No Differences in Code-Related Emergent Literacy Skills in Well-Matched 4-Year-Old Children with and without ASD

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Abstract

This study used data from a prospective community-based sample and compared the code-related emergent literacy skills (phonological awareness and letter knowledge) of four-year-old children with ASD (n = 36) to their peers without ASD (n = 36), matched for age, gender, socio-economic status, language ability, and nonverbal cognition. We also compared groups on parent-reported home literacy measures, including the amount of time their child enjoyed being read to. There were no significant group differences in emergent literacy, indicating that an ASD diagnosis was not related to children's emergent literacy performance. We found no group differences in parent-reported home literacy experiences. This highlights the need for careful consideration of factors beyond ASD traits that may influence literacy outcomes in this population.

Keywords*:* Emergent Literacy; Home Literacy Environment; Autism Spectrum Disorder; Phonological Awareness; Alphabet Knowledge

Learning to read accurately and fluently with comprehension is crucial to academic achievement and future occupational attainment (Sparks, Patton, & Murdoch, 2014). Development of reading accuracy (i.e., word recognition) relies on a range of skills that children typically develop during the pre-school years, including alphabet knowledge, phonological awareness (the ability to manipulate sounds in spoken words), and vocabulary knowledge (National Early Literacy Panel, 2008). These precursor literacy skills are fostered in the home environment, with the quality and quantity of shared book interactions with adults linked to children's literacy development (Sénéchal, 2006).

Children with Autism Spectrum Disorder (ASD) are at increased risk of failure in acquiring and developing adequate reading skills (e.g., Henderson, Clarke, & Snowling, 2014; Westerveld, Trembath, Shellshear, & Paynter, 2016). Although the majority of children with ASD show difficulties in reading comprehension, studies suggest as many as 50% of children with ASD struggle with reading accuracy, with some children not learning to read at all (Nation, Clarke, Wright, & Williams, 2006; Westerveld, Paynter, O'Leary, & Trembath, 2018). To better understand the early reading trajectories of children with ASD, research has started to investigate these young children's development of important precursor reading skills, including the code-related skills of phonological awareness and alphabet knowledge (National Early Literacy Panel, 2008), just prior to and following school-entry (Davidson & Ellis Weismer, 2014; Dynia, Lawton, Logan, & Justice, 2014; Lanter, Watson, Erickson, & Freeman, 2012; Westerveld et al., 2017). Overall, these studies have revealed relative strengths in code-related emergent literacy skills in preschoolers with ASD compared to their oral-language skills. Moreover, compared to their peers without ASD, after controlling for oral language ability, children with ASD showed particular strengths in alphabet knowledge (knowing letter names and/or knowing what sounds letters make) (Dynia et al., 2014), which may be due to a particular interest in letters (Davidson & Ellis Weismer, 2014; Westerveld et al., 2017).

Several reasons have been put forward in an attempt to explain the emergent literacy profiles of preschoolers with ASD. First, autism-specific traits including restricted interests may be associated with early strengths in letter knowledge (Davidson & Ellis Weismer, 2014) and a reduced interest in participating in shared book reading (Westerveld & van Bysterveldt, 2017). Second, impairments in spoken language development often found in children with ASD may be associated with challenges in emergent literacy skills similar to those found in children with developmental language disorders (Cabell, Justice, Zucker, & McGinty, 2009). Third, comorbid cognitive impairments may hinder learning in general, including early literacy-related skills, in line with the diagnostic criteria

for an intellectual impairment (American Psychiatric Association, 2013). Thus, autism traits, associated language impairments, and/or comorbid intellectual impairments may explain emergent literacy differences in ASD.

Previous studies investigating emergent literacy skills in young children with ASD prior to school entry have focused on clinical populations recruited voluntarily and specifically for studies on reading/literacy (e.g., Davidson & Ellis-Weismer, 2014; Dynia et al., 2014; Westerveld et al., 2017), which may potentially introduce bias by recruiting families who have an interest in literacy or in research more broadly. The current study uses data from a prospective community-based sample to investigate two precursor reading skills (phonological awareness and letter knowledge) in four-year-old children diagnosed with ASD. The aim of the present study was to compare the performance of a group of four-year-old children with ASD to a group of peers without ASD closely matched for gender, age, socio-economic status, language ability, and cognitive ability on two key measures of emergent literacy, phonological awareness, and alphabet knowledge. We also investigated if there were differences in parent-reported home literacy practices between the two groups. Based on previous results we predicted group differences on alphabet knowledge with the children with ASD showing better performance. We expected differences in the home literacy environment with the parents of children with ASD reporting a lower interest in reading in their children.

Methods

Participants

Participants were drawn from the Early Language in Victoria Study (ELVS), a longitudinal, community-based cohort study that tracks language development from infancy (8 months) through to adolescence. Children with biomedical conditions, such as cerebral palsy, Down syndrome, or global developmental delays were excluded from the study (see Reilly et al., 2017). Of the larger cohort, 78 children were reported by their parents to have a diagnosis of ASD (asked from age four onwards). The diagnosis was then verified through a phone interview by an experienced psychologist or speech pathologist (see Brignell et al., 2018). All children were diagnosed with ASD in the community by a pediatrician or psychologist and 92% of the study sample were diagnosed by a multidisciplinary team. Using STATA and clearly defined matching criteria, we extracted data from a sample of children with ASD (n = 36) and a matched sample of peers without ASD (n = 36). Children were comprehensively matched on age, gender, socio economic status, nonverbal IQ, and language ability at age four (see Table 1). None of the children had started formal schooling. All families reported speaking English as the main language at home and to their child. 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.

Measures

Children in the ELVS cohort were individually assessed on a battery of language, cognitive, and literacy measures at age four in their homes. For the purposes of this study, data for the following measures were used.

Standardized language measure. Children's receptive, expressive and core language skills were assessed using the *Clinical Evaluation of Language Fundamentals – Preschool-Second Edition* (CELF-P2; (Wiig, Secord, & Semel, 2004). For the present study we report core language standard scores on the CELF-P2.

Non-verbal IQ. The *Kaufman Brief Intelligence Test - 2* (K-BIT-2; Kaufman & Kaufman, 2004) was administered and standard scores were used.

Phonological awareness. Phonological awareness was measured at intra-syllabic (rhyme awareness) and phonemic (initial phoneme awareness) level. This task was adapted from the *Sutherland Phonological Awareness Test* (Neilson, 1995). To measure rhyme awareness, children were presented with three pictures. After the examiner named each picture, the child was asked to identify which word/picture sounded like the first word/picture. To measure initial phoneme-level awareness, three pictures were presented and named by the researcher. The child was then asked to identify which picture started with the same sound as the first picture. For each measure, 10 test items were administered, and raw scores were calculated and used for analysis (max 10 for each measure).

Letter knowledge. To measure letter knowledge, the child was presented with individual letters on hand-held cards and asked to provide the name or sound of each letter of the alphabet. The 26 letters of the alphabet were presented in an order established by the ELVS team, starting with the first letter of the child's name. Remaining letters were presented in a non-alphabetic order (consistent across children). If the child failed to identify 13 letters consecutively, the test was discontinued. Raw scores were used for analysis (max 26).

Home literacy questions. Parents completed a home-literacy questionnaire and were asked to respond to the following questions: a) length of time child enjoys being read to? (not at all; < 5mins; 6-10 mins; 11-20 mins; 21-40 mins; 41-60 mins; > 60 mins); b) how often do you teach your child how to print letters and words? (per week) (never, seldom, sometimes, often, very often); c) how often do you help your child read letters and sounds? (per

week) (never, seldom, sometimes, often, very often); d) I look at or read children's books to my child (not very often, sometimes, often).

Results

Group Comparisons on Emergent Literacy Measures

There were no significant group differences on any of the emergent literacy measures at age 4, see Table 1. Missing value analysis showed <5% of each variable were missing, however data were missing completely at random, Little's MCAR test χ^2 (28) = 37.49, p = .108. More children with ASD (n = 8) did not complete the initial phoneme awareness task compared to their peers without ASD (n = 5). As it was unclear if this was due to non-compliance or inability to complete the task, missing values were replaced with 0; group comparisons remained non-significant (p > .05). For both groups combined, significant medium to large correlations were found between both Core Language and Nonverbal IQ and phonological awareness and letter knowledge (r's ranging from .34 to .59).

[Insert Table 1 about here]

Group Comparisons on Home Literacy Questions

Table 2 shows the responses to the home literacy questionnaire. There were no group differences in responses to the four home literacy questions, all p's < .05, Cramer's V = .06 - .34, however it is noted some expected cell sizes were < 5 so this should be interpreted with caution.

[Insert Table 2 about here]

Discussion

The current study investigated if there were group differences in performance on two code-related emergent literacy skills in children with and without ASD, who were closely matched for gender, age, socio-economic status, language ability, and cognitive ability. Participant data were drawn from a longitudinal community-based cohort sample aimed at tracking language development from infancy (Reilly et al., 2017). Using this methodology allowed us to avoid recruitment bias in which families volunteer to participate in a research study based on their interest in literacy. Contrary to our expectations, we found no differences between four-year-old children with ASD and their peers without ASD on phonological awareness and letter knowledge. These findings indicate that group differences found in previous studies (e.g., Dynia et al., 2014) may be attributed to language ability and/or nonverbal IQ, not ASD per se. These results are consistent with previous findings by Westerveld et al. (2017), who found that autism traits as measured on the *Social Communication Questionnaire* (Rutter, Bailey, & Lord, 2003) although moderately

correlated with letter knowledge (r = .255, p = 0.055), did not significantly predict children's code-related emergent literacy skills. The findings are also consistent with those of Davidson and Ellis Weismer (2014) who found that nonverbal IQ was a significant independent concurrent predictor of children's alphabet knowledge at age 5;5 as well as an independent longitudinal predictor of children's alphabet knowledge.

When comparing parent responses to the home literacy questions, no significant group differences were found. Based on previous research we expected children with ASD to be less interested in shared book reading (Lanter et al., 2012; Westerveld & van Bysterveldt, 2017) than their peers without ASD. However, in both groups of parents, > 66% of parents indicated the length of time their child enjoyed being read to was between 11 and 40 mins. Of note, recent research comparing the parent-reported home literacy environment of preschoolers with ASD to their typically developing peers (n = 41 and 164 respectively) showed that group differences in child interest in books and frequency of shared book reading disappeared when controlling for the children's level of phrase speech (Simpson et al., 2019). Taken together, our results show that in our community sample, four-year-old children with and without ASD were provided with similar home literacy opportunities and demonstrated similar code-related emergent literacy skills.

The results seem to contradict the common notion that preschool-age children with ASD show particular strength in alphabet knowledge which may potentially be linked to a profile of hyperlexia. Further research is clearly needed to understand why some children with ASD become hyperlexic and why some children with ASD may fail learning to read at all (Nation et al., 2006; Westerveld et al., 2018). A better understanding of environmental influences, including transition to school and expectations around literacy learning and achievement is needed to facilitate continued literacy learning beyond the pre-school period (O'Leary, Flückiger, Paynter, & Westerveld, 2019).

This study was not designed to track literacy progress over time, which means there were a limited number of emergent literacy measures available for analysis. It should also be noted that despite a range in performance on language and nonverbal IQ measures, the sample itself was restricted to children who were relatively capable and could complete standardized testing at age 4. For some of the measures, it was not clear if they were missing scores or if the children were unable to complete the task. However, we conducted analyses with exclusion or substitution as 0 which did not influence results substantively. The home literacy questions asked parents to describe the frequency of shared book reading behaviors using categories such as never, sometimes, and very often. We acknowledge that these

labels are open to interpretation and that future research should incorporate actual frequencies of occurrences such as daily, every other day, and once a week. This study only focused on code-related emergent literacy skills and does not address the significant reading comprehension difficulties many children with ASD demonstrate.

Conclusion

Consistent with previous research, language and non-verbal cognitive ability were linked to code-related emergent literacy skills of phonological awareness and letter knowledge in four-year-old children. However, in contrast to expectations, our results show that carefully matched groups of four-year-old children with and without a diagnosis of ASD show similar code-related emergent skills with similar home literacy environments. This may be explained by three key possibilities. First, differences between children with and without ASD may occur due to comorbidities such as language or cognitive impairments explaining why we found no differences when groups were well matched on language and cognitive ability. Furthermore, the exclusion of children who were unable to complete standardized measures at this age may have inadvertently excluded those who likewise showed more significant literacy impairments. Third, both groups reported rich home literacy environments of a similar level that may have supported development of these skills. Future research is needed to explore further these possibilities including ensuring careful selection and consideration of possible confounds in group designs, exploring the impact of the home literacy environment, and tracking literacy development longitudinally to explore where developmental pathways may diverge to identify sensitive periods for identification, support, and intervention.

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Table 1

Participant Demographic Characteristics and Performance

	ASD	*N*	TD	*N*	ASD vs. TD	*d*
Gender (% Male)	75.0	36	75.0	36	*NS*	
Age in years, *M* (*SD)* *(*range)	4.13 (.08) (4.01 – 4.41)	36	4.13 (.07) (4.01 – 4.31)	36	$t(70) = -.18$, $p = .855$	<.01
SEIFA score, *M (SD)* (range)	1034.8 (57.6) (856 – 1104)	36	1043.7 (47.3) (856 – 1104)	36	$t(70) = .72$, $p = .476$	.17
CELF CLS, M (SD)	91.89 (13.61) (71 – 120)	36	94.28 (13.10) (73 – 116)	36	$t(70) = .76$, $p = .45$	.18
K-BIT-2, M (SD)	96.89 (17.30) (55 - 121)	35	96.89 (17.48) (63 – 130)	35	$t(68) = -.007$, $p = .995$	<.01
Rhyme awareness	5.35 (3.64) (0 – 10)	31	6.42 (3.11) (0 – 10)	33	$t(62) = 1.266$, $p = .210$	.32
Initial phoneme awareness	4.61 (3.12) (0 – 10)	28	4.48 (2.89) (0 – 10)	31	$t(57) = -.156$, $p = .876$	.04
Letter knowledge	8.85 (9.77) (0 – 26)	33	6.68 (8.96) (0 – 26)	34	$t(65) = -.949$, $p = .346$	.23

SEIFA: Socio-Economic Indexes for Areas; CELF CLS: Clinical Evaluation of Language Fundamentals, Core Language Score, Standard Scores; K-Bit: Kaufman Brief Intelligence Test, Standard Scores

Table 2

Participant Responses on the Home Literacy Questionnaire

	ASD (n = 34)	TD (n = 31)
Length of time child enjoys being read to[#]		
< 5 mins	4 (11.8%)	2 (6.5%)
6 – 10 mins	3 (8.8%)	4 (12.9%)
11 – 20 mins	18 (52.9%)	10 (32.3%)
21 – 40 mins	5 (14.7%)	11 (35.5%)
41 – 60 mins	2 (5.9%)	1 (3.2%)
> 60 mins	1 (2.9%)	3 (9.7%)
Frequency of teaching child how to print letters and words per week		
never	10 (29.4%)	8 (25.8%)
seldom	12 (35.3%)	12 (38.7%)
sometimes	7 (20.6%)	7 (22.6%)
often	5 (14.7%)	4 (12.9%)
very often	0	0
Frequency of helping child read letters and sounds per week		
Never	7 (20.6%)	7 (22.6%)
seldom	4 (11.8%)	6 (19.4%)
sometimes	8 (23.5%)	8 (25.8%)
often	10 (29.4%)	6 (19.4%)
very often	5 (14.7%)	4 (12.9%)
Frequency of looking at or reading children's books to child		
not very often	1 (2.9%)	2 (6.5%)
sometimes	5 (14.7%)	8 (25.8%)
often	28 (82.4%)	21 (67.7%)

[#]N = 33