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Shared book reading behaviours of children with Down Syndrome before and after participation in the MultiLit reading tutor program: an exploratory study

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ABSTRACT

This exploratory study compares the shared book reading behaviours of five school aged children with DS (aged 11 years 6 months to 15 years 6 months) before and after participation in an intervention which included selected components of the MultiLit Reading Tutor Program. The program was delivered 1:1 to participants each week over a 12 week period. Analysis of the average performance across the group revealed that the proportion of reading errors relative to the number of words read from preintervention to postintervention were significantly reduced. Significant improvement was also seen in shared book reading fluency following intervention. Individual case study data is also presented. Postintervention, reading errors per minute were reduced for two participants (P4 and P5). Reading dysfluencies per minute decreased for two participants (P1 and P5) while all participants improved in shared book reading fluency. Preliminary results suggest that children with DS can generalise skills taught in the MultiLit Reading Tutor Program to shared book reading, although variability regarding changes in literacy abilities postintervention was observed.

Introduction

Literacy skills are not only essential for academic success, they also improve an individual's quality of life by increasing their participation in society and overall wellbeing (Kell & Kell, 2014). In using the term "literacy" we are referring to a range of abilities including reading and writing which, themselves, reflect a variety of skills. For example, reading can be thought of in terms of reading accuracy, reading fluency, and reading comprehension. These skills can be applied to single words and also to connected text. Reading at text level is particularly important because part of equipping oneself to live independently and to contribute meaningfully in society involves the ability to engage in functional literacy activities. Some examples include being able to read labels on medicine containers, reading the newspaper to keep oneself updated with the latest current affairs, and being able to read a job description. Previous research indicates that many parents of children with Down syndrome (DS) have

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aspirations for their children to achieve functional literacy (Trenholm & Mirenda, 2006). Thus, it is critical to examine the reading abilities of children with DS across a range of meaningful contexts. In the current study, we had the opportunity to explore children's reading behaviours during a parent-child shared story book reading activity before and after a structured literacy intervention program.

Factors which can impact the literacy abilities of children with DS

DS is a chromosomal disorder associated with intellectual disability. For any child there are a variety of factors that can influence literacy acquisition, however, for children with DS there are some specific cognitive, linguistic, hearing, and oral-motor factors that can place them at risk of impaired literacy acquisition (Abbeduto, Warren, & Conners, 2007; Abbeduto et al., 2001). For instance, some children with DS experience limited phonological memory and weak phonological awareness skills which may result in decoding/encoding difficulties during reading and spelling (Laws & Gunn, 2004; Lemons & Fuchs, 2010a). In addition, it has been reported that some children with DS experience difficulties with certain morphosyntactic structures, (Vicari, Caselli, & Tonucci, 2000). This may affect vocabulary and broader comprehension skills during reading.

In view of impaired literacy acquisition in this population, a number of studies have investigated the efficacy of literacy interventions for children with DS. Although evidence-based methods were used, most of these interventions have relied on researcher-developed materials that are not easily accessed by educators and clinicians, and are not accompanied by manuals and/or training modules that support high quality implementation (e.g. Baylis & Snowling, 2012; Burgoyne, Duff, Clarke, Buckley, & Snowling, 2012; Burgoyne, Duff, Snowling, Buckley, & Hulme, 2013; Cupples & Iacono, 2002; Goetz et al., 2008; Lemons & Fuchs, 2010b). The only study we know of that has examined the efficacy of more widely accessible literacy instruction programs in children with DS was conducted by Lemons, Mrachko, Kostewicz, and Paterra (2012). These researchers investigated the efficacy of the Road to Reading program (in 6 children), the Road to Reading program plus phonological awareness training (in 5 children) and Road to the Code program (in 4 children). School staff administered these programs over 12 weeks.

The above mentioned studies generally reported improvements following literacy intervention although some studies showed larger effects than others. Importantly, none of these studies focussed on outcomes relating to children's reading of story books that were not included in the materials used during the literacy intervention. This is an ongoing area of challenge for children with DS – to generalise skills learnt during intervention and apply them in various functional contexts (e.g. reading signboards, story books). Outcomes of previous studies have focussed primarily on precursor literacy skills such as phonological awareness as well as the reading aloud of single words and nonwords. Some studies assessed these outcomes using tests that were independent of the learning materials used during the literacy intervention but others did not. While assessment of precursor literacy skills and reading aloud of single words and nonwords is vital, it is also important to look at outcomes which represent more naturalistic reading contexts in children's lives such as shared story book reading.

Shared book reading

Parents play an important role in their children's literacy development. This includes engaging in shared story book reading with their children (e.g. Baker, Mackler, Sonnenschein, & Serpell, 2001). Indeed, a survey by Al Otaiba, Lewis, Whalon, Dyrlund, and McKenzie (2009) showed that parents understood the importance of literacy at home and valued participating in a shared book reading activity with their children.

In the present study we examined interactive reading experiences where mothers and children share in the reading of a story book. Specifically, children with DS were asked to read while mothers listened and provided a range of comments and questions. Thus, in this study, the term "shared book reading" refers to the situation where both mothers and children participated in a book reading activity. This is in line with the idea of shared book reading being a social interactive experience (Westwood, 2012). Exploring the shared reading behaviors of children with DS before and after their participation in a literacy intervention allowed for examination of children's reading errors and fluency during story book reading.

In the current study, we focused on accuracy/fluency rather than on reading comprehension before and after a literacy intervention program. Causality is not claimed with this research design. Rather, this exploratory study offers a rich account of children's reading behaviours during a naturalistic, mother-child shared interaction. We report on analyses of the group and of each individual within the group in order to provide a more comprehensive account of the literacy behaviours of children with DS during shared book reading before and after literacy intervention.

The MultiLit reading tutor program

The Making Up Lost Time in Literacy Reading Tutor Program (MULTILIT, 2007a) is an intervention program designed to enhance literacy skills in all low progress readers (regardless of the reason for their reading difficulties). Components of the program include a Sight Words program (MULTILIT, 2007b), Word Attack Skills program (MULTILIT, 2007c), and MultiLit Reinforced Reading (MULTILIT, 2007d). Prior research has shown that MultiLit is beneficial in improving reading accuracy, reading fluency and reading comprehension. For example, Wheldall and Beaman (2011) outlined the efficacy of MultiLit for indigenous students. See also Buckingham, Beaman, and Wheldall (2012) and Wheldall, Beaman, and Langstaff (2010) for further information on the efficacy of MultiLit, amongst other studies.

The efficacy of the MultiLit Reading Tutor Program has seldom been investigated independently of the team who created the program and, as far as we are aware, has never been used in previously published research that was designed to enhance the literacy skills of children with DS. However, a recent study that examined the efficacy of the MultiLit Reading Tutor Program in improving phonological awareness, word reading, and word spelling in 15 individuals with DS, using standardised tests that were independent of the literacy instruction materials, revealed some of the largest effect sizes ever reported for any literacy intervention in this population (Lim, Arciuli, Munro, & Cupples, 2017). As part of that study, a subset of children and their parents agreed to participate in shared book reading before and after the intervention in order to explore whether the text level reading behaviours of children with DS would change.

Objectives of the current study

Shared story book reading represents an ecologically valid reading context that has rarely been investigated in previous studies of literacy intervention for children with DS. The main aim of the study was to investigate the effect of selected components of the MultiLit Reading Tutor Program on children's text level reading behaviours during shared book reading, in terms of group and individual performance.

Here, we examined reading errors, as well as shared book reading fluency. Conventionally, reading fluency relates to the situation where a child reads the text alone. As noted, in this study, shared book reading fluency takes into account the fact that both parent and child participated in the activity of shared story book reading, with parents intervening from time to time.

We anticipated that at a group level, reading errors and dysfluencies would decrease, and that shared book reading fluency would improve, following intervention. We also wanted to explore individuals' performance in a more in-depth way. Hence, we report on five single case studies.

Method

Participants

We report results for five children with DS in the current study. These participants were a subset from a larger group of 15 children with DS who participated in the MultiLit Reading Tutor Program on a 1:1 basis over 12 weeks. Participants were recruited from either the DS Association (Singapore) or a school for special needs in Singapore. Four participants attended the same special education school catering to individuals with mild to moderate learning difficulties, while one participant attended a special education school catering to individuals with moderate to severe learning difficulties. The University of Sydney Human Research Ethics Committee approved the study. The main exclusion criteria were serious visual impairment and/or severe sensorineural hearing loss. The main inclusion criteria were that the child's dominant language spoken at home and at school was English.

The five children (one female) reported here ranged from 11 years 6 months to 15 years 6 months (mean age in months = 171.8). The group had approximately 7 years of formal schooling ($M = 7.8$, SD = 1.64) and English was the main language spoken at home by the children. Of the five children, two displayed mild speech errors. Participant 1 (P1) had a lateralised /s/ and Participant 5 (P5) had sound substitution errors where the following phonemes: /f/ (e.g. "food" was pronounced as "pood"), /l/ (e.g. "led" as "wed") and /r/ (e.g. "run" as "wun") were mispronounced.

Five mothers participated in the current study. All mothers held at least a diploma and English was their dominant language. In addition, we asked how frequently mothers and children participated in shared book reading activities at home. Four mothers stated that they read with their child once a week, while one mother read with her child less than once a week. This indicates that shared book reading was a context that most of our parents/caregivers participated in fairly regularly with their children.

Assessments conducted prior to the literacy intervention served to provide information on the participants' broader abilities. The following tests were administered: the *Raven's Coloured Progressive Matrices* (Raven's CPM; Raven, Court, & Raven, 1995), the communication

domain of the *Vineland-II Adaptive Behavior Scales– Second Edition* (VABS–II; Sparrow, Cicchetti, & Balla, 2005), the sound isolation and sound deletion tests from the *York Assessment of Reading for Comprehension* (YARC; Snowling et al., 2009), and the word reading subtest from the *Wide Range Achievement Test–Fourth Edition* (WRAT–4; Wilkinson & Robertson, 2006).

The Raven's CPM measures nonverbal intelligence in individuals ranging in age from 4 years to 11 years 11 months. The manual reports Cronbach's alpha of .94 for the normative sample. The communication domain of the VABS–II measures an individual's receptive, expressive, and written skills via parent report. The VABS–II assesses individuals ranging in age from 5 to 90 years. The manual reports split-half reliability for the communication domain of the VABS-II is .93 for a normative sample aged 6–11 years and .89 for ages 12–18. The sound isolation subtest from the YARC assesses an individual's ability to identify the initial and final phoneme while the sound deletion subtest evaluates an individual's ability to delete either the initial, middle, or final sound of a word. The YARC assesses individuals ranging in age from 4 to 7 years. For both the sound isolation subtest and the sound deletion subtest, the manual reports Cronbach's alpha of .93 for a normative sample. The WRAT word reading subtest assesses an individual's ability to read words that increase in complexity from simple words such as "milk" to more complex words like "rudimentary". The WRAT assesses individuals ranging in age from 5 to 94 years and the manual reports Cronbach's alpha of .92 for a normative sample. These assessments (i.e. Raven's CPM, communication domain of the VABS–II, YARC sound isolation and sound deletion subtests, as well as WRAT word reading) have a mean standard score of 100 with a standard deviation of 15.

Table 1 presents scores for the two YARC subtests, WRAT word reading, Raven's CPM and the communication domain of the VABS-II. As the chronological ages of the participants exceed the normative age ranges for YARC sound isolation, YARC sound deletion, and the Raven's CPM, raw scores have been reported. Table 1 details the results of these assessments for the five participants.

Procedure

MultiLit Reading Tutor Program intervention

The children reported here were part of a larger study of the efficacy of MultiLit (Lim et al., 2017). In relation to the current study, the MultiLit Reading Tutor Program (MULTILIT, 2007a) was offered to children on a 1:1 basis, three times a week for 12 consecutive weeks, with each session lasting 45–60 min. Sessions were conducted in participants' homes or at a speech pathology clinic. Table 1 indicates the number of MultiLit sessions that each child attended.

Children with DS were taught to read single words using the Word Attack Skills component of the Reading Tutor Program (MULTILIT, 2007b). Part of this program required children to read a short story which contained some previously learnt single words. This is designed to help children with DS to generalise reading skills learnt at the word level to text level. Children were also taught to read high frequency words through the Sight Words component of the Reading Tutor Program (MULTILIT, 2007c). A placement test was used to determine each child's starting level (see Table 1). The Reading Tutor Program offers a Reinforced Reading component where instructors read a book daily with the child for 20 min (MULTILIT, 2007d). However, in our implementation of the program we did not include this element because

Table 1. Participants' characteristics.

Participant	Age	Gender	Standard score		Raw score			MultiLit Word Attack Level (Level 1 to 13)		MultiLit Sight Word Level (List 1 to 20)		Number of MultiLit sessions attended (max:36)
			WRAT[a] word reading	VABS–II[b] communication domain	YARC[c] sound isolation (max:12)	YARC[c] sound deletion (max:12)	Raven's[d] CPM (max:36)	Start level	End level	Start level	End level	
P1	15 years 6 months	Male	55	57	0	1	10	1.6	4.1	10	20	23
P2	11 years 6 months	Male	55	64	5	2	10	1.4	1.8	1	3	30
P3	15 years 6 months	Male	60	69	8	5	22	5.1	11.3	N.A[e]	N.A[e]	31
P4	14 years 11 months	Female	55	67	9	5	12	3.2	11.3	N.A[e]	N.A[e]	24
P5	14 years 2 months	Male	55	63	2	0	9	1.4	2.1	3	10	34

[a]*Wide Range Achievement Test–Fourth Edition* (WRAT–4; Wilkinson & Robertson, 2006).
[b]*Vineland–II Adaptive Behavior Scales– Second Edition Communication Domain* (VABS–II; Sparrow et al., 2005).
[c]*York Assessment of Reading for Comprehension* (YARC; Snowling et al., 2009).
[d]Raven's Colored Progressive Matrices (Raven et al., 1995).
[e]Not applicable as the participant read all 200 sight words from List 1 to List 20 correctly.

we wanted to determine if implementing the MultiLit Sight Words and MultiLit Word Attack Skills program alone would result in positive improvements during story book reading.

Shared book reading

All five children with DS participated in two shared book reading sessions (i.e. prior to and after the conclusion of the MultiLit intervention). These sessions were conducted in participants' homes or in a speech pathology clinic. The time interval between the shared book reading sessions was approximately 24 weeks (the first shared book reading session was conducted 12 weeks prior to the beginning of the intervention, followed by 12 weeks of MultiLit intervention).

Mothers and their children sat in a comfortable position at a table. Mothers were asked to read with their child as they normally would at home. Both sessions were recorded and timed, with the preintervention shared book reading sessions ranging between 5 min 31 s to 10 min 1 s (M = 7 min 35s; SD = 1 min 58s) and the postintervention shared book reading session ranging between 5 min 27 s and 10 min 45 s (M = 7 min 47s; SD = 1 min 52 s).

Materials for shared book reading

The following selection of children's story books were used: *The Little Mermaid* (Walt Disney Company, 1997b), *The Lion King* (Walt Disney Company, 1997a), *Cat and Kitten* (Berryman & O'Carroll, 2002), *My Mum is Mad and Other Stories* (Horsley, 1997), and *The Wizard of Oz* (Baum, 1998). These books were offered as the shared book reading materials in this study as they had familiar themes which could help to maintain children's interests. Mothers chose which book to read with their child. For example, one mother said that her child enjoyed reading books about animals so she chose *Cat and Kitten*. Each mother-child dyad read the same book for both preintervention and postintervention shared book reading sessions. All children were willing participants and happily agreed to undertake the shared book reading sessions.

Data coding

Shared book reading interactions were recorded using a video camera on a tripod stand and orthographically transcribed. The classification of particular reading behaviours followed a previous study by Arciuli et al. (2013) which investigated the shared book reading behaviours of mothers' and their children with autism. Coding was enacted using a software program called The Codes for the Analysis of Human Language (CHAT) located within the Computerised Language Analysis (CLAN) program (MacWhinney, 2000).

Coding children's reading behaviours

Children's oral reading behaviours were coded by examining the children's reading errors and dysfluencies, as well as shared book reading fluency. Reading errors were categorised into (a) substitutions including sound substitutions, real word substitutions and nonsense words; (b) omissions such as sound, word, phrase, sentence omissions; or morpheme omissions; (c) insertions, and (d) unintelligible utterances. Reading dysfluencies were categorised according to four main categories. These included: (a) fillers and hesitations; (b) sound, syllable or word repetitions; (c) self-corrections where the child corrected himself/herself

correctly or incorrectly; and (d) phonological awareness such as sounding or spelling out new words.

Reliability

The first author, a practicing speech pathologist, conducted the coding. A random sample of 20% of the shared reading data was selected for both intra-rater and inter-rater reliability. For intra-rater, the procedure involved re-coding each transcript containing the child and mother's utterances on two separate occasions. Thereafter, the coding on the first occasion was compared to the coding on the second occasion for intra-rater reliability and was 98%. For inter-rater reliability, the first author's coding was compared with coding by another author. Both independently coded their own de-identified data. The inter-rater reliability was 97%.

Treatment fidelity regarding implementation of the MultiLit Reading Tutor Program

Fidelity can be measured using compliance, context or competence measures (O'Hare & Doell, 2015). Compliance fidelity measures included the use of the MultiLit Reading Tutor Program manual and all instructions were followed in accordance with the MultiLit Reading Tutor Program manual. The MultiLit Reading Tutor Program program also provided online help, workbooks and teaching videos to support clinicians. To ensure context fidelity, the MultiLit Reading Tutor Program was delivered by the first author, a qualified speech pathologist, who underwent a one day training workshop in the MultiLit Reading Tutor Program. This included detailed explanations and practical exercises for all aspects of the program. Although no competency measures were obtained, the first author who delivered the intervention is a clinician with experience implementing intervention programs for children with intellectual disability.

Data analysis

Both preintervention and postintervention children's codes were entered into the CLAN program to enable calculation of reading errors, as well as shared book reading fluency rate. Shared book reading fluency scores were derived using the conventional reading fluency formula as we felt it was the most appropriate formula to use. This was calculated by taking the total number of words read correctly multiplied by 60, and divided by the number of seconds to read the text (Rathvon, 2004).

Results

Analysis of the group's reading behaviours

Children's reading errors

Children's reading errors were calculated by taking the total number of incorrect words divided by the total number of words read. A Wilcoxon signed rank test showed that there was a significant difference in the proportion of reading errors relative to the number of words read from preintervention (mdn = .36, range = .39) to postintervention (mdn = .32,

range = .25; $z = -2.03$, $p = .042$, $r = .64$). A nonparametric test was chosen in view of the small sample of participants.

Table 2 shows the children's reading error types at preintervention and postintervention arranged according to the average frequency of each reading error per minute.

The most common reading error produced by the group during preintervention and postintervention was real word substitutions. At preintervention, real word substitutions occurred at an average of 1.61 times per minute (e.g. "raising" instead of "rising") while at postintervention, real word substitutions occurred at an average of 1.76 times per minute. During preintervention, a breakdown of these real word substitutions showed that 20% of substituted words retained the semantic meaning (e.g. reading "hide" for the target word "hid"), 50% of substituted words were likely to have been read using a variety of strategies such as phonological awareness, letter sound correspondence, or visual memory skills (e.g. reading "fired" for the target word "flared"), and 30% consisted of other substituted words (e.g. reading "man" for the target word "farm"). At postintervention, a breakdown of these real word substitutions showed that 21.21% of substituted words retained the semantic meaning (e.g. reading "flicking" for the target word "flickering"), 51.51% of substituted words were likely to have been read using a variety of strategies (e.g. phonological awareness, letter sound correspondence, visual memory) such as reading "night" for the target word "right", and 27.27% consisted of other substituted words (e.g. reading "fish" for the target word "lady").

Other prominent reading errors included morpheme omissions and nonsense word substitutions. At preintervention, morpheme omissions occurred at an average of .82 times per minute (e.g. "climb" instead of "climbed") while at postintervention, morpheme omissions occurred at an average of .64 times per minute. Nonsense word substitutions ("nosted" for "noticed") occurred at an average of .78 times per minute preintervention while at postintervention, these occurred at an average of 1.05 times per minute. A breakdown of nonsense word substitutions showed that 58.62% of nonsense words retained the correct first sound, but 41.37% of nonsense words did not bear any resemblance to the target word. At postintervention, a breakdown of nonsense word substitutions showed that 61.76% of nonsense words retained the correct first sound, and 38.23% of nonsense words did not bear any resemblance to the target word. Other less frequent reading error types and their rates per minute at preintervention and postintervention are listed in Table 2.

Table 3 reports the types of children's reading dysfluencies at preintervention and postintervention arranged according to average reading dysfluency rate (per minute).

Table 2. Children's reading errors at preintervention and postintervention during shared book reading.

Types of children's reading errors	Average reading error per minute preintervention	Average reading error per minute postintervention
Real word substitutions	1.61	1.76
Morpheme omissions	.82	.64
Nonsense word substitutions	.78	1.05
Partial or whole Word omissions	.89	.66
Sound substitutions	.36	.76
Sound omissions	.26	.27
Insertions	.30	.17
Unintelligible utterances	.29	.75
Whole phrase or sentence omissions	.07	.02

Table 3. Children's reading dysfluencies at pre and postintervention during shared book reading.

Types of children's reading dysfluencies	Average reading dysfluencies per minute (preintervention)	Average reading dysfluencies per minute (postintervention)
Fillers and hesitations	2.38	2.19
Sounding or spelling out (incorrect)	.32	.41
Repetitions	.10	.06
Self-corrections (correct)	.02	.04
Sounding or spelling out (correct)	.02	.00

A Wilcoxon signed-rank test showed that there was no significant difference in the reading dysfluency rate per minute from preintervention (*mdn* = 2.54, range = 3.07) to postintervention (*mdn* = 2.02, range = 3.93; $z = -.14$, $p = .89$, $r = .60$).

At preintevention, the highest reading dysfluencies observed were fillers and hesitations (e.g. "er") which occurred at an average of 2.38 times per minute, while at postintervention, fillers and hesitations occurred at an average of 2.19 times per minute. Sounding or spelling out a target word incorrectly (e.g. "c-o-p" for "top") was observed at an average rate of .32 times per minute at preintervention while at postintervention this was observed at an average of 0.41 times per minute. Last, sound, syllable, or word repetitions (e.g. "p-p-ainter") were observed at an average of .10 times per minute preintervention; while at postintervention these occurred at an average of .06 times per minute. Other less frequent reading dysfluency types can be found in Table 3.

Children's shared book reading fluency

At preintervention, the average shared book reading fluency for the group was 17.84 correct words per minute (CWPM) (SD = 14.73) while postintervention, the average shared book reading fluency for the group was 22.20 CWPM (SD = 15.37). Results of a Wilcoxon signed rank test showed that there was a significant increase in shared book reading fluency from preintervention (*mdn* = 19.79, range = 37.17) to postintervention (*mdn* = 23.67, range = 39.18; $z = -2.02$, $p = .043$, $r = .64$).

Analysis of each child's reading behaviours

In this section, we report on case studies to examine the text reading behaviours of the participants before and after attending the MultiLit Reading Tutor Program.

The first participant (P1) and his mother read the story book *My Mum is Mad and Other Stories* (Horsley, 1997) during the shared book reading session. The proportion of reading errors relative to total words read did not change substantially from preintervention to postintervention (.36 words read incorrectly to .35). Nevertheless, at postintervention, reading dysfluencies decreased from 4.47 to 2.02 dysfluencies per minute. Shared book reading fluency improved from 19.79 CWPM to 23.67 CWPM.

At preintervention, P1's three most prominent reading errors during shared book reading were real word substitutions, followed by omission of words and morpheme omissions. Postintervention, real word substitutions (i.e. 2.87 times per minute at preintervention compared to 2.39 times per minute at postintervention) and word omissions (i.e. 2.39 times per minute at preintervention compared to .37 times per minute at postintervention) were

reduced. The exception was morpheme omissions which increased from 1.12 times per minute at preintervention to 1.47 times per minute at postintervention.

An analysis of reading errors showed that P1 was able to successfully self-correct some words that were read incorrectly at preintervention. For example prior to intervention, real word substitutions were made. For instance, "basket" was read as "bucket", "white" was read as "was", "said" was read as "had", "wanted" was read as "was" and "be" was read as "become". Postintervention, P1 was able to read the words "basket", "white", "said", "wanted" and "be" independently. A sample of P1's shared book reading interaction before and after intervention is detailed in Appendix 1.

However, variable reading performance was observed in P1 during shared book reading. Participant 1 read some words correctly during preintervention but misread them at postintervention. For instance, "two", "noisy", and "wanted" were read correctly during preintervention but misread as "hoo", "naughty", and "hanted" at postintervention. Additionally, there were occasions when reading errors were observed at preintervention and postintervention on similar words. Some examples included nonsense word substitutions such as "api" (preintervention) and "apis" (postintervention) for the target word "babies", "puhis" (at preintervention and postintervention) for the target word "pushed" and real word substitutions such as "past" (at preintervention and postintervention) for the target word "fast". Other examples included morpheme omissions such as reading "puppy" for the target word "puppies".

The second participant (P2) and his mother read the story book *Cat and Kitten* (Berryman & O'Carroll, 2002) during the shared book reading session. During the two book reading interactions with his mother, P2 often kept quiet and required a substantial amount of prompting from his mother to read. As such, P2's mother would often start reading the sentence for him or occasionally provide him with a sound cue to read the target word. Postintervention, there was a decrease in the proportion of reading errors relative to total words read from .46 at preintervention to .32 at postintervention. Reading dysfluencies increased from 3.84 to 5.60 dysfluencies per minute. However, postintervention, shared book reading fluency improved from .77 CWPM to 3.24 CWPM.

At preintervention, P2's top three oral reading behaviours were hesitations and fillers (3.07 times per minute), sounding or spelling out a word incorrectly (i.e. .66 times per minute), and sound omissions (i.e. .44 times per minute). Postintervention, P2 made more hesitations and fillers (i.e. 4.36 times per minute) in line with his increase in reading dysfluency, while sounding or spelling out a word incorrectly increased to 1.24 times per minute. No sound omissions were made following intervention. Some examples of P2's reduction in reading errors included reading the following target words correctly (i.e. "kitten", "trot", "old"). Prior to intervention, the words were read as "ki", "t" and "o" respectively. A sample from P2's shared book reading interaction before and after intervention is detailed in Appendix 2.

The third participant was P3. Participant 3 and his mother read the story book *The Little Mermaid* (Walt Disney Company, 1997b) during the shared book reading session. From preintervention to postintervention, the proportion of reading errors relative to total words read remained stable, with .20 at preintervention and .19 at postintervention. Reading dysfluencies increased from 1.96 to 2.36 per minute. However, shared book reading fluency improved from 24.18 CWPM to 30.06 CWPM following intervention.

At preintervention, P3's three most noticeable oral reading behaviours consisted of real word substitutions (i.e. 2.75 times per minute), followed by hesitations and fillers (i.e. 1.70 times per minute), and word omissions (i.e. .92 times per minute). Following intervention, a

breakdown of reading errors showed that P3 made less real word substitutions. For example, prior to intervention, the target word "beckoned" was misread as "be", "boat" was misread as "goat", "seagull" was misread as "single", "straighten" was misread as "strengthen", "kept" was misread as "keep", "hid" was misread as "hide", "sailing" was misread as "sail", "celebration" was misread as "information", and the word "lights" was misread as "nights". Participant 3 was able to read all the words (i.e. "beckoned", "boat", "seagull", "straighten", "kept", "hid", "sailing", "celebration", and "lights") correctly at postintervention. Indeed, at postintervention, P3's real word substitutions occurred at a reduced rate of 2.48 times per minute, although hesitations and fillers (i.e. 1.99 times per minute) as well as word omissions (i.e. 1.12 times per minute) increased slightly.

Participant 3 read some words incorrectly on both occasions during preintervention and postintervention. For instance, the target words "gaped" and "swam" were misread as "grabbed" and "swum" on both occasions, while "frolicked" was read as "frock" (preintervention) or "flock" (postintervention). At times, P3 also showed variable performance where words that were read accurately at preintervention were misread during postintervention. For example, "below", "flickering", and "playmate" were read correctly at preintervention but misread as "low", "flicking", and "mermaid" respectively during postintervention. A sample of P3's shared book reading interaction before and after intervention is detailed in Appendix 3.

The fourth participant (P4) and her mother read the story book *The Lion King* (Walt Disney Company, 1997a) during the shared book reading session. The proportion of reading errors relative to total words read reduced slightly following intervention, from .15 to .11. Reading dysfluencies increased from 1.40 to 1.67 per minute. Postintervention, shared book reading fluency improved from 37.9 CWPM to 42.42 CWPM.

At preintervention, the three most frequent oral reading behaviours displayed by P4 were real word substitutions (i.e. 1.90 times per minute), followed by morpheme omissions (i.e. 1.60 times per minute), and nonsense word substitutions (i.e. 1.20 times per minute). Postintervention, real word substitutions increased (i.e. 2.42 times per minute) but some of P4's substitutions following intervention bore a closer resemblance to the target word. For instance, prior to intervention, "particular" was read as "part", "noticed" as "noised", "kingdom" as "miskitten", "dreadful" as "deadful", "future" as "funture", "grumbled" as "gremed", and "hairball" as harball". Postintervention, "particular" was read as "particu", and "noticed" as "notice". Other words like "dreadful", "future", "grumbled" and "hairball" were read correctly after the intervention.

Similarly, other reading errors such as morpheme omissions (e.g. omissions of regular past tenses and possessives) were reduced to .84 times per minute at postintervention compared to 1.60 times per minute at preintervention. However, nonsense word substitutions increased from 1.20 times per minute to 1.40 times per minute following intervention.

Participant 4 was also observed to read some words incorrectly during preintervention and postintervention. For instance, "horses" and "whole" were read as "hooves" and "world" respectively on both occasions. The target word "scraggly" was read as "scully" (preintervention) or "sandry" (postintervention), and "position" was read as "posinin" (preintervention) or "pernitional" (postintervention). At other times, words were read correctly at preintervention but misread at postintervention. For example, "our" and "balance" was read correctly at preintervention but misread as "your" and "bounce" during postintervention. A sample of P4's shared book reading interaction before and after intervention is detailed in Appendix 4.

The fifth participant (P5) and his mother read the story book *The Wizard of Oz* (Baum, 1998) during the shared book reading session. The proportion of reading errors relative to total words read reduced following intervention, from .54 to .36. Additionally, reading dysfluencies decreased from 2.54 to 1.79 per minute. Postintervention, shared book reading fluency improved from 6.53 CWPM to 11.59 CWPM.

At preintervention, the three highest oral reading behaviours observed were hesitations and fillers (1.81 times per minute), followed by sound substitutions (1.09 times per minute) and morpheme omissions (.73 times per minute). These were all reduced following intervention, where hesitations and fillers were observed at 1.40 times per minute, sound substitutions decreased to .97 times per minute and morpheme omissions reduced to .28 times per minute.

An analysis of P5's reading behaviours showed that some reading errors made at preintervention were accurately read at postintervention. For example, prior to intervention, the target word "lived" was read as "aliv", "farm" was read as "man", "dog" was read as "pish", "playing" was read as "p", and sound substitutions such as misreading the target word "said" as "taid". P5 was able to read these words (i.e. "lived", "farm", "dog", "playing", "said") accurately at postintervention. Like the other participants, variable reading performance was also observed where words that were read correctly during preintervention were misread at postintervention. Some examples included reading "uncle" and "little" correctly at preintervention but misreading them as "un" and "tittle" respectively during postintervention.

Additionally, there were instances where P5 misread some words on both occasions during preintervention and postintervention. For example, the target words "Dorothy" was read as "Dadati" (preintervention) or "Dadodi" (postintervention), "pleased" was read as "praised" (preintervention) or "heavy" (postintervention), and "whirlwind" was read as "wai-wind" (preintervention) or "where-ind" (postintervention). Nevertheless, some of P5's incorrect reading attempts at postintervention showed a closer resemblance to the target word. For instance, the target word "flowers" was read as "fl" at preintervention but "fowers" at postintervention. A sample of P5's shared book reading interaction before and after intervention is detailed in Appendix 5.

Discussion

The primary aim of the current study was to explore the text level reading behaviours of children with DS at a group level during a shared story book reading activity with a parent or caregiver before and after the 12 week MultiLit Reading Tutor program. Specific aspects of oral reading that were examined were reading errors, reading dysfluencies, and shared book reading fluency. We anticipated that, at a group level, there would be a reduction in reading errors as well as dysfluencies, and that shared book reading fluency would improve following intervention. We conducted case studies of each individual within the group in order to provide a rich account of whether reading behaviours changed following the MultiLit Reading Tutor Program.

Reading errors and dysfluencies

Analyses of group data revealed that there were statistically significantly fewer reading errors during shared story book reading after the MultiLit Reading Tutor Program intervention. A

comparison of reading errors before and after intervention revealed that although children with DS used real word substitutions more frequently postintervention (i.e. 1.61 times per minute at preintervention vs. 1.76 times per minute at postintervention), a higher proportion of these substituted words were observed to retain the semantic meaning (i.e. 21.21% at postintervention compared to 20% at preintervention). For example, children were observed to substitute "swim" for the target word "swam", "aunty" for the target word "aunt", or "gonna" for the target word "going". This suggests that the meaning of the text was maintained when reading aloud. Notably, the proportion of substituted words that were uncategorised (that is, those errors that did not retain semantic meaning or did not reflect a variety of other strategies such as phonological awareness) were reduced at postintervention (27.27%) compared to preintervention (30%).

Additionally, morpheme omissions, as well as partial/whole word omissions decreased following intervention. A reduction in these types of reading behaviours could be due to the children acquiring better decoding skills after the MultiLit Reading Tutor Program intervention, and thus attempting to read unfamiliar or novel words instead of omitting them. However at postintervention, children with DS were also observed to make more nonsense word substitutions (from .78 times per minute at preintervention to 1.05 times per minute at postintervention). A breakdown of these nonsense word substitutions showed that a larger proportion of these errors retained the correct first sound (i.e. 58.62% at preintervention but 61.76% at postintervention), such as "anevelope" for the target word "antelope", "nosted" for the target word "noticed", "puhis" for the target word "pushed", or "formagician" for the target word "formation". This too suggests that the children may have been trying to tap into phonological awareness strategies to read, and attempting to use the first sound in a word to aid in decoding.

In terms of other reading error behaviours, there were little changes for sound omissions from preintervention and postintervention. We found that sound substitutions and unintelligible utterances increased, but this was not a large increase relative to other reading errors. Nevertheless, it is encouraging that there was a statistically significant reduction for reading errors at the group level. Reading dysfluencies for the group did not decrease significantly postintervention.

The children in the current study did not present with pervasive speech sound errors or resonance disorders when assessed informally prior to beginning this project by the first author, a speech language pathologist. Of the five children, two displayed mild speech errors. Participant 1 had a lateralised /s/ and P5 had sound substitution errors where the following phonemes: /f/ (e.g. "food" was pronounced as "pood"), /l/ (e.g. "led" as "wed") and /r/ (e.g. "run" as "wun") were mispronounced. However, it is possible that during text level reading, difficulties with expressive phonology could be involved in some types of errors, particularly during the reading aloud of polysyllabic words.

Shared book reading fluency

Conventionally, reading fluency refers to how quickly an individual is able to accurately decode and read words in connected text (Silverman, Speece, Harring, & Ritchey, 2013). In this study, the term shared book reading fluency is used to capture the situation where both mother and child engage in a shared book reading activity. Our analyses revealed significant improvement for shared book reading fluency after literacy instruction. This suggests that children with DS were successful in their attempts at generalising reading skills learnt during the MultiLit Reading Tutor Program to shared book reading.

It is important to be aware that our measures of shared book reading fluency and reading dysfluencies are not directly proportional to each other because they were calculated differently. Specifically, shared book reading fluency was calculated by taking the total number of words read correctly, multiplied by 60, and divided by the number of seconds to read the text (Rathvon, 2004). By contrast, the rate of reading dysfluencies was calculated by adding up the number of fillers and hesitations, sounding or spelling out occurrences that were either correct or incorrect, repetitions and self-corrections and then dividing this by the time taken to read in minutes. Differences in how shared book reading fluency and dysfluencies were calculated may help to explain why results revealed improvements in shared book reading fluency at text level but no statistically significant decreases in reading dysfluencies. Another reason could be related to the study's relatively small sample size. Nevertheless, the significant improvement at postintervention for shared book reading fluency suggests that children with DS in this study were able to decode words and read more fluently compared to their preintervention shared book reading performance.

Individual case studies

In examining individual participants' performance, reading error scores at text level for all participants (i.e. P1, P2, P3, P4 and P5) were reduced from preintervention to postintervention, although to varying degrees. This highlights the heterogeneity of reading ability seen in children with DS.

For P1, an increase in morpheme omission was observed at postintervention compared to preintervention. It is possible that P1 was focused on decoding the root word (e.g. "puppy"), and may have neglected to attend to the suffix (e.g. "-ies"), resulting in morpheme omission.

In P2's case, notably sounding or spelling out a word incorrectly increased at postintervention compared to preintervention. This indicates that P2 may require further drilling in phonological awareness skills and letter sound correspondences. The book, *Cat and Kitten* (Berryman & O'Carroll, 2002) was chosen by his mother partly because it was an early reader series and contained some high frequency words. Additionally, P2 and P3 showed an increase in hesitations and fillers at postintervention compared to preintervention. For instance, P2 was observed to pause frequently at the beginning of a sentence or word, while P3 was observed to pause when he encountered new or unfamiliar words in the text. One possible explanation could be that P2 and P3 may have attempted to tap into their phonological awareness skills by blending sounds together silently in their head, as taught in the MultiLit Reading Tutor Program intervention. This automaticity in blending sounds skilfully may not come with ease for P2 and P3, and could partly contribute towards the increased frequency of hesitations and fillers seen at postintervention.

For P4, it was observed that some erred words at preintervention were read correctly at postintervention yet other words were read incorrectly on both occasions (i.e. during preintervention and postintervention). Some of the reading errors contained the first letter of the target word such as "hooves" for the target word "horses". This suggests that P4 may be tapping into a variety of strategies to decode the word, such as using knowledge of phonological awareness and semantics.

P5 showed the greatest reduction in reading errors among the five children (i.e. a reduction of 17.49% from preintervention to postintervention), where the percentage of incorrect

words during shared book reading decreased from 53.85% at preintervention to 36.36% at postintervention. However, P5, like the rest of the group, also showed variability in oral reading accuracy at text level. Indeed, across all the children in this study, all could read a word correctly in one instance (i.e. at preintervention), but misread the same word incorrectly on another occasion (i.e. at postintervention).

Limitations and future research

The current study has some limitations. The small sample size of five mother-child dyads and the within group pre-post design must be acknowledged. Future studies could recruit a larger group of children with DS for results to be generalisable to a wider DS population. In addition, to comprehensively investigate text level reading outcomes following the MultiLit Reading Tutor Program, future research should also incorporate the reinforced reading component and consider reading comprehension outcomes.

We cannot rule out the possibility that participants in this study may have improved with age or due to second exposure to the book rather than as a result of the MultiLit Reading Tutor Program (although we think practice effects from preintervention to postintervention are unlikely given almost 6 months delay between the shared book reading sessions). Future research on shared book reading following literacy intervention could collect control data (implemented either within participants via multiple baselines or between participants via a wait-control group).

Another consideration is that each mother selected a fiction book for shared book reading, out of a variety of books presented. In future, researchers could choose a suitable book for shared book reading which has an appropriate level of difficulty based on standardised reading assessments for each child and readability measures for each book. In the current study, each child read the same book on both occasions, but the number of pages read during pre-post intervention may have differed. We accounted for this by using rate of reading behaviours according to the duration of text read. However, future shared book reading studies could instruct caregivers to ensure that the child completes reading of a specific portion of the text to allow a basis for accurate comparison of oral reading behaviours at two separate and consistent time intervals. In addition, we did not control the variable of parent prompting/questioning during shared storybook reading. Future research also needs to account for the potential impact of difficulties with expressive phonology on the text level reading behaviours of children with DS.

It might be worthwhile for future studies to combine the standardised assessment of text level reading without pictures, alongside the assessment of naturalistic parent-child book reading interactions. Future research could also examine the potential impact of difficulties with expressive phonology on the text level reading behaviours of children with DS.

Lastly, researchers should take into consideration the participants' reading experiences as this may affect individual outcomes. For instance, effects of variables relating to how often children read with their parents at home during the course of the intervention, how reading is taught within children's classrooms, and the frequency of oral reading in children's daily lives could be examined.

Apart from examining reading behaviours, overall enjoyment during the shared book reading interaction could also be considered. When children are motivated, they are more likely to engage and learn. Future studies could look at the quality of the mother-child

interaction during shared book reading. For instance, both mothers and children could be asked to rate whether the child enjoyed the shared book reading interaction or whether the activity cultivated a deeper relationship and strengthened mother-child bonding.

Conclusion

The current study provides an exploratory yet valuable perspective as to whether children with DS exhibited improvements in shared story book reading ability after participation in the MultiLit Reading Tutor Program. Although children with DS are likely to continue experiencing restrictions in reading new or unfamiliar words during shared book reading, the preliminary evidence reported here suggests that children with DS who participated in selected components of the MultiLit Reading Tutor Program are capable of generalising their skills to shared reading of story books that were not used during their literacy instruction.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix 1. shared book reading samples between P1 and his mother

Preintervention sample:

P1:   "I wanted to be a writer, and Bum said yes."

Mother: "Mum"

P1:   "I ad a bounhing bashetball."

Mother: "Bouncing."

P1:   "The xxx (unintelligible utterance) bounce it up and down. I bouncesed to to house."

Mother: "Bounced."

Postintervention sample:

P1:   "I wanted to be a writer, and Mum said yes."

Mother: And?

P1:   "I had a bouncing bastetball."

Mother: "Basketball."

P1:   "I bounce it up and down. I bounce it to the house."

Mother: "Bounced it."

Appendix 2. Shared book reading samples between P2 and his mother

Preintervention sample:

Mother: "So his name …?"

Mother: "What is this? And what's this?"

P2:   "T."

Mother: "And then this is …?"

P2:   "T"

Mother: "You join. This is what sound? Huh? T and what? Try. Remember "t" and "r". What is this? What sound is this "r"? What is this letter?"

P2:   "r."

Mother: "You join. You read again."

P2:   "Tro."

Mother: "Trot."

Postintervention sample:

Mother: "His name was …?"

P2:   "Trot"

Mother: "Then? Louder."

P2:   "Trot"

Mother: "Oh this one?"

P2:   "was."

Mother: "Trot was what? This one, look."

P2:   "six."

Appendix 3.   Shared book reading samples between P3 and his mother

Preintervention sample:

P3:   "Ariel swum water sucurface and found her single friend."

Mother: "Swam. To water's surface. The top of the water is the surface."

P3:   "Skittle, do you know what it is?"

Mother: "That's the name, Scuttle."

P3:   "She held the fork."

Mother: "They found a fork."

P3:   "Judging from my expert knowledge of humans, it's okiousyi a …?"

Mother: "Obviously. A dinglehopper."

P3:   "Humans use these to strengthen their hair. Thanks Skittle."

Mother: "Straighten. What is a fork for?"

Postintervention sample:

P3:   "Ariel swum to the water surface and found her seagull friend."

Mother: "Swam."

P3:   "Surtle, you know what is this?"

Mother: "Scuttle. What this is."

P3:   "She held up the fork. Judging from my expert knowledge of humans, it's obviously a d…"

Mother: "Dingelhopper."

P3:   "Humans use these to straighten their hair. Thanks Scuttle."

Appendix 4.   Shared book reading samples between P4 and her mother

Preintervention sample:

P4:   "I cracked on a gourd, dip my finger inside and made mark on Simba's forehead. Then I lifted the funture king up high for all to see. The elephants the trumpet with the trunks. The monkey jumped up and down, and the zebras stamped their horses with happiness".

Postintervention sample:

P4:   "I cracked open a gourd, dipped my finger inside and made a mark on Simba's forehead. Then I lifted the future king up high for all the see. The elephants trumpets with their trunks. The monkeys jumped an up and down, and the zebras stamped their horses with happiness".

Appendix 5. Shared book reading samples between P5 and his mother

Preintervention sample:

P5:   "Live on a man in K …"

Mother: "Farm."

Mother: "In where?"

Mother: "Kansas."

P5:   "She aliv with her uncle and little dog."

Mother: "Lived."

Mother: "Her aunt."

Mother: "Toto."

Postintervention sample:

P5:   "Lived on a farm in Kansas."

Mother: "Dorothy lived."

P5:   "She lived with aunt, her un, and her little dog, To."

Mother: "Her uncle."

Mother: "Toto."