Questionnaire; VABS-II Comm: Vineland Adaptive Behaviour Scales, 2nd Edition, Communication domain; SS: Standard score; AE: Age equivalent score; SIDC: Social Interaction Deviance composite score on the CCC-2

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