The emergent literacy skills of preschoolers on the autism spectrum

Final Report

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REPORT

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The Cooperative Research Centre for Living with Autism (Autism CRC)

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1. Literature review

1.1 INTRODUCTION

In recent years, therapists, parents, and educators have been buoyed by findings that evidence-based early intervention can alter the developmental course and trajectories of children with autism. These results point to observed gains in adaptive behaviour and cognition (e.g., Dawson et al., 2010; Vivanti, Dissanayake, Zierhut, & Rogers, 2012), as well as preliminary evidence for changes in brain activity (e.g., Dawson et al., 2012). Yet there has been a distinct lack of attention to the educational supports and outcomes of children on the autism spectrum once they reach school, including factors that predict and maintain learning advantage and disadvantage and strategies to support students, parents, and teachers (Autism Spectrum Australia, 2013). Most striking is the lack of research examining early literacy development in children with autism, known as *emergent literacy*, given that learning to read and write for meaning is widely accepted as the cornerstone of academic success for all children, including those with autism (Catts, Fey, Zhang, & Tomblin, 2001). Indeed, our recent systematic review (Westerveld, Trembath, Shellshear, & Paynter, 2015) revealed only three studies in which emergent literacy skills were identified as outcome measures, and none of which examined the relative contributions of all of these "skills, knowledge and attitudes that are developmental precursors to reading and writing" (Whitehurst & Lonigan, 1998). Therefore, our overall objective in this study was to measure and identify factors that predict emergent literacy skills in children with autism before they transition to school, in order to provide direction for early intervention to help optimise academic success.

1.2 EMERGENT LITERACY

Emergent literacy skills serve as the precursors to accurate and fluent reading with comprehension (Whitehurst & Lonigan, 1998). They include the code-related skills needed for accurate and fluent decoding (such as phonological awareness, early name writing, letter name and sound knowledge, and print concept knowledge), as well as the meaning-related skills required for adequate comprehension (such as vocabulary and oral narrative ability) (Pullen & Justice, 2003). Emergent literacy learning starts from birth (Justice, 2006) and is generally promoted in the child's home environment through literacy-based interactions with parents and other family members (Watson, Brown, Raban, & Byrnes, 2012). Engaging children in books, alerting them to print in the environment, and providing them with writing materials will assist children in acquiring important emergent literacy skills prior to school-entry (Justice, 2006). To illustrate, the frequency of shared book reading in the home has been linked to improved vocabulary in a study of 4-year-old children with typical development (Sénéchal, Pagan, Lever, & Ouellette, 2008), although this relationship is less clear in children with language difficulties (Petrill, Logan, Sawyer, & Justice, 2014). Furthermore, parents' attention to print, such as letters and words, during shared book reading may improve children's print-related knowledge (Justice & Pullen, 2003). The importance of emergent literacy development should not be underestimated as it is well known that children who start school with better developed emergent literacy skills are more likely to become successful readers (Tunmer, Chapman, & Prochnow, 2006). Once children start school and receive formal reading instruction, children typically make rapid gains in measures of early literacy development such as letter name knowledge and phonological awareness (Cunningham & Carroll, 2011). When evaluating children's emergent literacy performance it is therefore important to assess these children prior to school-entry and to consider how the development of these skills may be nurtured in the home and preschool environment.

1.3 THE SIMPLE VIEW OF READING

To better understand the underlying constructs of emergent literacy skill development and the links between emergent literacy development and later reading performance, we may use the Simple View of Reading as a conceptual framework (Gough & Tunmer, 1986). According to the Simple View, reading comprehension is the product of two relatively independent components, namely word recognition and oral language comprehension. In other words, for adequate comprehension of written text to occur, the reader needs to be able to decode (or recognize) the written words on a page and also be able to attach meaning to those words, sentences, or paragraphs. It is important to note that the relative contributions of these components change over time. In the early stages of reading when children are learning to 'crack the code', reading comprehension generally involves simple words and phrases and is heavily reliant on word recognition skills and less reliant on oral language comprehension. Once children become fluent decoders, generally around year 3 or 4 of schooling, reading comprehension is heavily reliant on oral language comprehension (Catts, Hogan, & Adlof, 2005) and the relative influence of word recognition declines. When investigating emergent literacy skill development, we therefore want to distinguish between the code-related skills needed for later accurate and fluent word recognition, as well as the meaning-related skills needed for successful oral language comprehension. Code-related skills include letter name and sound knowledge, early developing phonological awareness (e.g., *the first sound in man is 'm'*), and print concept knowledge (i.e., reading from left to right and realizing that words have meaning), whereas meaning-related skills include vocabulary and oral narrative ability (National Institute of Child Health and Human Development, 2005). Indeed, the strongest predictors of future reading development in children are alphabet knowledge, print-concept knowledge, phonological awareness, and oral language (Adlof, Catts, & Lee, 2010; National Early Literacy Panel, 2008).

1.4 READING SKILLS OF CHILDREN ON THE AUTISM SPECTRUM

It is estimated that between 30 – 60% of school-age children on the autism spectrum struggle with reading (Jones et al., 2009; Nation, Clarke, Wright, & Williams, 2006; Ricketts, 2011). Based on the Simple View of reading (Gough & Tunmer, 1986), poor readers generally belong to one of three categories: a) dyslexia: those who show weaknesses in word recognition, but adequate oral language comprehension; b) specific poor comprehenders: those who show adequate word recognition, but weaknesses in oral language comprehension; and c) mixed reading disability: children who show weaknesses in both word recognition and oral language comprehension. Considering that many children on the autism spectrum show comorbid language difficulties (Kim, Paul, Tager-Flusberg, & Lord, 2014), it is perhaps not surprising that many children on the autism spectrum show difficulties in reading comprehension (Jones et al., 2009). However, research has highlighted the wide variability in reading achievement in children on the autism spectrum, with some children unable to read at all despite adequate oral language skills (Nation et al., 2006), and other children demonstrating prolific word decoding skills, known as hyperlexia (Newman et al., 2007). Some researchers also query whether children on the autism spectrum follow the same developmental trajectory in emergent literacy as their peers with typical development (e.g., Nation et al., 2006).These results highlight the need for research investigating how children on the autism spectrum develop their emergent literacy across code-related and meaning-related skills.

1.5 EMERGENT LITERACY SKILLS OF CHILDREN ON THE AUTISM SPECTRUM

Our recent systematic review of the literature (Westerveld et al., 2015) only yielded three studies that investigated emergent literacy development in young children on the autism

spectrum (Davidson & Ellis Weismer, 2014; Dynia, Lawton, Logan, & Justice, 2014; Lanter, Watson, Erickson, & Freeman, 2012). Results from these studies confirmed the significant links between cognitive and oral language skills and children's performance on both code-related and meaning-related emergent literacy tasks. Furthermore, findings indicated relative strengths in aspects of code-related skills, particularly letter name knowledge, and weaknesses in meaning-related skills as measured by a definitional vocabulary task. In addition, children on the autism spectrum seemed to show difficulties with print concept knowledge (i.e., reading from left to right, pointing to separate words on a page), that could not be explained by their weaknesses in oral language. However, as discussed by Westerveld et al. (2015), there were several limitations identified in the three reviewed studies. These included the lack of a confirmed diagnosis of autism in two of the three studies (Dynia et al., 2014; Lanter et al., 2012), as well as the need for better description of children's oral language and cognitive skills to help tease apart the relative contributions of these skills to children's emergent literacy performance. Furthermore, inclusion of more detailed emergent literacy measures is needed to precisely describe the code-related and meaning-related emergent literacy skills of children with autism. The current study aimed to address these shortcomings by recruiting a sample of young children with autism prior to school entry and administering a comprehensive battery of emergent literacy assessments as well as collect data on factors related to the children's cognitive and language skills.

1.6 RESEARCH QUESTIONS

1. What code-related and meaning-related emergent literacy skills do preschool children with autism demonstrate?

2. How do home literacy environment, autism symptomology, age, and general communication skills correlate with children's emergent literacy performance?

3. What are the concurrent predictors of code-related and meaning-related reading ability?

2. Research Design

2.1 METHODS

This research involved a cross-sectional cohort study. Considering the heterogeneity of the disorder, previous researchers have emphasised the need to investigate behaviours within a group of children with autism, rather than using a control-group design (Ricketts, Jones, Happé, & Charman, 2013; Tager-Flusberg, 2004). This design will provide an improved understanding of the variation of emergent literacy skills in this population.

Ethics permission was granted by the Griffith University Human Ethics Committee (AHS/13/14/HREC) and by the Human Research Ethics Committee – The Sydney Children's Hospital Network (HREC/14/SCHN/270). Furthermore, organisational approvals were provided by AEIOU and ASPECT.

2.2 RECRUITMENT

A total of 60 children (51 boys, 9 girls) and their families participated in the study. Families resided in the greater Brisbane area (52) and metropolitan Sydney (8). Participants were recruited through AEIOU early childhood services for children with autism (*n* = 38), private speech pathology clinics (*n* = 8), and Westmead Children's hospital (*n* = 8). In addition, participants who were enrolled in the Longitudinal Study of Students with Autism (LASA: CRC 2.007) and met criteria for inclusion (see below), were approached via email and invited to participate (*n* = 2). Flyers were posted on parent support websites and distributed via established networks (*n* = 4).

2.3 INCLUSION CRITERIA

Inclusion criteria were as follows (a) children had received a written clinical diagnosis of autism spectrum disorder in the community, sighted by the research team, (b) children were at least 4 years of age and had not yet started formal schooling, (c) children spoke in short sentences, and (d) children were able to participate in preschool type activities such as pointing at pictures and following simple commands.

2.3.1 Autism Diagnosis

To confirm a diagnosis of autism, parents were asked to provide copies of written documentation of their children's autism diagnoses. Where available (*n* = 25), results were obtained regarding children's performance on the Autism Diagnostic Observation Schedule (ADOS) (Lord et al., 2012). For the 35 children who did not have an ADOS completed, parents were asked to complete the Social Communication Questionnaire (Rutter, Bailey, & Lord, 2003). As recommended by Lee, David, Rusyniak, Landa, and Newschaffer (2007), children who scored 11 or above were included. Four children obtained a score below 11; administration of the ADOS was offered to two of these children. One child did not meet the criteria for autism on the ADOS and was excluded from the current study. The remaining two children who scored below 11 on the SCQ (7 and 9 respectively) were also excluded. As a result, a total of 57 children, aged between 4 years, 0 months, and 5 years, 10 months (mean age 57.6 months; SD = 6.1 months) met the criteria for inclusion in the study (48 boys and 9 girls).

2.3.2 Spoken Language Performance

Children's performance on the communication domain of the *Vineland Adaptive Behavior Scales, Second Edition – Interview Survey* (Vineland-II; Sparrow, Cicchetti, & Balla, 2005)

was used to confirm that the children had sufficient oral language skills to participate in the activities. For some children, these results were available through their early intervention provider (AEIOU) or via the completed on-line surveys for the LASA study. For the remaining children, we administered this survey over the phone, prior to the first assessment session. It should be noted that all participants were reported to use phrases or simple sentences in the *Talking* section (see below) of the VABS-II. Therefore, none of the participants were excluded based on their performance on the VABS-II.

The VABS-II Communication Domain contains three subdomains: Listening and Understanding (receptive language), Talking (expressive language), and Reading and Writing (written language). For the current study, the Communication domain's three subtest age-equivalent scores were calculated for analysis based on recommendations made for this age group of children with autism (Yang, Paynter, & Gilmore, 2016) and to distinguish between children's spoken (receptive and expressive) and written communication skills.

2.3.3 Participants

Table I provides an overview of the participant characteristics, including age, autism symptom severity, and language skills. Mothers' level of education was used as an indicator of socioeconomic status (SES). Parent report indicated that 29% of mothers had completed year 12 (highest level of school education in Australia) and the remaining 71% of mothers had gone beyond year 12 to complete tertiary studies. All primary caregivers spoke English as their first language.

TABLE I. PARTICIPANT CHARACTERISTICS

n = 57	**Mean**	**SD**	**Range**
Age (months)	57.6	6.1	48 - 70
SCQ	16.03	5.69	5 - 32
DQ	79.1	19.5	44 - 119
VABS-II*:			
Expressive	36.91	8.79	16 - 59
Receptive	34.89	13.73	12 - 90

Note: DQ = Developmental Quotient; * n = 56. VABS-II scores presented as age-equivalent scores (presented in months).

2.4 PROCEDURE AND ASSESSMENT TASKS

Children were seen on two separate occasions by one of four research assistants, who were qualified practicing speech-language pathologists. Sessions lasted approximately 90 minutes and took place at the AEIOU centres, in the Griffith University Health Clinic, or in the children's homes depending on parent preference. The sessions comprised a set number of tasks assessing cognitive ability as well as emergent literacy abilities. However, the order of the tasks varied depending on the children's behavior and ability to attend to the tasks. Verbal instructions of the tasks that were not validated for use with children with autism were adapted and simplified; the most salient information was highlighted in the manual and care was taken that these adaptations were the same for all participants. All sessions were voice-recorded and referred to when needed for scoring. Finally, parents completed a family history questionnaire, a home literacy survey, and the SCQ Lifetime version (see below).

2.4.1 Cognitive ability

To determine the participants' level of nonverbal ability, two subscales from the *Mullen Scales of Early Learning* (MSEL; Mullen, 1995) were administered: Visual Reception and Fine Motor. Consistent with previous studies with children with autism, a developmental quotient (DQ = Ratio IQ) was calculated (Davidson & Ellis Weismer, 2014; Yang et al., 2016).

2.4.2 Autism Symptoms – Parent Report

To assess the severity of autism symptoms, the SCQ was used (Rutter et al., 2003). The SCQ is a 40-item parent questionnaire. There are two versions of the SCQ, the Current and the Lifetime. The Current version asks parents to focus on the most recent three months, whereas the second half of the Lifetime version refers to the time period between the child's fourth and fifth birthdays. Because of the age-range of the participants, some parents completed the Current version and some completed the Lifetime version. The Lifetime version differs from the Current version in that the Lifetime version is primarily used to confirm diagnosis of autism and the Current version is useful for measuring change over time. The SCQ has been used successfully in previous research investigating the links between level of autism symptoms and family outcomes (such as parental stress and relationship outcomes) (Paynter, Riley, Beamish, Davies, & Milford, 2013). The SCQ yields a total score (ranging from 0 – 40), and has good psychometric properties (Berument, Rutter, Lord, Pickles, & Bailey, 1999).

2.4.3 Emergent Literacy Skills – Code Related Measures

As there are no well-validated norm-referenced tests for measuring emergent literacy skills in young children with autism, the Phonological Awareness Literacy Screening for Preschoolers (PALS-PreK; Invernizzi, Sullivan, Meier, & Swank, 2004) was used to assess the children's code-related emergent literacy skills. The PALS-PreK was specifically designed to assess four-year-old children's emerging knowledge in the most important areas of emergent literacy, including name writing, alphabet knowledge, beginning sound awareness, rhyme awareness, and print and word awareness (p. 5). The tasks are relatively short and contain teaching and practice opportunities which seemed appropriate for children with autism. The PALS-PreK does not provide standard scores; instead the manual reports developmental ranges for expectations for children attending preschool programs. These developmental ranges were developed by examining the PALS-PreK scores (collected during the final semester of preschool education) of children who became successful readers in grade one.

Alphabet Knowledge

The alphabet knowledge component contains three subtests: letter name knowledge-upper case, letter name knowledge-lower case, and letter sound knowledge. These subtests require the children to name or sound out the 26 letters of the alphabet which are presented on a white sheet of paper in a random order. The maximum score for each subtest is 26.

Beginning Sound Awareness

This task requires the child to repeat a word that is depicted as a line drawing on a card (e.g., '*this is a mmman*'). The examiner emphasises the initial sound of the word, and asks the child to produce the first sound in the word ('*what sound does mmman start with*?). There are three different sounds; the subtest contains four practice items and eight test items.

Print and Word Awareness

This task uses a small book with black and white pictures and short printed phrases (*Hey Diddle Diddle)* and tests the child's knowledge of print concepts, such as identifying letters and words on a page, reading from left to right, and identifying the title of the book. There are 10 items for a maximum of 10 points.

Rhyme Awareness

In this task, children are provided with a picture of a word (e.g., 'mop') and are asked to point to the picture of the *'word that rhymes with mop, top, bike, or can*?' There are 10 test items for a maximum score of 10.

Name Writing

For this task, the child is asked to draw a picture of themself and to write his or her name. Name writing is scored on a scale from 0 (i.e., name is a scribble and the picture represents both child's picture and written name) (Invernizzi et al., 2004, p. 14) to 7 (i.e., the name is correct with no backwards letters or mirror image writing, and the name is separate from the picture). Although children were asked to draw a picture of themselves, the quality of the picture itself was not scored.

Rapid Automatic Naming

The Rapid Automatic Naming (RAN) subtest of the Woodcock Reading Mastery Tests – Third Edition (Woodcock, 2011) was used. The test measures the speed and accuracy with which the child is able to name sets of objects and colours. RAN tasks are predictive of future word decoding ability and naming speed may reflect general processing speed and access and retrieval of phonological information from long-term memory (Woodcock, 2011, p.47).

Digit Span

Children's digit span was assessed using the Recall of Digits Forward subtest of the NEPSY-II, a developmental neuropsychological assessment (Korkman, Kirk, & Kemp, 2007). This test has been normed on children ages 2;6 to 17;11 and requires the child to repeat a sequence of digits presented orally. This is a measure of immediate attention span or the amount of information a child can hold in mind at one time. Immediate attention span is correlated with phonological awareness.

2.4.4. Emergent Literacy Skills – Meaning related measures

Vocabulary Skills

Receptive vocabulary skills were evaluated using the *Peabody Picture Vocabulary Test – Fourth Edition* (PPVT-4; Dunn & Dunn, 2007). In this test, the child is asked to point to a picture (from four choices on a page) that matches the word spoken by the examiner. The PPVT-4 has been normed for children and adults from 2;6 years and provides a standard score. The PPVT-4 was standardised on a large sample that included children from a range of abilities levels and has been used extensively in previous research examining language skills of children with autism (e.g., Condouris, Meyer, & Tager-Flusberg., 2003).

Story Retelling and Comprehension

To assess children's ability to understand and retell a story, we used the Profile of Oral Narrative Ability (Westerveld & Gillon, 2010; Westerveld, Gillon, & Boyd, 2012). In this task, children are asked to listen twice to a recording of an unfamiliar story, while looking at the pictures of the story book on the computer screen. The story was an English translation of Ko au Na Galo (Ana Gets Lost; Swan, 1992), which is about a Pasifika girl named Ana who gets lost in the city while looking for her parents. Following the first exposure to the story, children are asked eight questions to test their oral narrative comprehension (ONC). Children are provided with the correct answer if they do not respond or if their answer is clearly incorrect. After the second exposure to the story, children are asked to retell the story without the use of the pictures. The stories were transcribed and scored for oral narrative quality (ONQ), using a rubric. The rubric covers six text structure elements: introduction, main character/s, supporting character/s, conflict, resolution and conclusion as well as a measure of holistic coherence and a measure of 'theme'. Children were awarded 5 points for proficient inclusion of a characteristic, 3 points for emerging proficiency, and 1 point for minimal or no evidence of inclusion. Total scores on the ONQ therefore ranged between 8 and 40. For a full description

of the task, including the prompts, the model story and the comprehension questions, see Westerveld and Gillon (2010).

2.4.5 Home Literacy Questionnaire

All parents completed a home literacy questionnaire developed by Boudreau (2005). As reported by Boudreau (2005), the questionnaire involves questions related to five constructs of early literacy knowledge: a) interactions around books; b) response to print in the environment; c) alphabet knowledge; d) phonological awareness; and e) writing, as well as f) children's orientation towards literacy (p. 36). For the current study, we investigated parents' answer to the questions, *On a scale from 1 (never) to 5 (very often), 1) how often do you read to your child?* and *2) how often do you attempt to teach your child the names or sounds of letters in the alphabet when reading to your child?*

2.4.6 Home Book Reading Video

All parents were asked to video themselves reading two books to their child. The books were *Pip and Posy, the Big Balloon* (Scheffler, 2012) and *Pop up. Peekaboo. Woof! Woof!* (Sirret, 2013). The first book contains 25 pages with illustrations and simple text and has a narrative structure. The second book contains 10 pages with lift-the-flaps and pop-up animals. Parents were provided with the simple instruction of reading to their child as they normally would and asked to complete a short form indicating the time of day they read the books to their child, whether it was a typical reading session, and whether the child had seen the book/s before.

The shared book reading video recordings were scored using time-interval coding (e.g., Pentimonti et al., 2012) and a clinical rating scale (Westerveld, Holt, & van Bysterveldt, 2015), that was developed and piloted for the present study based on an extensive review of the literature. The scale contains the following elements: a) Exposure to book language; b) child interest; c) adult responsiveness; d) explicit teaching of code-related skills; e) explicit teaching of meaning-related skills; and e) indirect language stimulation.

3. Findings

3.1 THE EMERGENT LITERACY SKILLS OF PRESCHOOLERS WITH AUTISM

Our first research question asked what code-related and meaning-related emergent literacy skills preschool children with autism demonstrate. Because the children in our study ranged in age from 48 to 59 months, correlational analyses were performed between age in months and performance on the PPVT, the VABS, the SCQ, DQ, and performance on all of the emergent literacy tasks. No significant correlations ($p < .05$) were found, and as a result further analyses were conducted with the group as a whole. Table II shows the group performance on the emergent literacy tasks, as well as the percentage of children who scored within or above the expected range (based on norms reported in the manual or in previous research).

TABLE II. Group performance on the emergent literacy tasks

N = 57	M	SD	Range	Devt range#	% Scoring ≥ expected range
Code-related					
LNK UC	16.11	10.50	0 - 26	12 - 21	63.2%
LNK LC	14.53	10.49	0 – 26	9 - 17	64.9%
LSK	8.93	9.10	0 - 25	4 - 8	52.6%
Name writing	3.75	2.41	0 - 7	5 - 7	42.1%
PA	6.78	3.99	0 - 10	5 - 8	75.4%
Rhyme	3.86	2.46	0 - 10	5 - 7	33.3%
PWA	5.11	3.18	0 - 10	7 - 9	40.4%
RAN - SS	88.51	23.51	55 - 144	≥ SS 85	57.9%
Digit Span - SS	89.53	25.44	28 – 139	≥ SS 85	52.6%
Meaning-related					
PPVT- SS	90.00	16.32	64 - 127	≥ SS 85	54.40%
ONC	1.40	1.76	0 - 6	≥ 4*	15.80%
ONQ*	6.75	7.69	0 - 34	≥ 16*	14.00%

LNK = Letter Name Knowledge; UC = Upper Case; LC = Lower Case; LSK = Letter Sound Knowledge; PA = Phonological Awareness; PWA = Print and Word Awareness; RAN = Rapid Automatic Naming; SS = Standard Score; PPVT = Peabody Picture Vocabulary Test – 4th Edition; ONC = Oral Narrative Comprehension (max score is 8; ONQ = Oral Narrative Quality (max score is 40). * see Westerveld, Gillon, van Bysterveldt, & Boyd, 2015.

3.1.1 Group Performance

When considering mean group performance, strengths were found on code-related measures of Letter Name Knowledge, Letter Sound Knowledge, and Phonological Awareness, with group means within the expected developmental range. Performance on tasks measuring name writing, rhyme, and print and word awareness was lower, with the group means below expectations. On meaning-related skills, group means on the PPVT were within normal range (SS 90), but performance on the oral narrative task was significantly below expectations compared to published data for 4-year-old children (Westerveld et al., 2015).

3.1.2 Individual Variation

As shown in Table II, there was a wide range in performance on all tasks, with scores ranging from zero to maximum on most tasks.

3.2 FACTORS ASSOCIATED WITH PERFORMANCE

Question two asked whether there were correlations between factors such as home literacy environment, autism symptomology, age, and general communication skills and children's emergent literacy performance. Our first step was to investigate SES, as measured by the mothers' level of education. As no significant ($p > .05$) correlations were found between SES and any of the measures, SES was not taken into account in the following analyses.

3.2.1 Correlations between predictors and emergent literacy skills

Next, we investigated correlations between Home Literacy environment, SCQ (autism severity), DQ (cognition), VABS (oral language), and the children's performance on the emergent literacy measures. Appendix 2 shows the correlations between these potential predictors and children's performance on the code-related and meaning-related emergent literacy measures.

3.2.1.1 Home Literacy Environment

Overall, parents created a relatively rich home literacy environment. Over 70% of parents indicated they read to their children often or very often and only 2% said they seldom read to their child. Furthermore 48% reported they often or very often attempted to teach their child the names or sounds of letters.

As shown in Appendix B, correlations between the home literacy environment (frequency of book reading and teaching children to write letters) and other variables ranged between .012 (oral narrative comprehension) and .230 (Letter name knowledge). None of these correlations were statistically significant ($p > .05$). Because of the low correlations, home literacy was not taken into consideration in subsequent analyses.

3.2.1.2 Autism Severity

There were no significant correlations ($p > .05$) between the total score on the SCQ and any of the emergent literacy tasks (see Appendix B).

3.2.1.3 Cognitive Ability (DQ)

As expected, significant correlations were found between DQ and oral language performance on the VABS. Furthermore significant correlations were found between DQ and all print-related emergent literacy measures (except Letter Name Knowledge). We also found significant correlations between DQ and the meaning-related measures. Appendix B shows the results.

3.2.1.4 Spoken Language Ability (VABS)

As shown in Appendix B, Spoken Language Ability showed significant correlations with the print-related measures of name writing, Rhyme and Digit Span. Significant correlations were also found between VABS Spoken language scores and the meaning-related measures of PPVT and Oral Narrative Comprehension.

3.2.2. Regression Analyses

To further investigate the predictors of emergent literacy performance, we calculated two aggregate measures of the code-related and meaning-related constructs. For code-related ability all variables that were known to measure the same construct (code-related ability) and were significantly correlated (p <.001) were selected: Letter Name Knowledge, Letter Sound Knowledge, Phonological Awareness, Print and Word Awareness, and Rapid Automatic Naming. For meaning-related ability, we selected: PPVT, Oral Narrative Comprehension, and Oral Narrative Quality which were likewise all significantly correlated ($p < .001$). All scores were converted to z-scores and these were averaged to create the two composite scores.

3.2.2.1 Predictors of code-related ability

Predictors of the code-related ability score were analysed through multiple regression with SCQ, DQ, VABS Spoken Communication, and PPVT entered as predictors. Combined, these explained 33.3% of the variance in code-related performance and together significantly predicted code-related ability scores

3.2.2.2 Predictors of meaning-related ability

Predictors of meaning-related ability score were analysed through a multiple regression with SCQ, DQ, and VABS Spoken Communication as predictors. These explained a significant proportion of the variance in meaning-related performance, explaining 42.5% of the variance in meaning-related ability.

3.2.3 Subgroups based on DQ, and PPVT scores

To further investigate the links between cognitive ability, verbal ability (receptive vocabulary; PPVT) and emergent literacy performance, we investigated subgroups based on DQ and PPVT.

It was found that children with a DQ ≥ 70 (n = 36) performed significantly better on measures of name writing, letter sound knowledge, print concepts and rhyme. They also outperformed the children with DQ < 70 on all meaning-related measures.

When subgrouping children based on PPVT performance, it was found that children who showed within average performance on the PPVT (SS ≥ 78) outperformed their peers with lower verbal ability on all measures, except on Name Writing.

3.3 SUMMARY OF FINDINGS

Overall, our assessment battery of emergent literacy tasks was successful in eliciting responses from a group of 4- and 5-year-old preschool children with autism. It should be noted, that consistent with our eligibility criteria, only children who spoke in short phrases and were able to participate in preschool-type activities took part in the study.

Results from this study showed that the preschool participants with autism showed relative strengths in code-related skills, such as alphabet knowledge (letter names and sounds) and early phonological awareness, but relative weaknesses in meaning-related emergent literacy skills, particularly oral narrative ability.

There were no significant correlations between socio-economic status, home literacy environment or autism severity and emergent literacy performance, except for letter name

knowledge. Notably, children who presented with more severe autism symptoms (as measured by the SCQ) performed better on the letter name knowledge task. However, it should be noted that most parents created a relatively rich home literacy environment.

As expected, significant correlations were found between children's nonverbal cognitive ability and oral language performance and emergent literacy performance. In other words, children with better cognitive and verbal skills performed better on tasks tapping emergent literacy skills.

The only significant individual predictor of code-related emergent literacy (when performance on all code-related tasks was combined) was children's performance on the PPVT (measuring receptive vocabulary). Significant individual predictors of meaning-related literacy included nonverbal cognitive ability, oral language performance, and autism severity.

4. Limitations

This study investigated the emergent literacy skills of 57 young children with autism, prior to school-entry. However, the generalisability of the findings may be limited by several factors. First, there may be recruitment bias. It seems likely that the families who chose to participate in this study were interested in literacy and may therefore create relatively rich home literacy environments. This may be reflected in parents' answers to the home literacy survey questions: 78% said they read to their children often or very often; almost 50% of parents indicated they often or very often attempted to teach their child names or sounds of letters. This may also be linked to the education levels of the mothers, 79% of whom had a tertiary education.

The absence of a link between autism severity (as measured by the SCQ) and children's code-related emergent literacy performance was somewhat surprising. Although all participants had a confirmed diagnosis of autism, we did not have ADOS results for all children. In the present study we used the lifetime version of the SCQ as we used this measure to both confirm diagnosis and as a measure of symptom severity, whereas previous research (e.g., Yang et al., 2016) used the current form. It may that as many of these children were engaged in early intervention that their current symptoms may differ and may be more likely to affect current skills. Further, it may be that only some aspects of autism symptomatology (e.g., social communication impairments) affect emergent literacy, whereas others (e.g., repetitive behaviours) may be less influential; the SCQ collapses each of these together however. Future research could investigate these separately.

5. Future Research

The aim of this study was to describe the emergent literacy skills of young children with autism prior to school-entry. Our results suggest that, from a very young age, children with autism show specific strengths in the code-related skills of letter name knowledge and early developing phonological awareness. In contrast, our preschool participants showed particular difficulties completing the meaning-related tasks of oral narrative comprehension and production ability. Results from our linear regression analyses indicated that the variability in these meaning-related skills may partly be explained by cognitive ability, oral language skills, and autism severity.

Based on these findings, we recommend future research to investigate the effectiveness of intervention strategies that are specifically aimed at improving these young children's meaning-related oral language skills. In the present study we found rich literacy environments were reported at home with parents regularly engaging in shared book-reading with their children. Taken together, we are currently conducting a study to investigate the effectiveness of a shared book reading intervention program with preschool children with autism to build on existing family strengths to address child needs.

Feedback from our informal focus groups following research results seminars to service providers such as Autism Queensland and Aspect has provided us with some clear ideas for dissemination of the findings and directions for future research. For example, future research should investigate how best to embed emergent-literacy activities in early intervention programs. Informal feedback from a range of early childhood professionals working with preschool children with autism (i.e. teachers, speech-language pathologists, occupational therapists) indicated that emergent literacy, although deemed important, was often not a top educational priority. Focus was more often on behavior issues and independent living and social-communication skills associated with transitioning to school. Questions were raised as to whether early literacy should be targeted, if it was not an area identified by families. Attendees also wondered if more targeted intervention during the preschool years would have ameliorated the difficulties of older children they service, for whom a lack of foundational literacy skills were starting to become a large barrier to learning. Future research to follow up children in their first two years of school to determine response to formal literacy teaching and correlation with emerging literacy skills at school entry would be useful, particularly to inform optimal interventions in the early school years.

Future research should also investigate why children with autism show obvious strengths in letter name knowledge. This finding is consistent with previous research (e.g., Dynia et al., 2014), and cannot be explained by the home literacy environment alone. A better understanding of this interest in print may inform understanding of the cognitive strengths in autism and may provide further insights into the processing style (cf. central coherence theories by Happé,1997) of children with autism to better understand their development of literacy skills.

Although the present study used a relatively large sample relative to previous research, a relatively restricted range of SES and age were gathered which may have impacted on the capacity to detect significant correlations with these measures. Future research using a larger and more varied group would allow greater investigation of the potential impact of SES as well as the development of emergent literacy skills over time. Following these children longitudinally will illuminate whether the emergent literacy skills measured prior to school-entry are predictive of future reading performance. This information will be important for early childhood educators and other professionals involved in the early intervention for children with autism and will potentially help guide early intervention practices.

The aspirations implicit in these recommendations - to identify and working with learning strengths, acknowledging and embracing individual differences, the importance of preparing children for school, and the need to maximise educational outcomes – are in no way unique to children on the autism spectrum. Instead, they are aspirations all caregivers, educators, and therapists have for the children they raise and support. Thus, the challenge and opportunity, in progressing this line of applied research, is to harness these aspirations and existing efforts, while enhancing them with the minimum educational modifications necessary.
We need to ensure that attempts to support literacy development target the strengths, in order to address the difficulties identified in this report. Such an approach will ultimately require a collaborative community approach involving families, early intervention providers, community librarians, book publishers, and other educational partners to make timely, inclusive, evidence-based, and enjoyable early literacy opportunities and instruction available to all children on the spectrum.

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Appendix 1

RECRUITMENT FLYER – EXAMPLE

AutismCRC

Language and pre-reading skills of preschool-age children with autism

Griffith UNIVERSITY

An invitation to participate

The team: we are a team of speech pathologists, teachers, health professionals and service providers who are interested in observing the early and emerging literacy skills of children with autism, before they start school. The results will potentially guide future education practices.

Participation: we are looking for children who have been diagnosed with autism and:

- are 4 or 5 years of age and have not yet started school
- speak in (short) sentences and can take part in preschool type activities such as pointing at pictures and following simple commands.

If you are unsure about meeting these requirements, please feel free to contact us

What's involved: participation will involve two assessment sessions with a qualified speech pathologist at a place convenient to you and your child. You will receive a detailed report and recommendations upon completion of the assessments.

If you are interested in obtaining more information, please contact us at Griffith University:

Mary-Ellen Feldhagen, Autism Centre of Excellence on ph: 07 3735 5640

Dr Marleen Westerveld, Speech Pathology, Griffith University:
m.westerveld@griffith.edu.au

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Appendix 2

CORRELATIONS BETWEEN POTENTIAL PREDICTORS AND THE EMERGENT LITERACY MEASURES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. SCQ	---	.063	-.073	-.187	.079	.255	.177	.042	.027	.052	.224	.025	.182	.131	.139	.125
2. Freq Reading		---	.076	.192	.035	-.074	.033	-.022	.081	.065	-.102	-.057	-.028	.009	.015	.188
3. Teach LNK			---	.095	-.120	.230	.065	-.145	.048	.024	-.092	.100	.058	-.017	-.186	-.082
4. VABS-AE				---	.455**	-.070	-.032	.324*	.146	.296*	.204	.097	.337*	.407**	.394**	.222
5. DQ					---	.227	.351**	.465**	.371**	.367**	.473**	.361**	.529**	.593**	.470**	.271*
6. LNK						---	.762**	.341**	.519**	.091	.353**	.505**	.357**	.159	.058	.128
7. LSK							---	.471**	.755**	.303*	.587**	.600**	.561**	.419**	.253	.304*
8. Name writing								---	.446**	.358**	.618**	.444**	.581**	.548**	.579**	.353**
9. PA									---	.459**	.598**	.483**	.534**	.596**	.362**	.467**
10. Rhyme										---	.546**	.119	.486**	.607**	.465**	.353**
11. PWA											---	.632**	.625**	.668**	.683**	.499**
12. RAN												---	.410**	.397**	.396**	.244
13. DigitSpan													---	.687**	.558**	.389**
14. PPVTrs														---	.693**	.447**
15. ONC															---	.531**
16. ONQ																---

SCQ = Social Communication Questionnaire; Freq Reading = Frequency of Reading; Teach LNK = teaching letter name knowledge; VABS-AE = Vineland Adaptive Behavior Scales – Spoken Language Age Equivalen; DQ = Developmental Quotient; LNK = Letter Name Knowledge; LSK = Letter Sound Knowledge; PA = Phonological Awareness; PWA = Print and Word Awareness; RAN = Rapid Automatic Naming; PPVT = Peabody Picture Vocabulary Test – 4th Edition, raw scores; ONC = Oral Narrative Comprehension; ONQ = Oral Narrative Quality.